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Sustainable Waste Management; Case study of Nagpur INDIA

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I. BACKGROUND

There has been a significant increase in municipal solid waste (MSW) generation in India in the last few decades. This is largely because of rapid population growth and economic development in the country. The per capita of MSW generated daily in India ranges from about 100 gm in small towns to 500 gm in large towns. The increased MSW generation can be ascribed to our changing lifestyles, food habits and change in living standards. In India the amount of waste generated per capita is estimated to increase at a rate of 1%-1.33% annually. It is estimated that the total waste quantity generated in by the year 2047 would be approximately about 260 million tonnes per year, more than five times the present level of about 55 million tonnes. The enormous increase in solid waste generation will have significant impacts in terms of the land required for waste disposal. It is estimated that if the waste is not disposed off in a more systematic manner, more than 1400 sq. km of land which is equivalent to the size of city of Delhi would be required in the country by the year 2047 for its disposal.

In our country municipal corporations are primarily responsible for solid waste management. But with the growing population and urbanization municipal bodies are facing financial crunch and can no longer cope with the demands. The limited revenues earmarked for the municipalities make them ill equipped to provide for high cost involved in the collection, storage, treatment and proper disposal of waste. Municipalities are only able to provide secondary collection of waste, means they only collect waste from municipal bins or depots. A substantial part of the municipal solid waste generated remains unattended and grows in the heaps at poorly maintained collection centres. Open dumping of garbage facilitates breeding of disease vectors such as flies, mosquitoes, cockroaches, rats and other pests.

At present the standard of solid waste management is far from being satisfactory. The environmental and health hazards caused by the unsanitary conditions in the cities were epitomized by the episode of Plague in Surat in 1994. That triggered public interest litigation in the Supreme Court of India. Based on the recommendations of the committee set up by the apex court in that Public Interest Litigation (PIL), the Government of India has framed Municipal Solid Waste (Management and Handling) Rules 2000, under the Environmental Protection Act, 1986. The Municipal Solid Waste (Management and Handling) Rules 2000 are as follows:

1. Collection of municipal solid wastes- Organising doorstep collection of municipal solid waste from houses, hotels, restaurants, office complexes and commercial areas.
2. Segregation of municipal solid wastes- Municipal authority shall organise awareness programs for segregating the waste at source as dry and wet waste and promote recycling or reuse of segregated materials.
3. Storage of municipal solid waste- Municipal authorities shall establish and maintain storage facilities such that wastes stored are not exposed to open atmosphere and shall be aesthetically acceptable and user friendly and it should have easy to operate design for handling, transfer and transportation of waste.
4. Transportation of municipal solid wastes- Vehicles used for transportation of waste shall be covered and waste should not be visible to public, nor exposed to open environment and shall be so designed that multiple handling of wastes prior to final disposal, is avoided.

5. Processing of municipal solid wastes- Municipal authorities shall adopt suitable technology or combination of such technologies to make use of wastes so as to minimize burden on landfill.
6. Disposal of municipal solid waste- Land filling shall be restricted to non-biodegradable, inert waste and other waste that are not suitable either for recycling or for biological processing. Land filling of mixed waste shall be avoided unless the same is found unsuitable for waste processing.

II. SWACHATA DOOT APLYA DARI: A SCIENTIFIC AND INNOVATIVE APPROACH FOR MUNICIPAL SOLID WASTE MANAGEMENT

As can be seen from the above guidelines, collection and segregation of municipal solid waste is a primary requirement for implementation of MSW Rules 2000. Primary collection of garbage is important to prevent littering of waste on the streets. As per the MSW guidelines, waste has to be collected in segregated form so that it can be recycled to the extent possible by adoption of suitable technology. This recycling will minimise the burden on landfills.

Though doorstep collection of segregated waste is important for municipal solid waste management, it is not carried out by many of the municipal bodies in the country as they are lacking in financial resources or the expertise to comply with those rules and they often make little effort to revise outdated and deficient waste management systems. As the authorities were hardly able to provide cost-efficient service to citizens, one possibility was to outsource solid waste management by putting in charge professional private organizations like Centre for Development Communication (CDC). The key concept is a daily door-to-door collection of segregated domestic waste, but the model includes all aspects of solid waste management from waste generation to waste processing (e.g. recycling and vermi-composting) and the final disposal. The end consumer is both main contributor and main beneficiary, as he should segregate the waste instead of littering it and, in turn, profits from the cleanliness of the city and creation of a new awareness that CDC work is generating. Presently the Swachta Doot project is being successfully being implemented in several cities of India.

The Swachta Doot Project is a major solid waste management program that includes the following aspects:

A. Daily door-to-door garbage collection
B. Waste segregation
C. Garbage lifting and Transportation
D. Employment Generation
E. Awareness building

A. Daily Door-to-door Garbage Collection

Daily door-to-door garbage collection is the core of the CDC model. It is most essential for complying with the norms prescribed by the Municipal Solid Wastes (Management and Handling) Rules, 2000 as well as the Supreme Court Guidelines for solid waste management.

Swachta Doot
Rag pickers and private sweepers who were previously working in the same sector and spent their life at foul-smelling and most unhygienic places rummaging through debris with bare hands and getting an uncertain and irregular low payment for this dirty work are brought into organised sector by CDC, and now called as Swachta Doots

Training
Swachta Doots undergo a special training that equips them with the abilities necessary for their job:

- Handling the waste in a proper and hygienic manner
- Polite and helpful behaviour towards local residents
- Discipline, sincerity commitment to their work

The properly trained workers collect the waste from households and shops seven days a week and 365 days a year. This service is provided in the morning time (between 6.00 am to 1.00 pm). They wear colourful work clothes (uniforms) so that residents and shopkeepers can easily identify them. Training and neat public appearance helps the worker to be better accepted by the community.

The garbage is directly transported and unloaded to local containers (transfer stations) using specially designed vehicles. Those Containers are brought to landfill sites outside the city by municipal corporation workforce. There is a close cooperation between CDC and the municipal bodies so that waste is not stored longer than necessary in residential areas.

This way of domestic waste management is in compliance of MSW guidelines and guarantees that:

- Waste is handled only once
- It is exposed nowhere
- There is no need of burning the garbage or dumping it in streets, drains and open places

Equipment
CDC has developed a micro-plan to adopt waste collection to the special conditions that prevail in different areas. For example, in slum areas different type of waste is produced than in posh colonies and the size of the streets is varying. To implement this micro-plan, CDC uses different types of vehicles.

Swachta Doots collect the garbage with specially designed mechanical tricycle rickshaws and multi bucket wheelbarrows. They have several advantages:

- Workers can access even very narrow roads (for example in Slum areas)
- Segregated waste collection
- The waste can be directly unloaded in the container. It does not have to be touched. So, hygienic conditions for workers are improved.

CDC follows a dynamic model of selection of equipment and modifies the equipment according to the requirements of a particular locality, town or a city.

Evolution of Primary Collection Equipment

a) Open Body Tricycle Rickshaws: The open body tricycle rickshaw is the most basic primary collection equipment and its capacity is about 50 Kgs. Its benefits include low cost and since it collects the mixed waste, it takes less time for waste collection from individual households. This type of equipment is no more in use as it collects the waste in mixed form, which is in contravention of MSW Rules. Further the collected waste is often dumped onto the ground or road and attracts rag pickers to sort out the recyclable part of the waste, exposing them to serious health risks. Additionally, since the waste is transported open to atmosphere, it is non-aesthetic and it is also observed that waste keeps spilling from the sides of the rickshaw.

b) 6 Container Tricycle Rickshaws: In order to overcome some of the problems faced in the above model, CDC evolved a 6-container tricycle rickshaw for primary collection of waste. The major advantages of this type of equipment is that it allows collection of waste in segregated form and prevents multiple handling as the waste can be directly unloaded to the secondary collection vehicle. Due to these reasons, this type of equipment complies with the MSW guidelines. Its cost is a little more than the open body tricycle rickshaw and can carry 75 kgs of waste in one trip. The only limitation with this type of equipment is that it led to frequent thefts of plastic containers requiring their replacement. This unnecessarily adds to the costs.

Types of Containers	
Metal Containers	*Plastic Containers*
Heavy, Corrosive and Expensive	Light Weight & Durable and Non- Corrosive

c) Closed Body Container with 2 compartments: In some of the areas, a new type of tricycle rickshaw has also been utilised viz. Closed Body Container with 2 Compartments, which aids in segregated collection of waste, and since it's a closed body type the waste is not exposed to the atmosphere and therefore has aesthetic appearance. This type of equipment can carry 150 Kgs of waste and costs about Rs. 8000/-, which is a little more than 6 container type tricycle rickshaw. The only limitation with this equipment is that since the waste cannot be unloaded to the secondary collection vehicle, it leads to multiple handling, which is in contravention to MSW guidelines. This type of equipment is highly suitable for smaller cities where the waste can be directly transferred after collection to the landfill site.

d) Closed Tipping Bodies with 2 containers: To overcome the problem of multiple waste handling, a further improvement is in the design of rickshaw has been incorporated, that includes hydraulic lifting of the rear side of the rickshaw unto the height of secondary collection vehicle so that the waste can be directly disposed off. This type of equipment is most expensive and requires more maintenance as compared to the earlier ones.

e) Mechanised Auto Rickshaws with closed container body with compartments: In some cases CDC has deployed mechanised equipment in the form of Auto rickshaws for primary waste collection. The benefits of this type of equipment include high coverage area and can handle more waste. Further, since it has a closed container body, it is aesthetic in appearance and can directly unload the waste to final disposal point. This type of equipment is most optimum for smaller cities and towns as the overall economics is favourable as compared to manually driven rickshaws. The only demerit with this equipment as compared to the earlier models is that the initial capital cost is higher.

f) Mechanised operations with Medium Utility Vehicles: In line with the above-mentioned mechanised operations, CDC has also introduced medium utility vehicles for primary waste collection in some of its projects. The advantage of this type of system is that it can handle more waste than auto rickshaws and is most ideal for bin-free cities. It fully complies with the MSW guidelines and is aesthetic in appearance, as waste is not exposed in the open atmosphere. The demerit is that it is more expensive.

Door-to-Door Garbage Collection - The Monitoring System

Supervisors and Zonal In-charges inspect the field everyday. They regularly get in touch with households and shops to check for feedback, complaints and suggestions so that a satisfying service can be maintained. The CDC customer care service, telephone number is available from 6.00 am till 8.00 pm. In most cases complaints are redressed within 30 - 60 minutes during working hours, or the next morning if problems arise outside working hours.

B. Waste Segregation

Waste is not all the same. It has different characteristics according to which it can be divided accordingly:

- Recyclable e.g. glass, paper, plastic
- Organic e.g. food leftovers, garden waste
- Toxic e.g. tin, batteries
- Reusable e.g. plastic bottles, polythene bags

While recyclable waste is dry in nature, the organic kind is wet and 100% biodegradable. Hence, bacterial action is faster in the latter. If waste is segregated, it is easier to handle, does not cause much pollution and can be reused, recycled or decomposed.

The CDC model of waste management is based on the principle of segregating waste and treating it according to its characteristics. Waste should be segregated at the place or source of origin. In order to realize this concept CDC, implements the following approach:

- Educating the community about waste characteristics and the consequences of inappropriate waste dumping
- Collecting the waste in a segregated manner every day
- Using specially designed multi-chambered rickshaws for garbage collection

C. Garbage Lifting and Transportation

Since June 2004, CDC is also lifting the local containers and transporting them to landfill sites in few cities. This enables CDC to co-ordinate the different processes of primary waste collection and transportation. Containers are lifted before they overflow and waste is not stored longer than necessary in residential areas. Furthermore, superfluous containers can be removed for better public convenience.

D. Employment Generation

As CDC is not a profit-oriented organization, it is committed to improve quality of life, especially for the deprived section of the society. For this reason, most grassroots workers have been recruited from slum areas. CDC started its work initially with few workers. This number increased every day and now CDC could create livelihood for about 6000 persons in the Swachta Doot Project. The services have grown in various cities and presently CDC is catering to a population of nearly 6 million.

The following table highlights some of the current projects of CDC in various cities including employment generated approximate quantity of waste collected, utilized and finally transported as inert material to landfill sites.

City	House-holds covered	Road sweeping (length in km)	Employment generation	Waste collected (T/day)	Organic matter (T/day)	Recyclable content (1) (T/day)	Inert & Inorganic (T/day)
Jaipur	50000	150	300	100	60	10	30
Nagpur	450000	200	2500	900	540	90	270
Ahmedabad	30000	35	125	60	36	6	18
Gandhinagar	60000	0	100	120	72	12	36
Surat	100000	0	100	200	120	20	60
Nanded	10000	0	150	20	12	2	6
Delhi	200000	450	629	126	0	0	0
Bilaspur	10000	0	30	10	0	0	0
Udaipur	3000	40	30	0	0	0	0
Bharatpur	10000	60	94	15	0	0	0
Hanumangarh	17000	60	90	0	0	0	0
Beawar	10000	85	100	16	0	0	0
Jaisalmer	3000	30	32	0	0	0	0
Total	953000	1110	4280	1551	840	140	420
Average 5 members per Household				0 indicates non availability of data			

Note: 1) Recyclable contents include paper, glass, plastic and metal
2) All weight values are approximate values.

Introduction of door-to-door collection service has improved the financial condition of Swachta Doots who now receive regular payment as compared to the earlier situation when they could earn low (12-15/-per day) and irregular incomes. They are now enjoying dignified working conditions at CDC, as their profession is viewed with greater respect amongst society members compared to their earlier work. As both genders are treated equally the number of women is almost as high as the number of male grassroots workers. Women are given the chance to make an own contribution to the living standard of their families. Additionally unemployed or underemployed educated youth profit from these job opportunities as they are recruited as Managers and Supervisors.

E. Awareness Building

It is CDC's conviction that the cleanliness of city is a collective good. It can only be achieved with the participation of all concerned. Therefore, CDC encourages and motivates people to keep their surroundings clean. They are provided education regarding sanitation and garbage disposal through various means of communication such as:

- Posters, folders, booklets, leaflets
- Exhibitions
- Wall paintings
- Living society meetings
- Debates and painting competitions in schools
- Regular talks with citizens

III. BENEFITS OF SWACHTA DOOT PROJECT

Social

- Improving social standard of Swachta Doots by providing training and financial stability
- The community is made aware of the consequences of unscientific waste throwing and can participate actively
- As the citizens are also involved in the project they develop a sense of belongingness

- People appreciate the service and consider it as necessary and essential. This makes the project self-sustainable

Economic
- City's image as a "green and clean" city can boost local economy especially in tourism branch
- Creates new avenues of employment
- Composting of organic matter and recycling of paper, glass, plastics and metals yield productive outcomes and reduces burden on landfill site

Public Health and Life Quality
- Waste is handled in a hygienic and scientific manner, so no pollution is caused at any stage
- Garbage on the roads is tremendously reduced
- Drains are no longer clogged with garbage – no smell, no breeding site for malaria spreading mosquitoes, no meeting place for pigs and other stray animals
- Quality of life improves as the whole city looks clean and aesthetic

This shows that the model is not only a convincing theoretical concept but also a successful intervention in the field of Municipal Solid Waste Management.

Methodology
- The idea of door-to-door (D2D) collection of garbage was not new for Nagpur Municipal Corporation (NMC). This work was started in 1996 in some wards of the city covering about 30% of the total population. But after the Supreme Court directive regarding 100% D2D garbage collection, it was implemented throughout the city.
- Requirements for implementing the directive included equipments like cycle rickshaws, ghanta gadi and manpower.
- In the city of Nagpur there are different types of residential areas like skyscrapers, slums, independent houses, bungalows, government colonies, etc. These categories have been grouped and suitable volunteers have been deployed for garbage collection.
- The volunteers were trained and oriented about waste disposal.
- Every volunteer i.e. 'Swachata Doot', cover about 200 – 300 households everyday depending upon the category.
- All the volunteers have been provided with uniforms and safety kit, which includes hand gloves, face mask, cap, etc.
- To oversee project implementation, one supervisor and coordinator has been appointed for every zone.

Key Highlights

- First project in India involving D2D collection of garbage from 100% households on all 365 days.
- The only project on solid waste management in India to recruit physically challenged persons. At present there are 37 such persons working on this project and thereby earning livelihood for themselves and their families.
- No dependence on external funding.
- Community involvement on a large scale.
- Well-defined roles for NMC, NGO and the community under the scheme.

Strategy followed

All concerned stakeholders were consulted before finalizing the implementation plan.
Implementation plan

- The work of D2D collection of waste by 'Volunteer' begins at 6.00 a.m. daily.
- Every household in the given group is attended daily.
- The doot goes around the demarcated households & announces his arrival by blowing a whistle.
- When the cycle rickshaw is completely filled with waste, it is unloaded in the nearby community dustbins. After unloading, the volunteer covers the remaining households.

- During every unloading, the recyclable waste is separated by the volunteer.
- At no point of time, he does manual handling of the waste collected.
- Monitoring indicators have been set in consultation with the NGO, which have further ensured prompt implementation of the project, e.g. households covered, timely complainant redressal, regular and surprise filed visits, community feedback, etc. are monitored regularly.

IV. RESULTS

- Benefits to NMC
  1. Successfully implemented the Supreme Court guidelines.
  2. Savings worth Rs. 5 crores in terms of lower costs for providing D2D garbage collection service to the citizens.
- Benefits to CDC (NGO)
  1. Other municipal corporations in India are adopting Swatchata Doot model. CDC has assisted in preparation of policy in Rajasthan.
  2. CDC's budget for the financial year 2003-04 was Rs. 53 lakhs. After being appointed as implementer for this project, its financial credibility has escalated to Rs.15 crores. Moreover, we have been appointed to implement similar project in other cities of India.
  3. Financial institutions like Kotak Mahindra, ICICI, Tata Finance, etc. have come forward to sponsor equipments required for D2D collection. To date credit worth Rs.1 crore has been availed from these institutions.
  4. NMC has further reposed its confidence in CDC activities and has handed over the responsibility of secondary transportation of Municipal Solid Waste also to a joint venture involving CDC.
  5. Improvement in sanitation.
- Benefits to Citizens
  1. Regular D2D collection of garbage and active participation in the zero garbage drive.
  2. Better and prompt service at minimum costs.

Stakeholders / Partners:
'Swachata Doot Aplya Dari' is a joint initiative undertaken by various stakeholders / partners to maintain good hygiene and jointly create a cleaner city. In the following section we would like to highlight those who have made a significant contribution towards the initiative. These include:

a) Nagpur Municipal Corporation (NMC): Keeping the city clean has taken on a whole new meaning in the orange city i.e. Nagpur, the second capital of Maharashtra. Being innovative, clean and green has had a significant bearing on the city's future competitiveness and attractiveness as a business and traveling hub. Firm determination and hard administrative measures have contributed towards the success of the efforts of NMC. The innovative steps taken by NMC in MSW handling and disposal have led to visible changes in the city. Nagpur is recognized as one of the cleanest cities in the country.

b) Civic Cops (Nuisance Detectors): The civic cops supervise the work of Swachata doots i.e. the volunteers and addresses the grievances of the citizens. Furthermore, they collect the previous day's regarding information and report it to the higher authorities at the zonal office in writing, which was collected at the main office. Supervision by higher officials at the zonal office and appreciation of their efforts keeps these civic cops motivated & on their toes.

c) Non – Governmental Organizations (NGOs) Center for Development Communication (CDC): CDC had the most Herculean task i.e. implementation, wherein it had to involve people in implementing the programme, apart from recruiting volunteers, training and orientation, convincing the masses, etc. 'Show and tell' observation of a functioning D2D primary collection system was used to train the volunteers.

As it is rightly said ‘public support comes when people see tangible results and benefit from such change’. The residents not only co-operated but also applauded the joint efforts undertaken by CDC, who have been responsible for making Nagpur a ‘Green and Clean’ city.

d) Swachata Doot (Volunteer): The volunteers or the Swachata Doots were the vital links and key contributors for making Nagpur a ‘Green and Clean’ city. These volunteers some of who were earlier know as *‘Rag Pickers’* would previously collect and sort the recyclable dry waste like paper, plastics, metals, rags, etc for their daily living. Commencement of ‘Swachata Doo Aaplya Dari’ scheme has had positive impacts on the lives of these rag pickers and substitute sanitation workers resulting in livelihood creation for the members of the most downtrodden segment of society giving them dignity of wlrk as ‘Swachata Doots’ having uniform and protective.

e) Citizens: The citizens have contributed to the scheme by whole-heartedly adopting the idea of waste disposal to volunteers only and making voluntary token monetary contribution towards the welfare of the volunteers.

Shifting Millions from Open Defecation to Hygienic Practices

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A successful case study of WaterAid Bangladesh and Village Education Resource Centre (VERC) to achieve 100% sanitation in Bangladesh

Bangladesh fact file

- 74% of the population have access to water supplies, but the quality of many of the supplies is poor.[1]
- According to 2003 survey report, average sanitation coverage is only 32% falling to 15% in some areas, and poor hygiene practices are widespread[2].
- Every day 20,000 metric tons of human excreta are deposited on public lands and in waterways, causing serious contamination of surface water.
- Unsafe water and human excreta are the main transmission routes of 40 of the 50 most prevalent diseases.
- An estimated 250,000 people, including 115,000 children under the age of five, die every year of diarrhoeal diseases.[3]
- The treatment of hygiene-related diseases costs 5 billion taka (US $80 million) a year.[4]

Introduction

The Government of Bangladesh and its development partners plan to achieve nation-wide total sanitation by 2010. This is essential, as poor hygiene practices, open defecation and minimal environmental sanitation are currently taking a major toll on the national's health.

Traditional approaches to improving sanitation have focused on technocratic and financial patronage, rather than health and hygiene education. Water supply coverage is relatively high, but safe water alone leads to only minor health improvements and does not prevent serious diseases like cholera and dysentery.

The majority of people in Bangladesh have a poor understanding of the link between poor hygiene and disease. People tend to want to have latrines for reasons of convenience, privacy and status, rather than sanitation and health.

There are a number of barriers to achieving total sanitation, as outlined below:

Barriers to achieving total sanitation

- The Government is centralised and functions in a top-down and supply-driven manner
- Fixed latrine models are too expensive for the poorest people and in many geophysical areas prove non-user friendly
- Lack of tenure rights, particularly for slum dwellers, mean poor people have no right to build latrines where they live
- Women's specific sanitation-related needs are unrecognised by the community
- Cultural taboos and embarrassment hinder open discussion

Institutional reform will be a key factor in implementing people-centred integrated water, sanitation and hygiene programmes. Although the debate is on, any significant change in the policy on decentralisation appears unlikely in the near future.

[1] Ahmed, M.F. Alternative Water Supply Options for Arsenic Affected areas of Bangladesh, ITN, BUET and WSP-SA, P. 11-12
[2] Ref. Bangladesh Country Paper on Sanitation for SACOSAN, Govt of Bangladesh, Oct 2003
[3] WatSan Information Booklet, NGO Forum for Drinking Water Supply and Sanitation
[4] S. A.. Ahmed, Water & Sanitation Program, personal communication April 2002, based upon "Health Care Expenditures in Bangladesh" in "Health Situation and Health Care Expenditures in Bangladesh, Evidences from Nationally Representative Surveys", BBS, April 1999

WaterAid Bangladesh and VERC's innovated approach

WaterAid Bangladesh and its rural partner NGO VERC have jointly developed an integrated, empowering approach in collaboration with community people living in rural areas. The approach has proven effective in establishing safe water supplies, environmental sanitation and promoting good hygiene practices. Other partners of WaterAid's are now using this approach as a 'tool kit' with which to build a context sensitive approach for their specific target communities.

The approach is based on the following key principles:

- **Integration** Safe water supply, environmental sanitation and hygiene promotion are addressed simultaneously. Projects are appropriate, sustainable and affordable for the community.
- **Participation** The whole community, including the hardcore poor, are actively involved in project planning, implementation, monitoring and evaluation. Individuals in the community are trained to become trainers; the community determines the best water supply and sanitation infrastructure option and hygiene promotion education inputs are facilitated.
- **Empowerment** People's capacities, skills and indigenous knowledge are recognised and valued. Support is provided in the form of capacity-building to strengthen the ability of individuals who emerge as leaders to work as agents of change within the community. Communities act as facilitating agents in their neighbouring areas. Empowered communities increase their confidence to analyse and voice their needs constructively to local government agencies or other development programmes.

Key aspects of the approach

- People's skills, abilities and knowledge are valued
- 0% subsidy for latrine construction
- 'Whole community' approach
- Use of participatory research tools to analyse the problems
- Formation of Village Development Committees - local engineering groups
- Identification of potential community leaders and involve them as community 'catalysts'
- Mobilisation of local resources
- Involvement of local government

Outcomes of the approach

- More than 250 villages are 100% sanitised
- Eight sub districts are actively working towards creating 100% sanitised.
- 20 innovative hygienic latrine designs have been put forward by communities
- A cultural shift from 'top down' to 'bottom up' approaches has happened in the organisation and at community level
- WaterAid Bangladesh and partners are providing training support to a number of local and international aid agencies to integrate the approach
- The Government of India is replicating the approach in the state of Maharastra

Village Education Resource Centre (VERC), a rural based partner of WaterAid, began piloting the 100% Sanitation Approach in 1999 in response to the poor impact of previous attempts to improve sanitation.

VERC's approach is based on the assumption that, once the issues have been understood, communities have the commitment and ability to overcome their water and sanitation problems themselves. Field staff assists communities in drawing up a behaviour-focused working definition of 100% sanitation, through which communities come to recognise that in the area of water and sanitation the behaviour of an individual has a direct impact on the health and wellbeing of others. Community mobilisation is triggered and the community plans and implements sustainable solutions that meet their own needs. Community elites work together with the hardcore poor providing land, materials and/or cash for the construction of latrines, to achieve total community coverage.

Due to empowerment of the community, many technical, social and economic innovations took place. The communities designed many local and low-cost models of toilets which are affordable and to suit the local conditions of the community. The engineers from VERC and Water Aid Bangladesh encouraged this innovation by providing technical help and support without dictating ways of doing it. There are more than twenty models of toilets innovated by the local community and the cheapest one costs only Tk.70 (US$ 1.05).

The process involves the community in all aspects of the project. This introduces ownership of the programme, as well as ensuring sustainability for the future. As part of the wider community, local Government bodies, NGOs, community based organisations and other stakeholders have successfully been brought into the process. The approach is proving self-replicating as other villages are adopting the 100% Sanitation Approach, seeking advice and help from community leaders.

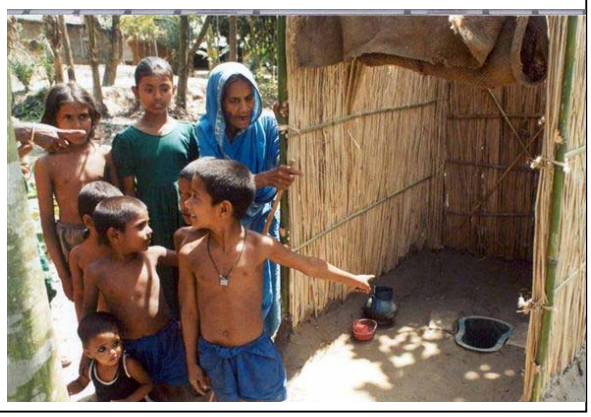
Programme to Programme Support

WaterAid Bangladesh and VERC provided training support to World Vision Bangladesh and Dhaka Ahsania Mission (lead NGO of DPHE-DANIDA Coastal belt project) in their implementation of a sanitation project following the 100% sanitation approach. They are working to assist 1230 villages for total sanitation. Plan International and CARE Bangladesh are also following the same approach for total sanitation in seven sub districts of Bangladesh.

WaterAid is also working in collaboration with four partner organisations on rural sanitation programmes serving over 3200 villages of 160 unions across 15 districts.

A working definition of 100% sanitation

- No open defecation or open/hanging latrine use.
- Effective hand-washing after defecation and before eating / taking or handling food.
- Food and water are covered.
- Good personal hygienic practices, such as brushing teeth and trimming nails
- Latrines are well managed.
- Sandals are worn when defecating.
- Clean courtyards and roadsides.
- Garbage is disposed of in a fixed place, such as a pit.
- Safe water use for all domestic purposes.
- Water points are well managed.
- Waste water is disposed of down drains or in a fixed place.
- No spitting in public places.



Impacts & Benefits of 100% sanitation projects

- **Women's advancement**

In Bangladesh there is a rigid division of labour regarding activity related to water, sanitation and hygiene promotion. Women and adolescent girls are disproportionately burdened by inadequate and poor quality water and sanitation services as they normally collect water, clean the household and care for the sick. Lack of privacy in sanitation facilities also exposes them to increased risks of urinary tract infection, reproductive health problems and physical attack.

Women have reported that improved access to water and sanitation services has resulted in a more productive use of time and resources. Traditional gender roles are being challenged as men and women recognise the direct contribution that women's participation is making to the community's improvement and to household economic benefits. Through the process of forming and developing community institutions women have increased their confidence and capabilities in private and public spheres.

- **Poverty reduction**

Loss of earnings and production are additional handicaps for poor people, whose physical fitness is their main productive asset. Use of safe drinking water and sanitation facilities, together with improved hygiene practices, has a direct impact on poverty by reducing the vulnerability of poor people, especially women and children, to disease, ill health and death. Use of improved facilities releases women and girls' time for paid work, schooling and rest. Savings are made from household expenditure on medical expenses.

- **Improved governance**

Poor people in Bangladesh lack the awareness, information and opportunities to demand their rights. The worst off are excluded from collective decision-making and denied the voice to lobby government for basic services. Through community empowerment, constructive relations are being built with Union and Upazilla level government in rural areas.

- **Scaling up to national sanitation**

Given the success of the new approach WaterAid has expanded its rural and urban programmes, refining and developing new initiatives. Programmes are better linked to local government and efforts for their emulation in national programmes will continue. The Government recognises the public health benefits of water and sanitation and has adopted a National Strategy for Sanitation based on the demand-responsive approach.

In 2003 the Water Supply and Sanitation Collaborative Council, of which WaterAid is a member and the Government collaborated in the development of a National Sanitation Campaign. The campaign launched in October 2003. The target is to achieve total sanitation by 2010.

In October 2003 the Government also arranged an international conference named South Asian Conference on Sanitation (SACOSAN). The overall goal of the conference was to "accelerate the progress of sanitation and hygiene work in South Asia so as to enhance people's quality of life, in fulfilment of the Millennium Development Goals and the commitments made in the World Summit on Sustainable Development (WSSD). In the conference VERC approach was presented as a successful case study.

DFID's assessment [5] of VERC results in areas with improved water facilities and 100% sanitation

- Reductions of 99% in diarrhoea, 90% in dysentery and 51% in stomach-related problems such as intestinal worms, in rural areas.
- Monthly medical costs for common illnesses are 55% lower.
- Working days lost due to illness have fallen from 77 to 35 per year in rural areas
- Schooldays lost due to illness have fallen from 16 to 7 per year in rural areas.
- Expenditure on food and clothing has risen by 6%.

[5] Farouk A. Chowdhury, an Economic Evaluation of WaterAid Bangladesh's Water and Sanitation programme in specified areas of Bangladesh, December 2002, DFID Bangladesh.

WaterAid is an international non-governmental organisation dedicated exclusively to the provision of safe domestic water, sanitation and hygiene education to the world's poorest people. These most basic services are essential to life; without them vulnerable communities, particularly women and children, are trapped in the stranglehold of disease and poverty.

WaterAid works with poor people in 15 developing countries in Asia and Africa and has been working in Bangladesh since 1986. WaterAid works with local partner organisations setting up low cost, sustainable projects using appropriate technology that can be managed by the community itself.

WaterAid also seeks to influence the policies of other key organisations, such as governments, to secure and protect the right of poor people to safe, affordable water and sanitation services.

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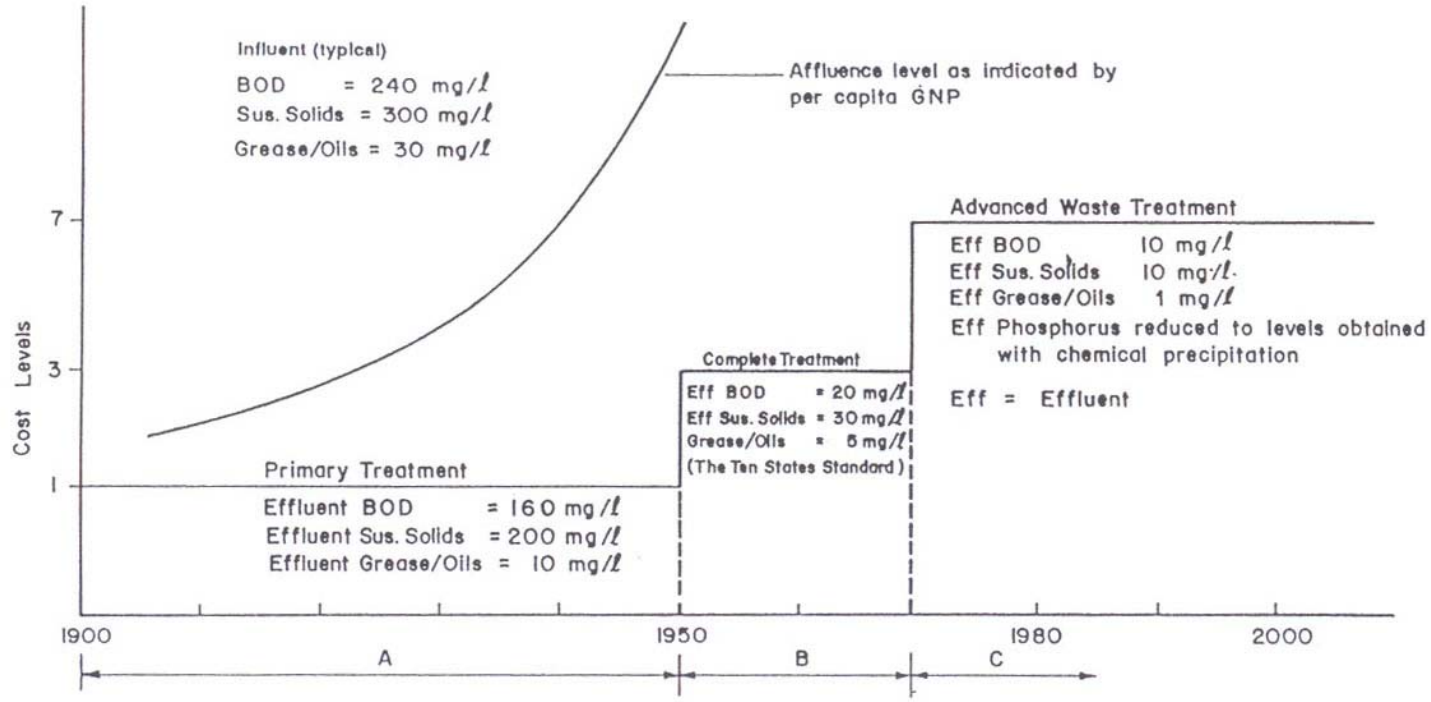

Fig. 5.1 Schematic Drawing Showing Effluent Standards Requirements for Disposal of Municipal Sewage to Receiving Waters where DO is a Salient Ambient Parameter (Inland Waters and Confined Coastal Waters Including Estuaries and Semi-enclosed Bays)

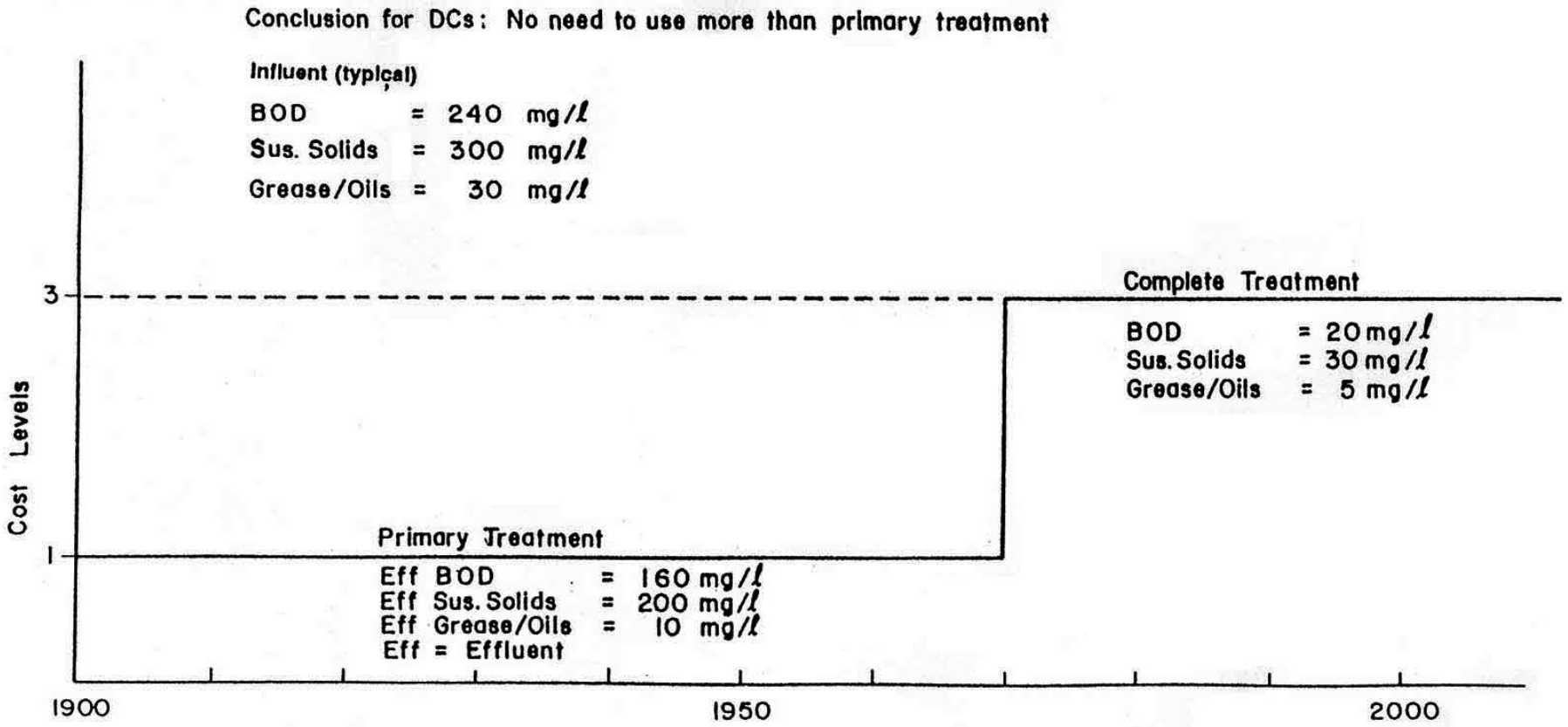

Fig. 5.2 Schematic Drawing Showing Effluent Standards Requirements for Disposal of Municipal Sewage to Inland/Confined Coastal Waters (where DO is not a significant ambient parameter)

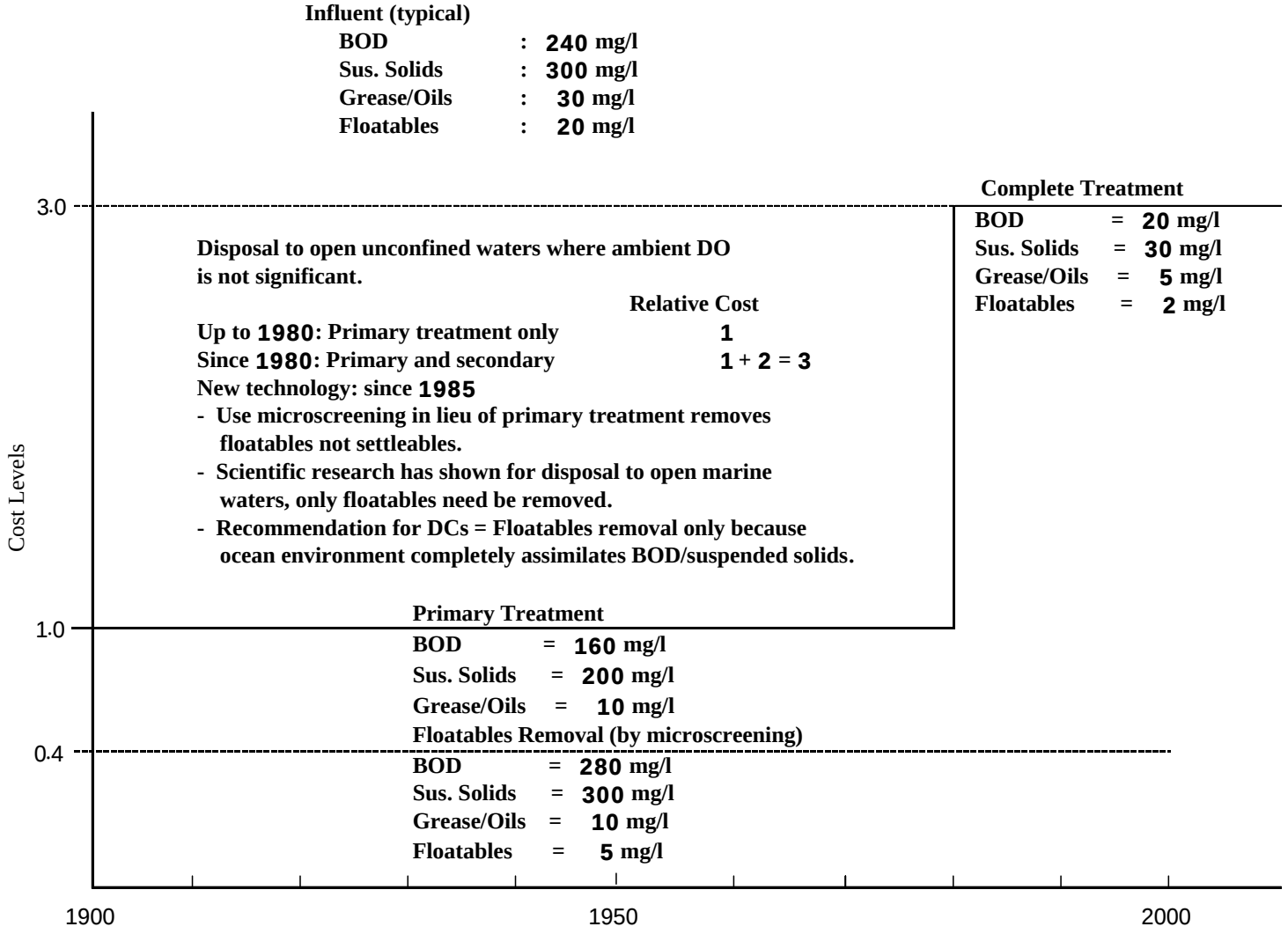

Fig 5.3 Schematic Drawing Showing Effluent Standards Requirements for Disposal of Municipal Sewage to Unconfined Marine Waters (where access to open ocean is feasible and DO is not a significant parameter)

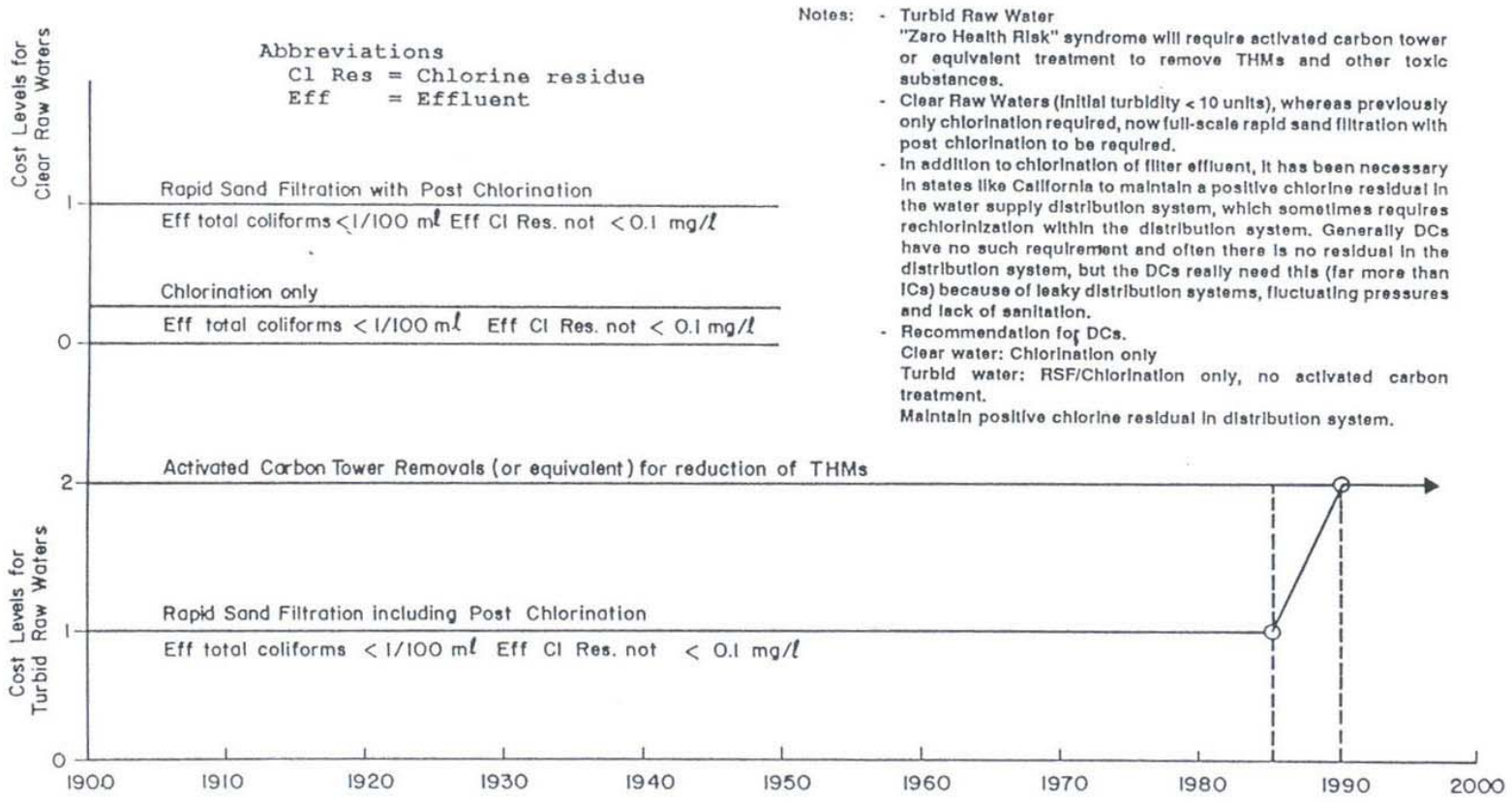

Fig. 5.4 Schematic Drawing Showing Drinking Water Standards for Chlorine Residuals, Coliforms, and THM Toxicity Parameters

Notes: - **Drawing based essentially on experience in California where requirements are imposed by California State Regional Water Pollution Control Boards as well as by USEPA.**

- **Recommendation for DCs: Gravity/API separator only, with due attention to O&M. Where more is needed for eco-protection, supplement with prolonged ponding (several days).**

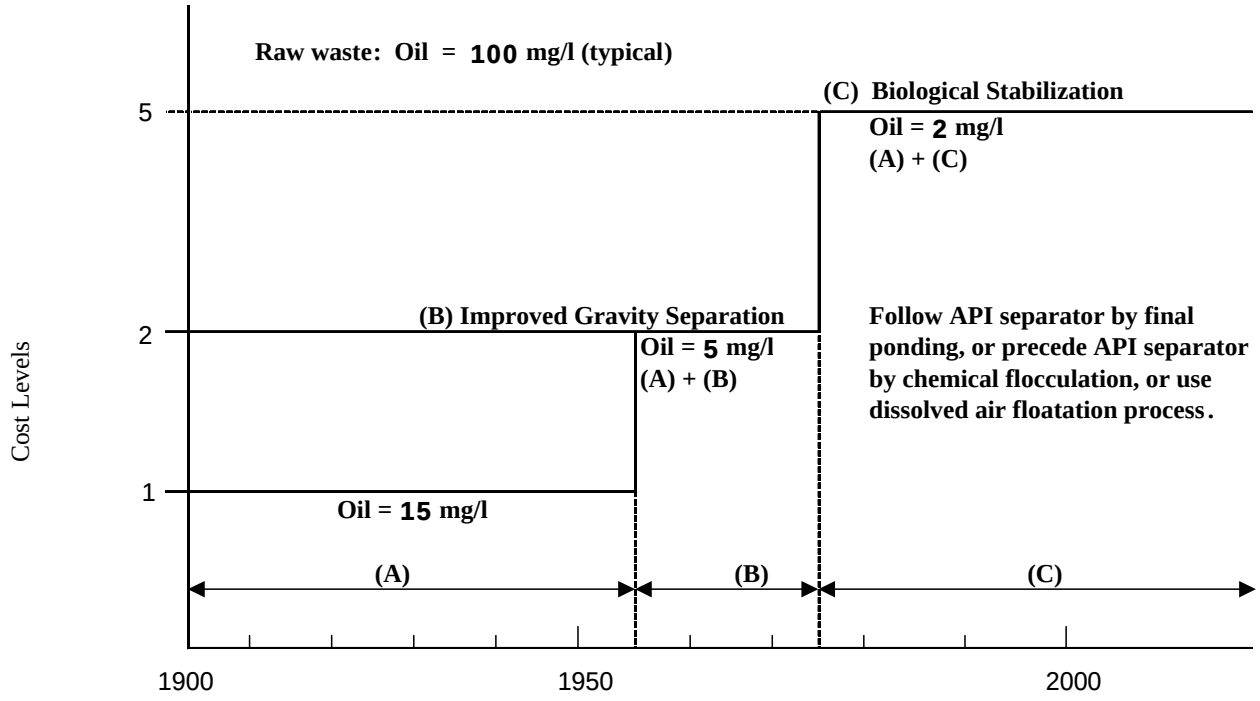

Fig. 5.5 Schematic Drawing Showing Effluent Standards Removal of Oil from Petroleum Refinery Waste

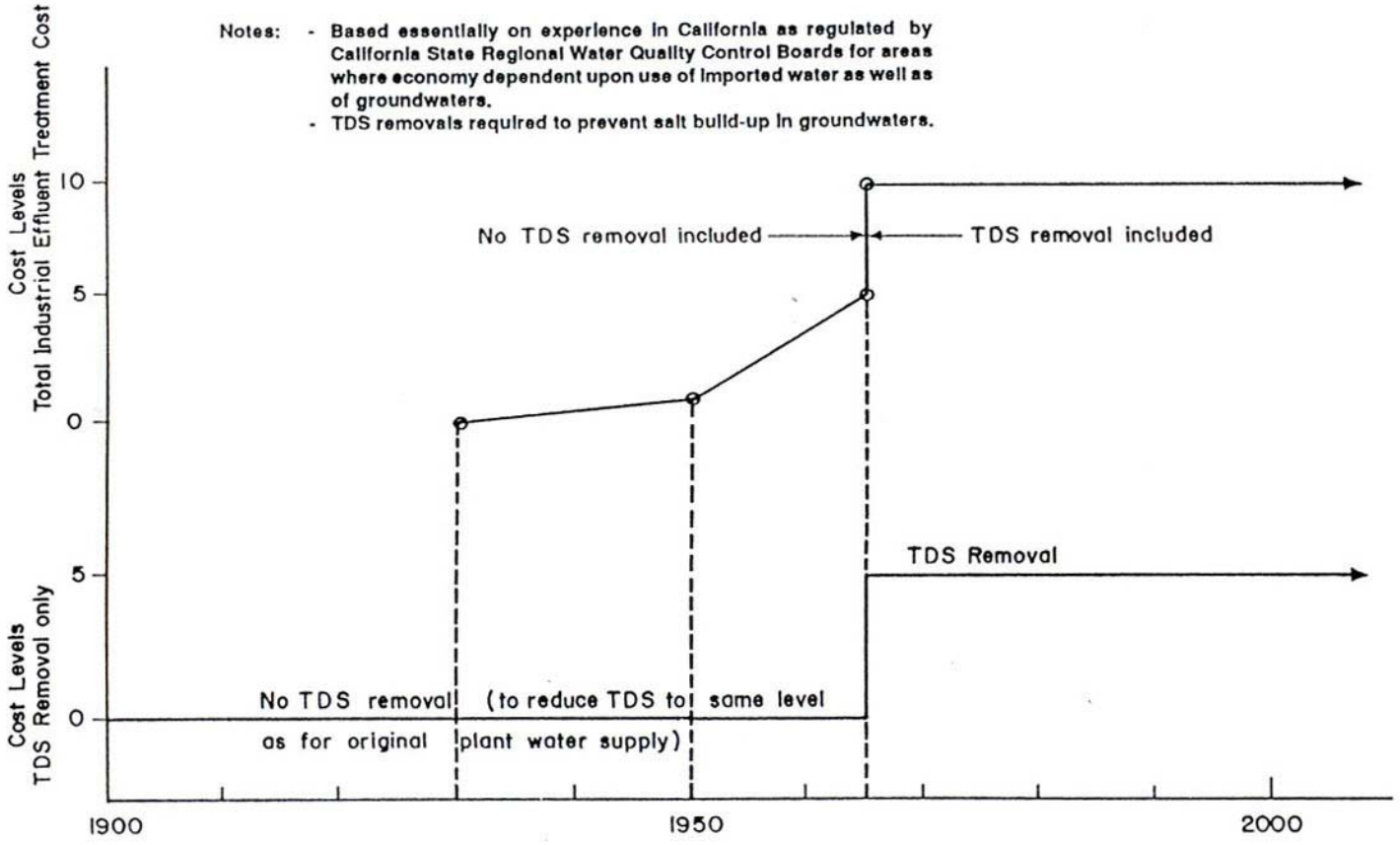

Fig. 5.6 Schematic Drawing Showing Treatment Effluent Standards Requirement for Disposal of Industrial Wastes by Soil Infiltration Affecting Valuable Groundwaters in Semi-Arid Regions for Parameter of Total Dissolved Solids (TDS)

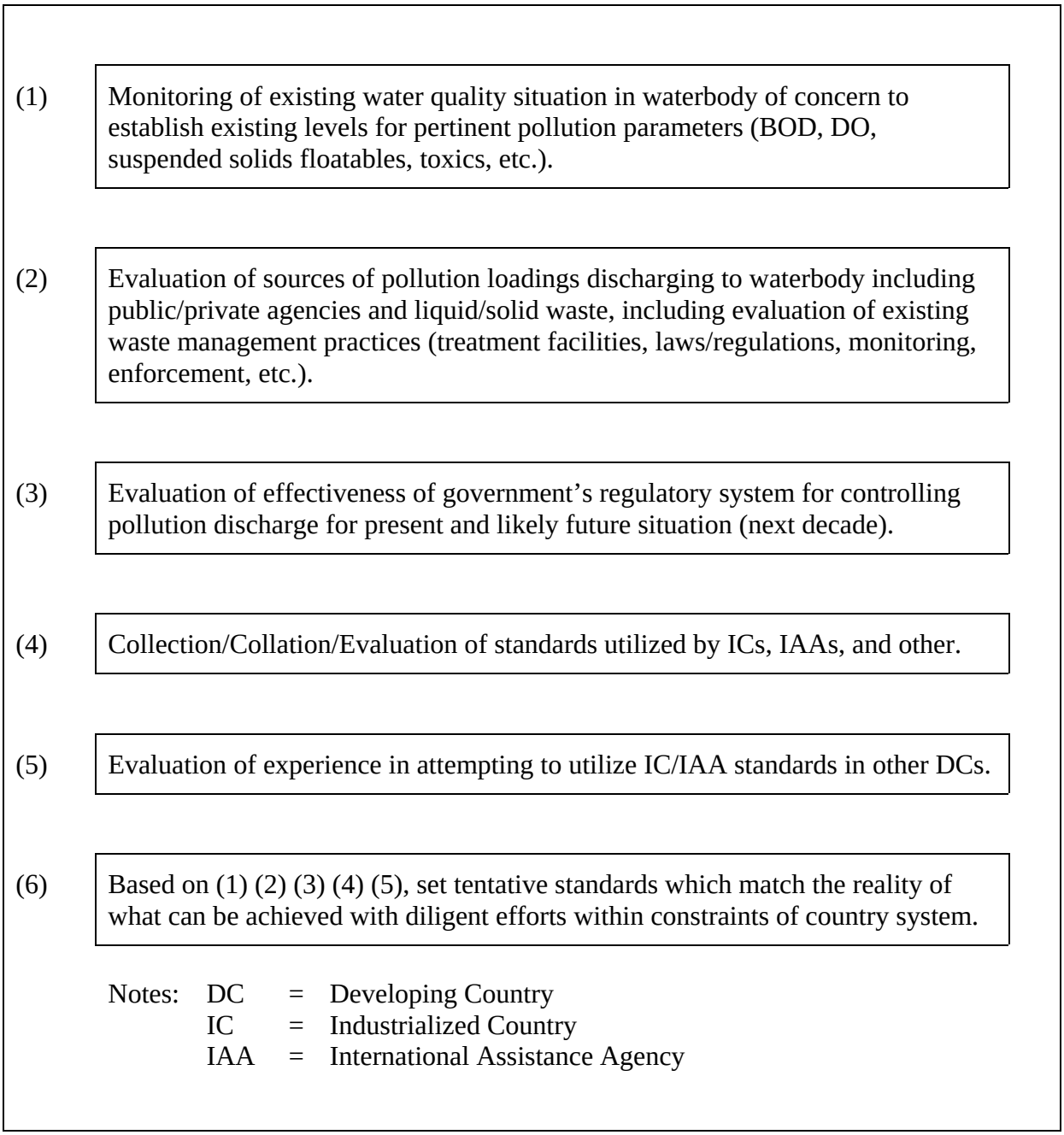

Fig. 5.7 Schematic Chart Showing Steps in Setting Appropriate Ambient Standards for Receiving Waters in Developing Countries

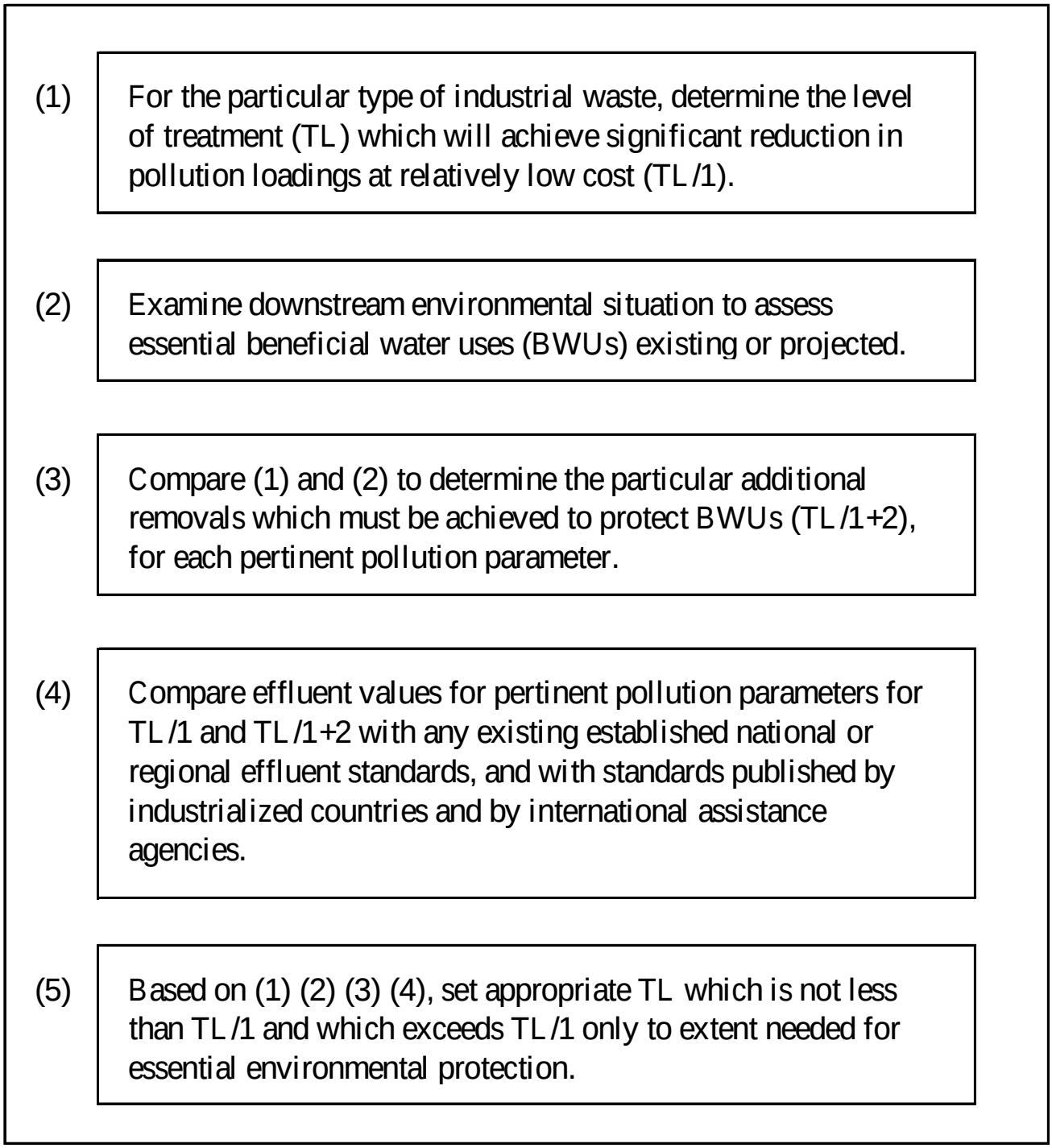

Fig. 5.8 Schematic Chart Showing Steps Involved in Setting Appropriate Industrial Wastewater Effluent Standards In Dcs

VI. SUMMARY AND CONCLUSIONS

6.1 Environmental Standards Experience in Developing Countries

Since the establishment of the DC/NEnPAs (most were formed following establishment of UNEP at the Stockholm Conference of 1972), these NEnPAs have promulgated numerous ESs, mostly in the WQ and AQ sectors. Generally the NEnPAs have assumed that promulgation of ESs would somehow achieve environmental cleanup, primarily because of the impact of the experience of the USA (which has had the lead role in the ICs in use of ESs). The USEPA has had the power and funds to set ESs and to enforce them including monitoring/surveillance capabilities. Generally the ESs set by the DCs, because of the complexity of the process of devising appropriate DC/ESs, have been essentially adaptations of ESs used by the ICs, and often have not been affordable/appropriate for DC use, hence have often been largely ignored. They have not served to contribute to continuing sound national economic-cum-environmental development and often have been counterproductive and have tended to impair the credibility of the NEnPAs with the national economic planning and implementing agencies. An important aspect of this is the lack of recognition that use of ESs, to be meaningful, must involve continuing surveillance/monitoring by the NEnPA together with power for follow-up enforcement measures, but generally the DC/NEnPAs have not had these capabilities, and it is expected that they will have limited such capabilities in the foreseeable future (the next decade or two). Hence, if ESs are to be successfully used by the DCs, the approach for this must not be an adaptation of IC practices but to use practices tailored for DC use.

6.2 Utilization of Results of Study by Developing Countries

Section 5 of the present study presents a series of guidelines which indicate how the findings and conclusions of the present study may be applied by DCs to help meet their needs. These guidelines are based on the "Engineering Approach" which embodies the concept that the planning of water supply and pollution control facilities should be as cost effective as possible, meaning (i) use of ESs which are appropriate, (ii) competent planning/design of facilities to achieve least cost investment which will meet the standards, and (iii) competent monitoring and enforcement following construction to ensure adequate performance.

6.3 Manual on Environmental Standards for Developing Countries

6.3.1 Need for Manual

It would certainly be in the interest of developing countries for a manual to be developed that would function as follow:

(a) When a country intends to allocate resources to spend on environmental affairs, it would use the organized formats presented in the manual to determine:

(i) The technical areas which are most critical with respect to benefits in environmental expenditures.

(ii) The type of improvements which would produce maximal beneficial

results to the environment.

(iii) The appropriate standards to which the project should be designed, to achieve optimal economic-cum-environmental development.

(iv) The hierarchy of risks to be attacked in order as resources become available (short term and long term planning).

(b) When a country plans for the financing of a given project, the financing authority would make use of the manual to determine the overall appropriateness and cost effectiveness of the project.

(c) Without an organized system for project analysis and the development of appropriate standards, the decisions as to what projects to implement is largely subjective in nature. Such a subjective decision making process tends to produce projects which benefit selected groups, rather than the population as a whole. Without a system for developing appropriate standards, there is a tendency in developing countries to simply "copy" standards being used in the ICs, such as the USA. The application of standards developed in affluent countries will almost always result in large wastage in terms of capital costs and in terms of building systems where the needed minimum O&M budgets/skills will not be available. The ESs must be tailored to suit the particular needs of the particular DC, and must be revised from time to time as economic and socio-economic conditions improve.

6.3.2 Recommendations

It is recommended that the international assistance agencies (IAAs) fund a project which would develop a manual entitled, "A Procedures Manual for Formulation of Appropriate Environmental Goals/Standards and Associated Design Objectives for Developing Countries", beginning with the water quality and air quality sectors. This would be a "Phase II" study to follow-up on the information presented in the present report. The estimated cost for Phase II is approximately $ 1 million each for water quality and air quality.

The IAAs should also fund similar projects covering every important environmental degradation sector for both (a) the "brown" (urbanizing/industrializing) problems of degradation and (b) the "green" problem area (forests, wildlife, aquatic resources, eco-swamps). For category (a) far priority ESs needs are for occupation health, industrial emergency response systems, and urban highways.

In the area of natural resources, very few guidelines useful for DCs are available, but are needed as much as for the brown sector. The reason for the relative inattention to the green sector is that, historically, the field of environmental protection began in the brown area (the area at sanitary engineering). The need for applying sound scientific/engineering planning is equally great in both brown and green sectors if DC growth is to be sustainable, that is, economically-cum-environmentally sound.

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APPROPRIATE ENVIRONMENTAL STANDARDS IN DEVELOPING NATIONS

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ABSTRACT

Developing Countries are increasing their wealth, but have substantial ecological problems including high population growth, mass movement of rural populations to cities, and severe net negative cultural and ecological/environmental impacts. Additionally the World Community is now so closely watched by the media that political leaders of developing countries are forced by their citizens to give the appearance of personal and environmental protection by adopting the same ecological/environmental standards/criteria as the industrialized nations, when the economic and manpower resources make enforcement essentially impossible. The problem is intensified by the fact that the standards/criteria for industrialized countries are often based upon non-scientific/non-economic rationales driven by politically motivated media and environmental pressure groups. The developing countries, as well as the industrialized countries must eventually maximize the utilization of their available resources by utilizing the best scientific/economic rationale possible. Data is presented for the U.S.A. showing its development from about 1890 to the present. From these data it was apparent that the developing countries are following a very similar pattern. It is accordingly very important that these countries be aided to develop and utilize scientific/economic standards/criteria appropriate to their stage of development.

KEYWORDS

Standards; criteria; Developing Countries; Industrial Countries; ecology; environment; World Bank; Asian Development Bank; U.S.A.; development stage; political; media; pressure groups.

INTRODUCTION

Discharge standards established in the more highly industrialized countries for the protection of air, land, and water environments are often utilized without modification in developing countries. A number of reasons for this practice are discussed in the following paragraphs. It is proposed that such direct transfer is not optimal from scientific and public health viewpoints. The highly industrialized countries have often based their design standards upon a very politically guided interpretation of protection of beneficial values of the air, land, and water environment. Developing countries should base their standards upon net benefits to a sustainable society and environment. That is, they should initially engage in short-term planning, focusing on critical local public health and societal goals to establish first level local standards.

These standards can be made more rigorous as the society develops a greater economic base from which to address its more subtle environmental secondary problems. In fact, the more industrialized nations did engage in this process up to the mid 1970s when the current era of "eco-irrationalism" became dominant. Presently the wealth of many of these industrialized nations allows them to indulge in politically motivated environmental requirement excesses without significantly affecting the lifestyle of their citizens.

The development of standards in any country is subject to political pressures. In the U.S.A., because of societal development from a public health orientation to a more ecologically based structure outlined by Anderson and Garber (Anderson and Garber, 1990), the responsibility for the development and subsequent enforcement of environmental programs was shifted from the US Public Health Service to a newly created agency, the US Environmental Protection Agency (USEPA). Political pressures had created a situation in which certain observable or perceived negative environmental impacts appeared to the public to be so critical that there was no time for scientific study and the subsequent development of rational standards. Conservative, costly standards and related enforcement to effect compliance with those standards were demanded. Conceptually these standards would be modified as research results justified such modification. Unfortunately little of this research has been done, thus there is a paucity of scientific knowledge as to contaminant toxicity and related risk assessment. For the most part the requirements are established based on untested theoretically based models. In many cases the actions of the national legislature, in setting up the laws under which the standards were developed and enforced, was dominated by what was termed economic equity; but what was in reality uniformity in regulation which ignored economic design and did not encourage environmental improvement. It was hoped in this manner that no area of the country would be permitted to gain a competitive advantage under the new laws. This situation often makes U.S.A. standards impractical for use by other nations. Unfortunately the U.S.A. is perceived by the less industrialized nations as having the most fully developed environmental programs, thus the U.S.A. standards have often been utilized, if not copied, by other less developed nations. Such copying could be either directly or indirectly via "international" standards established by various international agencies.

Although there has been much publicity given to the need to develop technology appropriate for use in developing countries, very little has been done to initiate the preparation of standards or criteria appropriate to their ecological needs. The reasons for this were suggested above, but more specifically include the following.

1. The political simplicity of transposing standards/criteria of the industrialized countries to the developing country makes such a practice the process of least effort and greatest apparent acceptability. Additionally the World Health Organization, the International Assistance Agencies and others who advise the Developing Countries tend to copy the U.S.A. standards because the only readily available background data is found in U.S. EPA publications and these publications have been spread all over the World. An added difficulty is the importation of foreign "experts" by aid agencies such as USAID who really do not appreciate the need to use technology and design appropriate to the Developing Countries.
2. Due to the appearance of condescension, officials in developing countries have great political difficulty in proposing standards/criteria/technology which are perceived as "less stringent" than those used in industrialized countries.

3. Because "appropriate technology" means solving an ecological problem with lower costs, the risk level in the population, generated by risk assessment models, may appear to be greater. Few officials can or are willing to recommend risk levels higher than those used in industrialized countries.

These factors along with other socioeconomic considerations usually result in the developing countries adopting the standards/criteria used by industrialized countries. However, such standards/ /criteria are most generally not affordable and are not, as a practical matter, implementable being inappropriate both from the point of view of affordability and the unavailability of needed operation and maintenance or other needed skills. Consequently there is often little resulting improvement in environmental/ecological quality. Ideally developing countries, where appropriate and possible, should attempt to relate their standards and criteria to those utilized in the industrial countries at the time those countries were at an equivalent stage of development. For example the criteria in California U.S.A. for allowable grease/oil in petroleum refinery waste effluents was 50 mg/l 50 years ago but is presently 2 mg/l. As a practical reality this change has had little perceptible effect upon the receiving water environment. Operation and maintenance skills suffer because facility operation budgets are most often only a fraction of the need because sufficient funds are simply not available.

In developing countries, sewerage and water services (as well as most other capital expenditures included in the larger definition of urban ecology) tend to focus on service to the more affluent areas of population centers. This is often a practicable and acceptable initial plan of implementation, considering the overall limitation on funds and the need for cost recovery for financing. Facilities must be paid for, and generally the user must pay. There is no way to give poor people what they need within the funds available to developing societies. Massive aid from industrial societies aimed specifically at these poor people is perhaps the only possible alternative. In point of fact the way to proceed is to increase the income level of the poor by helping increase the rate of development towards an industrial society state. The poor in any society will never be able to afford the same or an equivalent degree of service as the affluent. Sewerage and standard types of sewage treatment is a luxury affordable only when the GNP and average income is quite high. For the problem of excreta management for the poor the only affordable satisfactory approach in developing societies would be to provide well designed, decent on-site subsurface leaching systems. These with proper servicing handle the excreta problem at perhaps one tenth the cost of sewering. Very often substantial improvement projects are planned, but more often than not later phases of the program are not actually constructed. As a practical reality the basic public health of the less affluent areas in a city inevitably affect the public health of the total population accordingly water supply services and/or sewerage or excreta management programs must include service to the entire community.

Since the industrially developed countries are significantly affected by the conditions in the developing countries, it is very important to the World Society (Spaceship Earth) that the ecological standards/criteria utilized by the developing countries be appropriate to their relative stages of development. The standards/criteria which had been used by the presently industrialized countries, at a similar stage in their development, furnish guidelines as to appropriate actions. The larger goal for all the countries, and the World, must be achieving a sustainable society and environment, that is, economic-cum-environmental development. Officials in developing countries must be aided in resisting the imposition of inappropriate standards/criteria so that they can maximize the use of their resources for the ecological improvement so important to all world societies.

DISCUSSION

The general hierarchy of real and perceived societal needs has evolved in the affluent countries in the following historical sequence:

1. Food and shelter.
2. Protection from premature illness and death (communicable diseases).
3. Improvement of the aesthetic quality of life.
4. Maintenance of a desirable ecology.
5. Extension of life for the aged.
6. Improving the species through science such as genetic manipulation.

HISTORICAL ENVIRONMENTAL PROGRESS IN THE U.S.A.

Figures 1 through 9 illustrate some of the environmentally related changes which occurred in the U.S.A. as it became an Industrial Country (Ludwig, H.,Anderson, D. and Garber W., 1989).
Figures 1, 2, 3, and 4 follow the changes in national and personal wealth in the general period 1900 to 1988 when the U.S.A. was changing from a developing country to an industrialized country. Figure 1 shows the progress of the Gross National Product (GNP) per capita in constant 1929 dollars; increased from about 450 in 1890 to 1,400 in 1955 and is even higher now. (The effort of countries like China to reach $1,000 per capita within 10 years can be better evaluated with this background.) Figure 2 presents per capita assets in constant 1929 dollars; these assets increased from 2,000 in 1900 to 22,000 in 1960. Figure 3 permits examination of these changes relative to population. Figure 4 shows that average manufacturing salaries in constant 1929 dollars increased from about $10 per week in 1910 to almost $400 in 1985. During the period of rapid growth there were serious impacts upon the environment such as the stripping of the eastern and mid-continent forests. However, at the turn of the century the society was beginning to achieve control of public health and the primary need was to provide for food and housing. The U.S.A. was then a developing country, forced like many now developing countries to utilize its natural resources in achieving the next level of its hierarchy of needs.

Figure 9 should be viewed in comparison with Figures 1 and/or 2. That is, for public health reasons, there were only 9 regulated environmental parameters in 1930 and these were all for potable water. By 1988, as a national average, there were 63 regulated parameters for potable waters, 9 for air contaminants, and 38 for wastewaters. Figure 1 shows that during the 25 year portion (1930 - 1955) of the 1930 to 1988 period, the GNP per capita increased from about 780 constant 1929 dollars to about 1,400. Similarly from Figure 2, assets per capita increased from 7,800 to 22,500 constant 1929 dollars over the 1930 to 1960 portion of the period. There has also been a significant increase since 1960. The values in Figure 9 are based upon Federal requirements. Individual states may add more. For example in Southern California more than 140 "priority pollutants" are also tested for and controlled.

The parallel between the stage of development and the degree of environmental protection demanded by the public is clearly shown by Figures 1, 2, and 9. During this period, the country's resources grew rapidly, making such environmental regulation affordable. In 1930 the concern was for public health with water supply most critical. By 1988 concerns had included individual contaminants suspected of being toxic or carcinogenic, with zero risk for the population set as a primary goal. Inasmuch as the per capita GNP in the U.S.A. is now many times that of most developing countries, it can to a degree afford "non-engineering/economics". It could not have done so in 1930, so it is not reasonable to expect that Developing Countries be able to afford or to utilize standards and solutions now required in the U.S.A.. If the World

Community is convinced that some practices in Developing Countries can cause worldwide environmental/ecological problems, then the World Community must provide funding and other aid to the developing nations to aid them in reaching mutually acceptable solutions. It must be made clear to the World Community that each Developing Country's first priority must be to take care of critical environmental needs within their own boundaries; but that many cannot yet even afford that. It is therefore futile to expect such countries to contribute financially to global programs such as ozone depletion or "greenhouse" warming. The Developing Countries must be included and participate but the extra costs involved must be borne by the affluent societies.

Figures 5, 6, 7 and 8 clearly illustrate that public health in the U.S.A., during its period of development, was directly related to its GNP and the wealth of its citizens. Figure 5 for example shows the average age at death to have been about 38 years in 1874 and about 74 in 1983. Figure 6 is somewhat anomalous since it shows cancer increasing while other diseases decrease. The reasons for this are important, since the fear of cancer has driven the extreme standards/criteria adopted in the U.S.A. Part of the reason for the apparent increase in cancer deaths is improvements in diagnosis. However the major reason is that cancer is a disease of the aging, and increased affluence brings longer life spans. Table 1 shows the age - cancer relationship in the U.S.A. (Anderson and Garber, 1988).

TABLE 1

AGE AND CANCER DEATHS IN THE U.S.A.
1985

Age	Population	Cancer Deaths *	Age	Population	Cancer Deaths *
2.5	18,037,000	0	42	14,055,000	11,505
7	16,822,000	7	47	11,648,000	15,312
12	17,103,000	71	52	10,942,000	22,019
17	18,651,000	338	57	11,337,000	33,583
22	20,993,000	1,128	62	10,997,000	46,419
27	21,751,000	2,769	70	16,995,000	119,597
32	20,267,000	5,278	80	11,536,000	142,459
37	17,708,000	8,499			
	Sum	238,842,000		408,992	

Mean age at death for those who die of cancer = 67.23

* 1983 U.S.A. death rate for malignant neoplasms/100,000
Death Rate = 0.0000193 times age raised to the 4.412 power.

Given that the mean age at death from cancer in the U.S.A. in 1985 was over 67 years, at what time in the national development did the average age of the population reach this figure? Figure 5 shows this occurred in 1960. Prior to that time other causes of death were of greater significance. By 1990, with the ageing population of the U.S.A., cancer had become a significant cause of death. Accordingly, contaminant standards/criteria are now based upon protection from carcinogens. The writers believe that a basic criterion of zero carcinogens, arising from the concern about cancer, is extreme and probably not really affordable even in the U.S.A.. Certainly the Developing Countries must be careful not to promulgate standards with similar bases.

APPLICATION OF LEVEL OF DEVELOPMENT BASED STANDARDS

For developing countries where the average age at time of death is sub-

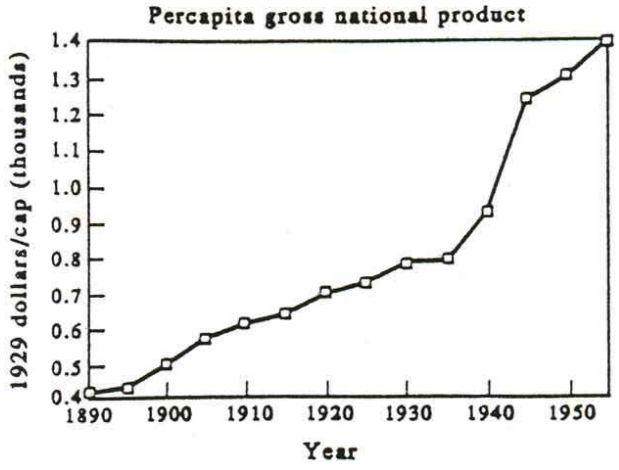


Figure 1

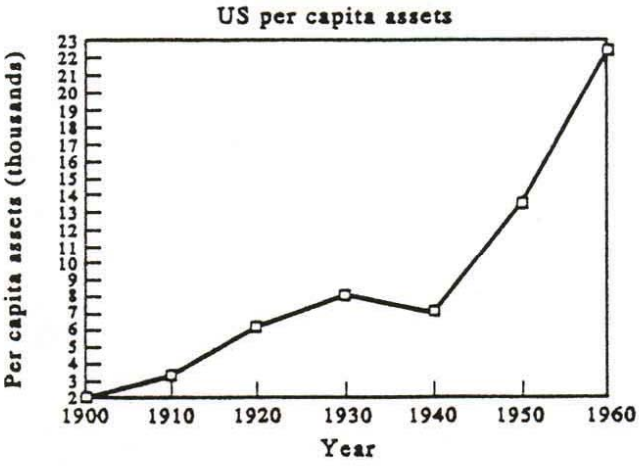


Figure 2

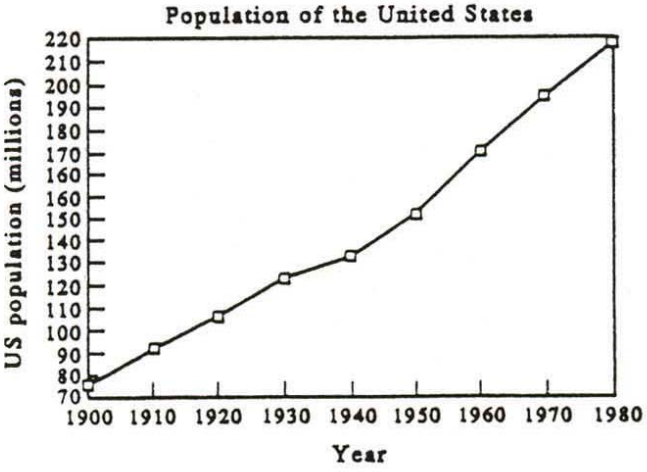


Figure 3

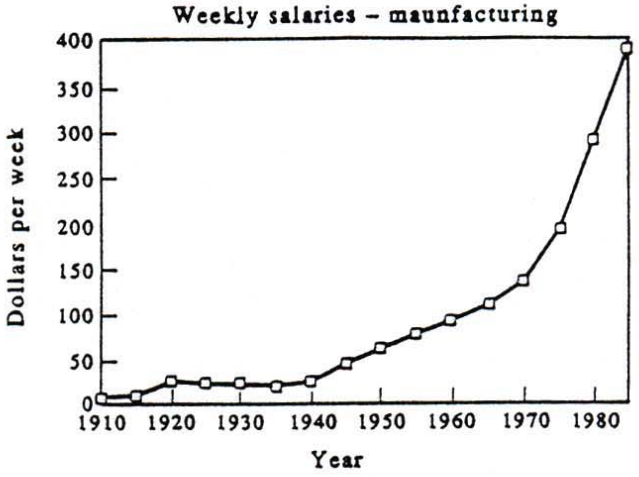
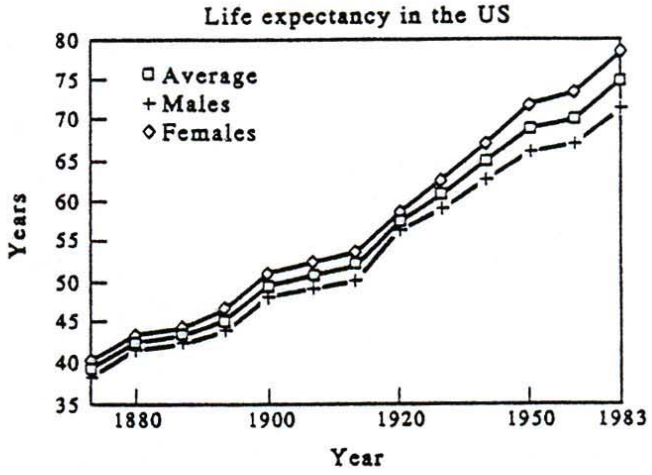


Figure 4



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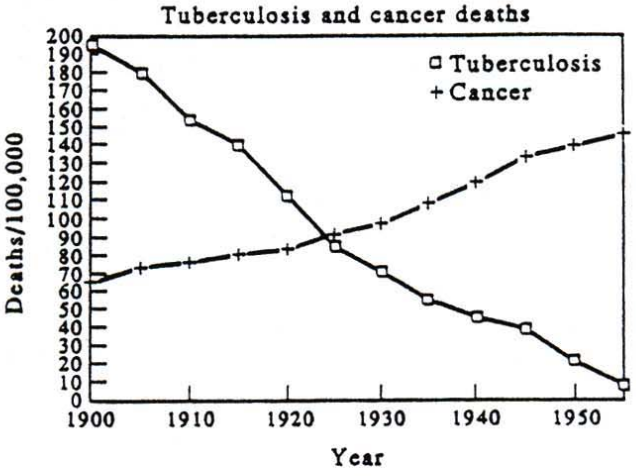

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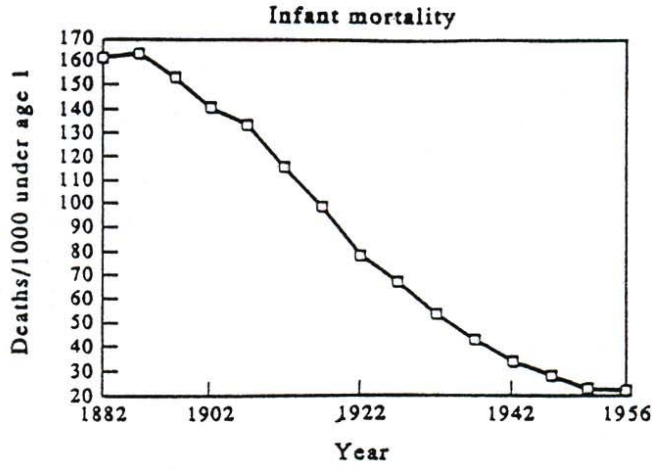

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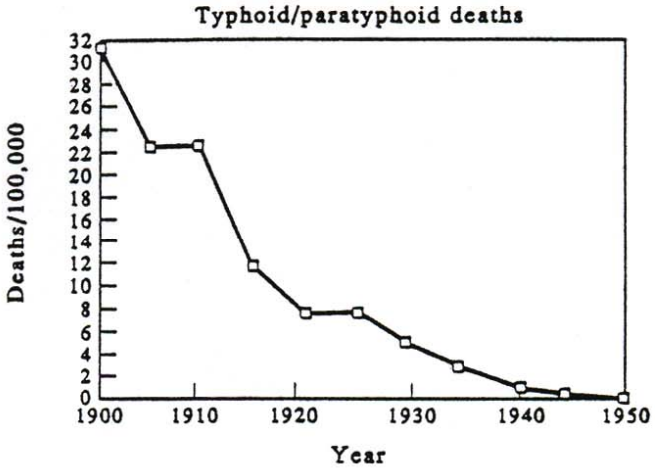


Figure 8

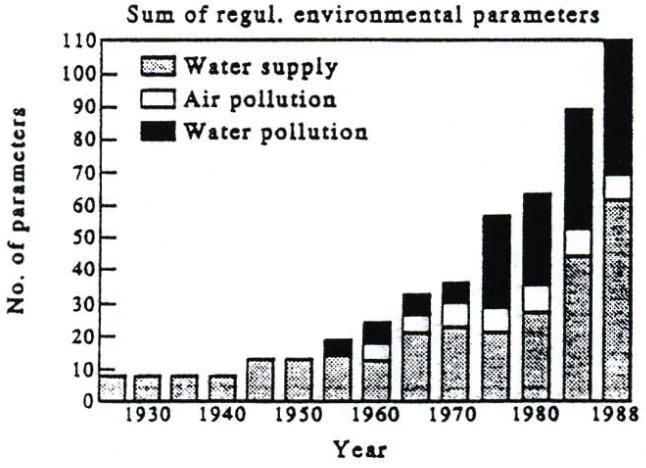


Figure 9

stantially lower than the level in the U.S.A., other causes of death are much more important. Therefore the use of cancer based standards/criteria does not address the real problem. These countries should be encouraged to develop their own standards/criteria reflecting their needs at their particular stage of development.

It is believed that, because of economic realities, all societies, developing or industrialized, must eventually return to an engineering/economic basis for setting standards. Moreover, if true public health protection is to be achieved in the urban areas of Developing Countries, affluent and non-affluent must receive suitable water and sanitary services. As already noted facilities must be paid for so the poor areas must have different facilities to affluent areas; but the facilities must address the significant problems while being appropriate in terms of the ability to pay. Work in Developing Countries in Southeast Asia (Ludwig, H.F., 1989)(Ludwig, H.F. and Browder, G., 1990) has indicated the following engineering/economic environmental socioeconomic considerations to always be required and/or known.

A. Urban Water Supply
   1. Total investment in all urban facilities.
   2. Percentage of the GNP represented by this investment.
   3. Is this percentage generally comparable with the percentages found to be suitable for other countries at the same level of development?
   4. How is the total investment distributed between major cities and their subsidiary regions and other cities and rural areas?
   5. Unit price of water in the various regions throughout the nation.
   6. Amount of the total investment in urban facilities in each area of the nation as a percentage of the family incomes in each of these areas.

B. Urban Sewerage/Sanitation
   1. Total investment in all urban facilities.
   2. Percentage of the GNP (or GDP for a region) represented by this investment.
   3. Is this percentage generally comparable with the percentages found to be suitable for a sustainable society in other countries at the same level of development?
   4. How is the total investment distributed between major cities and their subsidiary region and other cities and rural areas?
   5. What percentage of the GNP should be recommended on an engineering/economic basis as an allocation for sanitary sewerage facilities?
   6. What should be the distribution throughout the nation, on an engineering/economic basis, of the total resources determined to be suitable as the national sanitary sewerage allocation?

For the scientist/engineer approaching an evaluation of the feasibility of any water supply or sewerage/sanitation project at any place in the world, given the considerations listed above, certain basic engineering/economic questions must therefore be answered before the project can be recommended. These include the following.

1. What is the estimated project cost and is this cost in terms of the percent of the total infrastructure cost for the region within the limits found to be suitable for a sustainable society in countries at a similar level of development?
2. What is the estimated per family cost as a percentage of family income for the non-affluent as well as affluent areas in terms

of maintaining a sustainable society as compared with other countries at a similar stage of development?

3. What does a benefit/cost analysis show for the proposed project, including costs and expected benefits? The benefits should be tangible ones which include estimates of property value increase and public health improvements.

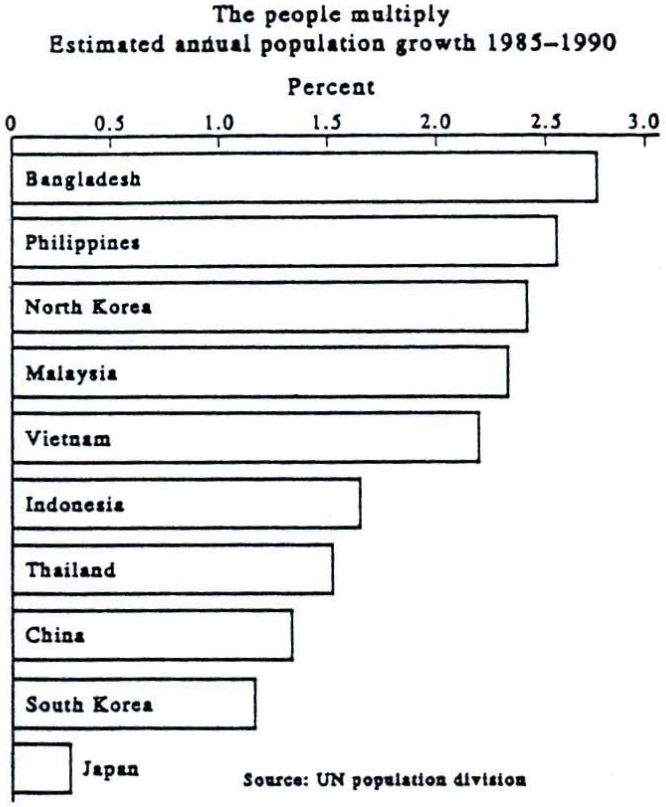
A BRIEF LOOK AT SOME DEVELOPING COUNTRY CONDITIONS

Developing countries face enormous problems which should not be ignored by the balance of the world community. The designation "Developing Country" is generally synonymous with countries having rapidly expanding populations (Brown, L.R., 1990). Such growth is present in Central and South America, Africa, and parts of Asia. The rate of growth varies from about 2 to 3 percent per year. In most cases land resources are stressed, so the excess rural population must move to the cities or encroach into upland forest or coastal fishery areas. As a result the ecology suffers, and the cities swell at about a 4% per year growth rate. Most of the largest cities in the world will soon be in the Developing Countries.

Growth of the cities is generally not at all desirable for the countries now experiencing it. Cities force investment to move toward them from the rural areas and thus encourage misuse of land resources as the farm population strip forests and overuse land in their struggle to survive. For example in India, between the 1970s and the early 1980s the forested areas within 100 kilometres of their 41 largest cities shrank by 33% (Economist, 6 October 1990). The cities themselves also develop enormous environmental problems because most Developing Countries do not have the resources available to cope with city population growths of 4% per year. To illustrate in part, more than 33% of the people in Dhaka, Manila, Kuala Lumpur, Bangkok, and Jakarta live in slums with non-existent sewerage service or safe potable water supplies. They also have essentially no access to roads, health care, or education. This condition obviously degrades human ecology including natural resources and the human quality of life in the urban areas. Basic health levels of all urban residents both affluent and poor are also seriously degraded. The world community is similarly affected since most of the world disease pandemics start in such slum conditions. Figures 10 to 13 (Economist, 6, October 1990) summarize some of the ecological conditions now seen in the parts of Asia undergoing these changes. Table 2 (Los Angeles Times, 16 October 1990) also illustrates one of the greatest imperatives faced by any Developing Country government, that of feeding the population. This problem is emphasized by the fact that whereas 55.7% of family income is needed for food in India, only 12.3% is required in the U.S.A.

Given these conditions and the fact that the largest of these Developing Countries, China, is attempting to achieve a goal of a Gross Domestic Product (GDP) level of wealth for its people of $1,000 per capita within 10 years, it is unrealistic to believe that the non-economically based standards current in the U.S.A and Europe can be afforded or enforced by developing countries. Japan, which is now a highly industrialized country, had a per capita income in 1956 similar to that now found in the Philippines. At that time period a growing chemical company discharged methyl mercury wastes to Minimata Bay which poisoned fish and people. Now Japan's GDP is such that there is the wealth required to attack ecological problems, although the amount of wastewater receiving treatment is still only about 40%.

How can the present non-economic/engineering approaches of the highly industrialized countries and their perceived evaluations as to worldwide ecological/environmental imperatives be reconciled with the immediate need of the Developing Countries to feed their citizens and develop wealth enough to first achieve decent acceptable living conditions and



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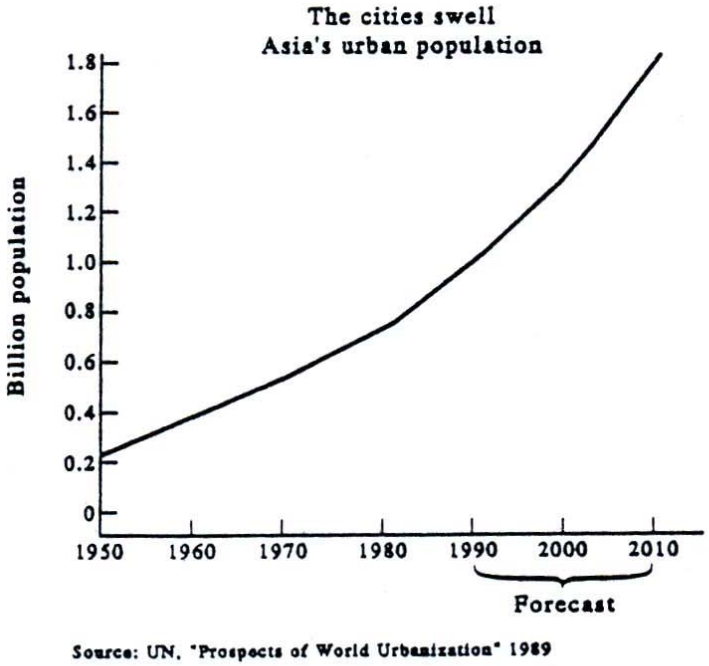

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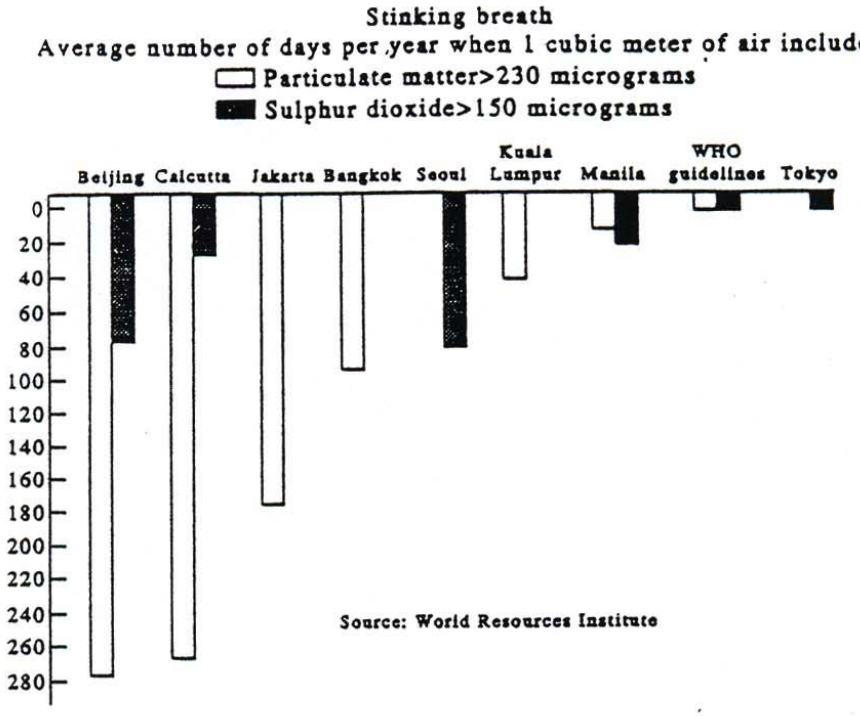

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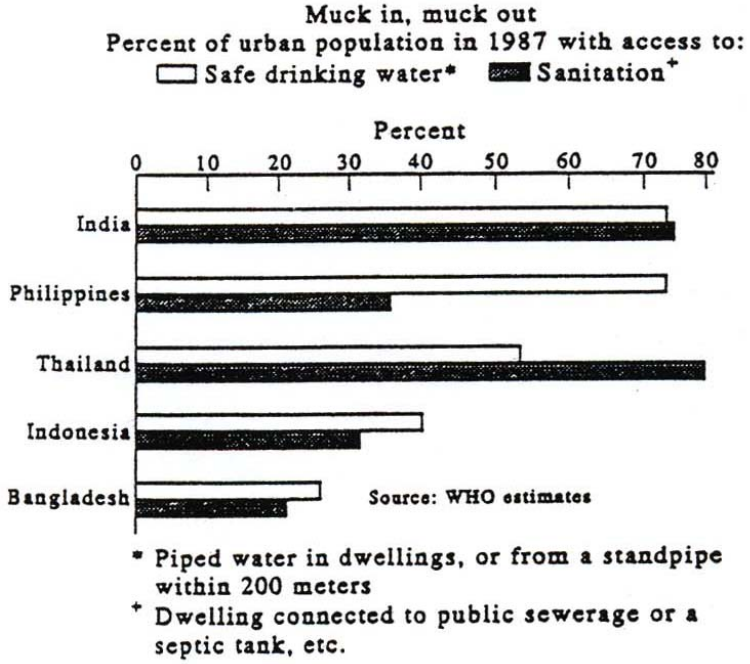

Figure 13

TABLE 2

FAMILY BUDGETS

Nation	Food & Beverage: % of Total	Nation	Food & Beverage: % of Total
U.S.A.	12.3	Finland	23.3
Canada	15.1	Switzerland	25.5
U.K.	16.2	Spain	27.7
Netherlands	16.8	Israel	29.2
France	19.4	South Africa	33.5
Belgium	19.6	Mexico	35.3
Denmark	20.5	Portugal	35.8
Germany*	20.5	Soviet Union	38.0
Japan	20.6	Ireland	38.6
Australia	20.6	Greece	38.7
Austria	20.7	South Korea	40.5
Sweden	21.7	Philippines	54.0
Norway	22.8	India	55.7
Italy	23.1		

* Figure for West Germany before unification

SOURCE: U.S. Dept. of Agriculture, Economic Research Service. Based on data from the United Nations - National Accounts Statistics Annual and from various country yearbooks.

eventually to become affluent societies? Criticism of their efforts by environmental groups and foreign "Green" parties will likely not be beneficial unless they are suitable to the realities of the situation in each separate Developing Country. The Prime Minister of Malaysia, on being so criticized for poor control of logging in his country, accused his critics of economic imperialism pointing out that Europe and America were once forest covered. These forests were destroyed to allow Europe and America to develop to the status of industrial nations. The answer to this problem is believed to be in the concept of Economic-cum-Environmental Development as recommended in October 1990 by the Asian Development Bank's report, "Economic Policies for Sustainable Development" (ADB, 1990). This study is believed to be unique in recognizing that the Decision Makers in practically all Developing Countries, at the technical level, are Economists, not those such as engineers who recognize the concurrent need for environmental protection, and the only meaningful solution is to modify economic development analytical procedures to incorporate proper attention to long-term environmental needs as well as the pressing and immediate economic needs. This reoriented approach, interalia, incorporates the concept that environmental standards in Developing Countries must suit the ongoing economic/ socio-economic constraints. Otherwise they will be unrealistic, unaffordable, unenforceable, and counter-productive.

Standards/criteria should be evaluated with this background, and the industrialized countries should seek to aid the developing countries to utilize the funds available to set and enforce standards/criteria aimed at the most important factors in the present level of their hierarchy of needs. Pressures to adopt the non-economic/non-scientific politically based standards/criteria of the industrial countries when resources to enforce them are non-exisent really represent an anti-environment approach.

CONCLUSIONS

Standards/criteria directed toward achieving ecological/environmental improvement should be considered as differing for each nation or region.

These standards/criteria should be related to the local stage of current development. At present, because of factors such as worldwide media coverage and increasing world travel and study, political leaders in developing countries are under constant pressure to try to afford their citizens the same degree of apparent ecological protection given in the affluent industrialized countries. This has often resulted in the adoption of the standards/criteria now implemented in the industrialized nations. Unfortunately the industrialized nations, under political pressures arising from poorly informed politically motivated media presentations and very active "environmental" pressure groups, no longer utilize a scientific/engineering/economic basis for formulating their standards/criteria. The writers believe that they must again do so, but for the moment, their affluence is such that they can still support such unrealistic politically based approaches. The Developing Countries, on the other hand, must utilize scientific/engineering/economic standards/criteria if they are réally to expect to achieve affordable rational goals. The Industrial Countries should examine their own period of development and review what their own standards/criteria were at earlier stages of such development to find how they can best help the developing countries to reach both their short-term and long-term goals.

Trained people exist within each Developing Country who know their hierarchy of needs most fully, and can best use available resources to meet their critical ecological problems. Assistance from other nations is available but often has not been utilized effectively and often has even been counter-productive in that the "Experts" made available from the affluent countries are themselves familiar only with the practice and standards of their own country. The Developing Countries need to be shown how their development can be furthered by ecological improvement, and how resources used for this purpose can be used to contribute optimally to economic-cum-environmental development. As shown by the example of the development of the U.S.A., criteria and standards should be established in terms of the stage of development the nation is then experiencing. Critical worldwide environmental questions will need worldwide resource allocations to aid the Developing Countries since local resources are most often limited by their current stage of development.

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ASIAN WATER SUPPLIES
Reaching the Urban Poor

A Guide and Sourcebook on Urban Water Supplies in Asia for Governments, Utilities, Consultants, Development Agencies, and Nongovernment Organizations

Arthur C. McIntosh

Asian Development Bank and International Water Association

The views expressed in this book are those of the author, unless specifically attributed to others, and do not necessarily reflect the views and policies of the Asian Development Bank (ADB), its Board of Governors, or the governments they represent.

ADB does not guarantee the accuracy of the data included in this publication and accepts no responsibility for any consequences of its use.

Use of the term "country" does not imply any judgment by the author or ADB as to the legal or other status of any territorial entity.

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Contents

Foreword

Most people living in cities would like to be connected to a 24-hour supply of piped water. Unfortunately, in most Asian cities less than 30% of the residents enjoy 24-hour supplies, and low service coverage and intermittent water supplies are the norm. The Asian Development Bank (ADB) would like to change this. ADB's "Water for All" policy emphasizes, among other things, expanding the delivery of water services, conservation of water, increased efficiencies, facilitation of the exchange of water sector information and experience, and improving governance. *Asian Water Supplies—Reaching the Urban Poor* has been produced for ADB by staff member Arthur McIntosh to provide greater understanding and awareness among key stakeholders on these matters. The book is particularly focused on ADB's overarching goal of poverty reduction.

There are three voices in this book: that of ADB (based on policy and the findings of regional consultations), the author (based on his more than 20 years' experience in Asian water supplies), and other noted authors in the sector (based on papers and publications). Structuring the book in this manner has provided some degree of balance and given Arthur McIntosh a certain amount of freedom to be frank when addressing sensitive issues, such as governance and corruption. This is the case in the first chapter, where the author brings attention to some of these issues by polarizing them. While ADB does not necessarily endorse every view of Arthur McIntosh put forward in this book, it does respect his opinions and endorses the overall thrust of this work.

In this first guide and sourcebook of its kind dealing with water supplies in developing countries, the author makes some provocative suggestions in separating myths and misconceptions from realities. He analyzes the reasons for poor performance of water utilities, proposes some solutions, and concludes that governance and tariffs are at the core of the problems and any possible solutions.

When considering governance, the main message is that transparent government policies must come first, followed by independent regulators. Civil society participation is also needed to ensure that policies are implemented. When operating water utilities, it is time to develop more autonomy, ensure staff performance is based on incentives, and stop the use of civil servant rules and salaries. Regulation based on policies, not contracts, should be developed for both public- and private-operated utilities.

In his examination of tariffs, it is suggested that the great inequities, which result in the poor subsidizing the rich, can only be rectified when consumers pay the full cost of water provision and when the money trail no longer runs through governments. It is surprising to learn, for instance, that in Manila those not connected to a 24-hour piped water supply (mostly the poor) pay around $20 per month for 6 cubic meters of clean water, while those connected (mostly the rich) pay around $4 per month for 30 cubic meters of clean water. This is the basis for two controversial recommendations: (i) hike the tariffs to help the poor, and (ii) fund development directly out of tariffs.

In some cities, there may be a link between high non-revenue water and low service coverage. The author suggests that leakage may be used to cover up the illegal use of water, because operators derive considerably more revenue (both official and unofficial) from selling water to vendors than from formally connecting consumers to the piped supply. As long as poor regulation encourages the status quo, there is little incentive for operators to do otherwise.

Business as usual is not an option. The inequities affecting the poor are begging for attention. ADB believes governments need to seriously consider the author's recommendations, as there are no other solutions on the horizon that could have the same impact. With this in mind, I commend the efforts of Arthur McIntosh in identifying the problems and proposing solutions.

This guide and sourcebook will be useful for governments, utilities, consultants, development agencies, and nongovernment organizations. The main finding of ADB's regional consultation in 2002 on *Water in Asian Cities—The Role of Civil Society* was the general lack of understanding and awareness of the sector among stakeholders. This book is expected to improve the situation. It is aimed at professionals in the sector, especially newly arrived professionals, who may not be aware of all the problems. It will be valued (as were ADB's water utilities data books) for its up-to-date data on Asian water supplies. The best measure of this guide's success, however, will be governments' readiness to enact reforms and civil society's readiness to keep governments accountable for their policies.

Jan P. M. van Heeswijk
Director General
Regional and Sustainable Development Department
Asian Development Bank

Preface

Objective

The purpose of this book is to give stakeholders a point of reference and some tools with which they can move forward. In this way, it is hoped that the mistakes of the last 20 years will not be repeated. It should not be necessary for a new generation of water professionals to learn everything all over again. Instead, they should be able to take what has been learned up to now and move on. To help facilitate this process, this book was designed to create greater understanding and awareness of the issues and possible solutions among all stakeholders in the sector.

Scope

This guide starts by identifying some myths, misconceptions, and realities. It then looks at problems and solutions related to a number of important topics. Governance and tariffs are identified as both core problems and core solutions. A new approach to the development and management of water supplies is proposed, which is based on transparent government policy and regulation and the involvement of civil society. Appendixes include (i) 19 city water profiles, (ii) 6 case studies on utilities, and (iii) 6 examples of small-scale water providers, all based on recent data from the field.

Approach

To the extent feasible, I have confined my views to areas of my own experience. On some topics—particularly water resources management, private sector participation, and sanitation—I have additionally included the pronouncements of others in the sector. Material sourced from outside the Asian Development Bank or my own experience is shown in italics. Although most chapters of the book deal with the problems and the solutions for a given subject, one of the findings is that problems cannot be solved in isolation. They can only be solved in the context of the big picture. While there is a chapter on sanitation, it scarcely does the topic justice, since sanitation deserves to be the subject of a book on its own. Additionally, the Asian water supplies sector as a whole is dynamic. For this reason, some of the data in this book might soon be out of date, but the principles outlined are expected to apply for some time. In those instances where cities and countries (such as Manila and India) are named, it is felt that the matters covered are common to many parts of the region and therefore do not reflect negatively upon the entities mentioned. Likewise, where I have been critical of governments in terms of governance, it should be noted that my statements do not necessarily apply to all governments.

How to Use the Book

This book can be read from cover to cover, or it can be used as a reference on a given topic. There is some repetition, but only on important points. Chapters were chosen to be topical, and there is not necessarily a flow from one to the next. However, Chapter 2 (Problems and Solutions) binds them all together. The chapters have introductions and “nutshell” summaries. Important pronouncements appear in red. When I use “we” and “us,” these refer to all stakeholders. Everyone involved in water supplies in developing countries can learn something from this book, especially new professionals in the sector, who will find this resource particularly useful in getting quickly up to speed.

Arthur C. McIntosh

Acknowledgements

Many people have contributed to this book. In terms of content, my Asian Development Bank (ADB) colleagues Graham Jackson, Alex Jorgensen, and Rudolf Frauendorfer made many useful comments and contributions. Philip McNamara, as editor, was responsible for some major restructuring, which greatly improved readability. He also showed great perseverance with the microediting, striking a balance between ADB's rules and my more casual style. Grendel Salvadar and Josephine Pagunsan made changes to numerous drafts. Vic Angeles and Anna Juico ably directed the ADB Printing Office inputs of Ronnie Elefano (cover design) and Ruben Marmita (map). Rose Arcano did a great job on the typesetting to make the book user-friendly. Haris Pinidiya, Rick McGowan, and Nancy Barnes made contributions on specific topics. Cesar Yniguez offered advice on the structure and flow. Akira Seki, ADB's former Director General, Regional Sustainable Development Department, gave me the green light and encouraged me to produce this book. Brad Philips, Director, Agriculture, Natural Resources, and Social Sectors Division, Regional and Sustainable Development Department, helped keep my feet on the ground and guided me professionally. Geoff Bridges pulled together the Study on Water in 20 Asian Cities (Appendix 1), which provided a factual basis for my work. Lynette Mallery (Publications/ADB) was encouraging and helpful in the presentation (title and cover design and guidance on typesetting) and in moving approvals through official channels. I would also like to thank Wouter Lincklaen Arriens, K. E. Seetharam, Almud Weitz, and Maria Paniagua for their contributions to regional technical assistance relevant to the book.

There are a host of others who also helped make this book possible. I would like to offer my special thanks to the International Water Association for stepping in early with an offer to copublish. This will make a big difference in translating rhetoric into action. Winnie Flores (my household help), who is shown on the front cover, inspired me to champion the plight of the urban poor. Poshan Nath Nepal (Kathmandu), Mohammed Didi (Malé), Premakumar Fernando (Colombo), Perry Rivera (Manila), and Ek Sonn Chan (Phnom Penh) authored the case studies in Appendix 2. Herve Conan, Maria Paniagua, Fiscalina Amadora-Nolasco, Usha P. Raghupathi, Abu Rayhan Al-Beeroonee, Huynh Thi Hoai Nguyen, and Kishore Kumar Jha contributed to the examples of small-scale water providers (Appendix 3). I would like to give credit to Eric Sales (ADB), Yayasan Dian Desa (Indonesia), Nepal Forum of Environmental Journalists (Nepal), Sevanatha Urban Resource Centre (Sri Lanka), and Environmental Broadcast Circle (Philippines) for the photographs provided.

I am especially grateful to Ranjith Wirasinha, Khun Chuanpit Dhamasiri, and Ir Hendropranoto Suselo, first for agreeing to review this publication and second for their very insightful comments.

Finally, and most of all, I need to acknowledge the contribution of my wife, Pauline, who supported my work on this book through almost every weekend for 2 years.

Arthur C. McIntosh

List of Tables, Figures, and Boxes

BOXES

Currency Conversion Equivalents

Currency	Rate to US Dollar (31 December 2001)[a]
Bangladesh taka	57.00
Cambodian riel	3,895
People's Republic of China yuan	8.28
Hong Kong dollar	7.80
Indian rupee	48.18
Indonesian rupiah	10,400
Japanese yen	131.80
Korean won	1,314
Malaysian ringgit	3.80
Maldivian rufiyaa	12.80
Nepalese rupee	76.48
Philippine peso	51.40
Singapore dollar	1.85
Sri Lanka rupee	93.16
Thai baht	44.22
Vietnamese dong	15,084

[a] Figures have been rounded.

Source: International Monetary Fund's *International Statistics Yearbook 2002*.

Abbreviations and Acronyms

ADB	Asian Development Bank
BOT	build-operate-transfer
CGE-M	Generale des Eaux and Marubeni
CMWSC	Chengdu Municipal Water Supply Company
DMC	developing member country
DWASA	Dhaka Water Supply and Sewerage Authority
GC	Greater Colombo
HMGN	His Majesty's Government of Nepal
IWA	International Water Association
JWSE	Jakarta Water Supply Enterprise
KWSB	Karachi Water and Sewerage Board
MCWD	Metropolitan Cebu Water District
MWA	Metropolitan Waterworks Authority
MWCI	Manila Water Company Inc.
MWSC	Malé Water and Sewerage Company Pvt. Ltd.
MWSI	Maynilad Water Services Inc.
MWSS	Metropolitan Waterworks and Sewerage System
NGO	nongovernment organization
NRW	non-revenue water
NWSC	Nepal Water Supply Corporation
NWSDB	National Water Supply and Drainage Board
O&M	operation and maintenance
OPRRA	Old Philippine Railway Residents' Association
PLC	public limited company
PMC	Pune Municipal Corporation
PPWSA	Phnom Penh Water Supply Authority
PRC	People's Republic of China
PSP	private sector participation
PVC	polyvinyl chloride
SSWP	small-scale water provider
SWMC	Selangor Water Management Corporation Ltd.
UFW	unaccounted for water
USAG	Utility of Water and Wastewater Treatment Company
WSD	Water Supply Department
WSSCC	Water Supply and Sanitation Collaborative Council

Measurement Units and Symbols

Measurement units

cms	cubic meters per second
l/c/d	liters per capita per day
m^3	cubic meter
$/m^3$	per cubic meter
MLD	million liters per day

Symbols

”	inch
>	greater than
<	less than
%	percentage

Currency symbols

$	US dollar[a]
NRs	Nepalese rupee
Rf	Maldivian rufiyaa
Rs	Indian rupee

[a] “$” is used only to refer to the US dollar.


72°00'E
122°00'E
42°00'N
10°00'N
Ulaanbaatar
Harbin
Tashkent
Sea of Japan
Dalian
Seoul
Tokyo
Osaka
Yellow Sea
Shanghai
Chengdu
Delhi
Kathmandu
East China Sea
Karachi
Dhaka
Macau
Hong Kong
LOCATION OF REFERENCE CITIES
Arabian Sea
Vientiane
Bay of Bengal
Bangkok
Bangalore
Chennai
Manila
Phnom Penh
Ho Chi Minh City
Cebu
South China Sea
Colombo
Malé
Kuala Lumpur
Celebes Sea
Singapore
N
0 200 400 600 800 1000
Kilometers
INDIAN OCEAN
Jakarta
Java Sea
Note: Boundaries are not necessarily authoritative.

Chapter 1

Myths, Misconceptions, and Realities

As an introduction to this book, I would like to be provocative in identifying what I feel are myths and misconceptions and in suggesting the corresponding realities. These realities are proposed at the outset in the hope that they will be considered by each reader but not fully accepted until the ideas presented in the following chapters have been explored. My views have purposely been polarized to bring attention to these matters, but I recognize that what I am stating will not apply across the board. The lack of awareness and understanding of the subject of Asian water supplies was recently illustrated during the Asian Development Bank (ADB) regional consultation in Manila (*Water in Asian Cities—The Role of Civil Society*). This explains why there are so many interrelated problems in the sector yet to be resolved. With that in mind, let me briefly examine some of the beliefs, which I have found to be commonly held, that have shaped perceptions related to urban water supply in Asia.

1. **Coverage with piped water requires major urban water utilities to seek funds from external sources.** I suggest that, in most cities with more than a million people, the development of urban water supplies can be funded directly through tariffs. Support for this statement comes from the millions of urban poor not being served in places like Manila (Philippines). These people pay up to $5 per cubic meter (/$m^3$) for water bought by the container, while those served with piped water often pay only $0.10/$m^3$. In Malé (Maldives), all people pay $5/$m^3$ for piped water. The People's Republic of China (PRC) is already heavily funding new investments directly from tariffs. Raising the tariffs of those served (most of whom are not poor) is feasible and will provide the funds needed to serve the poor, who will be happy to pay a fraction of their current costs for a reliable piped water supply. On a more practical note, I suggest that achieving this status could be a 5-year policy objective.

2. **Shortage of water is the reason for intermittent water supply.** I suggest that sound hydraulics and demand management through pricing and strict metering can assure a 24-hour piped water supply with very little water. In Malé, they deliver 34 liters per capita per day (l/c/d) with a reliable 24-hour supply.

3. **The poor are unwilling and cannot afford to pay the full cost of piped water.** I suggest that the poor pay many times the amount the rich pay for water, in unit rate and total cost terms. An example of this comes from Manila, where a household helper pays 900 pesos per month for vended water (water sold by itinerant vendors) while her employer pays 200 pesos per month for piped water.

4. **It is possible to run a $20–100 million per year commercial operation (selling water) with civil servant rules and salaries.** I suggest that management and staff must be the best available on the open market, and incentives must match performance. The Singapore Public Utilities Board, perhaps the best water utility in the world, pays its management staff more than $150,000 per year, compared with the average of $5,000 per year paid to managers employed by many Asian water utilities. Other good examples come from the water utilities of Malé (Maldives), Phnom Penh (Cambodia), and Bangkok (Thailand).

5. **Reducing non-revenue water (NRW) below about 20% of production is not economically justified.** I suggest that this is influenced by developed country costs and artificially low tariffs in developing countries. The Singapore Public Utilities Board and some cities in Japan have reduced NRW to less than 10% of production. I further suggest that many systems with NRW above 40% have numerous visible leaks in service connections, high rates of estimated consumption, and thousands of illegal connections that can all be addressed to reduce NRW. In these cases, the priority should be to fix visible leaks.

6. **The private sector will bring much needed funds for development to the table and improve water utility efficiency.** I suggest that the reality is that the private sector has brought funds to the table in areas such as water production and treatment (mostly through build-operate-transfer [BOT] contracts) but has failed to invest adequately in extending piped water supply services to those not yet served. Likewise, efficiency gains in terms of reducing NRW have generally been well below expectations. Jakarta and Manila are two examples.

7. **In answer to rapid urbanization, it is necessary to go farther and farther a field to find more water sources.** I suggest that there are simple options not yet seriously addressed, including demand management, rainwater harvesting, trading water rights, building check dams, and rehabilitating watersheds. These only require political commitment to be realized.

8. **Intermittent water supply is OK.** I suggest that people believe this because they are unaware of the coping costs and health risks tied to intermittent supply and, in many cases, do not know that 24-hour supply to the home is the norm in most countries.

9. **Appropriate legislation allows a water utility to operate with autonomy.** I suggest that legislation is a necessary but not sufficient condition for autonomy. Governments frequently do not allow corporate bodies to exercise their autonomy, especially in terms of staffing, tariffs, and investments. Examples of this come from the National Water Supply and Drainage Board in Sri Lanka and the Nepal Water Supply Corporation (see Appendix 2).

10. **Water utilities do not suffer when the money trail runs through governments.** I suggest that some elected officials are reluctant to raise tariffs, not to protect consumers but to protect their own power and access to funds. When there are major subsidies, the bulk of the money trail goes through governments. When consumers, through tariffs, pay the full cost of water supply, the money trail is direct from consumer to operator, and there is less chance for corruption because consumers will demand accountability. The latter is the case in Bangkok and Singapore.

11. **Households in Asia need at least 200 l/c/d.** The average domestic consumption in Europe is around 130 l/c/d. The average domestic consumption in Malé is 34 l/c/d. In major cities in Asia, half the people use less than 40 l/c/d. I suggest that there is a need for more equitable water use in Asian cities and that the average domestic consumption can be in the range of 100–150 l/c/d.

12. **Private operators are the cause of higher tariffs.** I suggest that, in general, higher tariffs are long overdue. It is therefore unfair to saddle private operators with this criticism. Moreover, I believe that the converse of this belief is true. In my opinion, there is no future for private operators while tariffs are kept artificially low. The reason for this is that some funds for investment will have to come from tariffs.

13. **Regulatory bodies are only needed because of private sector contracts.** I suggest that they are needed just as much for public water supplies, where accountability, efficiency, transparency, and equitability need to be monitored.

14. **Private operators are eager to serve the urban poor.** I suggest that the record shows that private sector efforts to help the poor connect to piped water are to some extent "showcased." The increase in new domestic connections tells the real story. The private sector sells water to vendors and distribution contractors, provides connections serving multiple households, and asks those connected to share water with their neighbors. The correlation between low service coverage and high NRW is no coincidence. Those with vested interests will try to maintain the status quo.

15. **Private sector participation (PSP) brings competition.** I suggest that the bulk of private sector contracts in the water sector has gone to just a few firms from two countries and that this is because prequalification criteria have restricted bidding. A recent example was the prequalification for a lease contract for the Kathmandu Valley water supply. PSP has not brought much competition.

Realities in a Nutshell

- Coverage with piped water does not always require major urban water utilities to seek funds from external sources.
- Shortage of water is not the reason for intermittent water supply.
- The poor are willing and can afford to pay the full cost of piped water.
- It is not possible to run a $20–100 million per year commercial operation (selling water) with civil servant rules and salaries.
- Reducing NRW below 20% of production is economically justified.
- The private sector will not always bring much needed funds for development to the table and improve water utility efficiency.
- In answer to rapid urbanization, it is not necessary to go farther and farther afield to find more water sources.
- Intermittent water supply is not OK.
- Appropriate legislation does not always allow a water utility to operate with autonomy.
- Water utilities suffer when the money trail runs through governments.
- Households in Asia do not need 200 l/c/d.
- Private operators are not always the cause of higher tariffs.
- Regulatory bodies are not only needed because of private sector contracts.
- Private operators are not always eager to serve the urban poor.
- Private sector participation does not always bring competition.

Chapter 2

Problems and Solutions

This is probably the most important chapter in this book, because it puts forward the notion that an individual problem cannot be solved in isolation. It can only be addressed after the core problems have been resolved. Although this guide deals with topics by chapters, and for ease of reading problems and solutions are discussed in the same chapter, it must be recognized that the prerequisite for any solution lies in addressing first the core problems. It should also be recognized that the solutions proposed may not be appropriate for every set of circumstances. What follows is an introduction to the main problems and solutions and the connections to the core problems and core solutions. Later in this guide, in chapters on specific topics, more justification for these connections is provided.

No piped water

A. Problem Chart

Figure 2.1 identifies poor governance and low tariffs as core problems. Polluted waterways result from a failure to invest in wastewater collection and treatment and implement legislation pertaining to pollution. Degraded watersheds result from illegal logging, human occupation of catchments, and a lack of revenue that can be used to reforest the land. Overexploitation of groundwater can be traced to a lack of monitoring and control. When industry is allowed to use this resource (which belongs to all) for free, and when tariffs for formal piped water are low, the wrong message is sent to groundwater users.

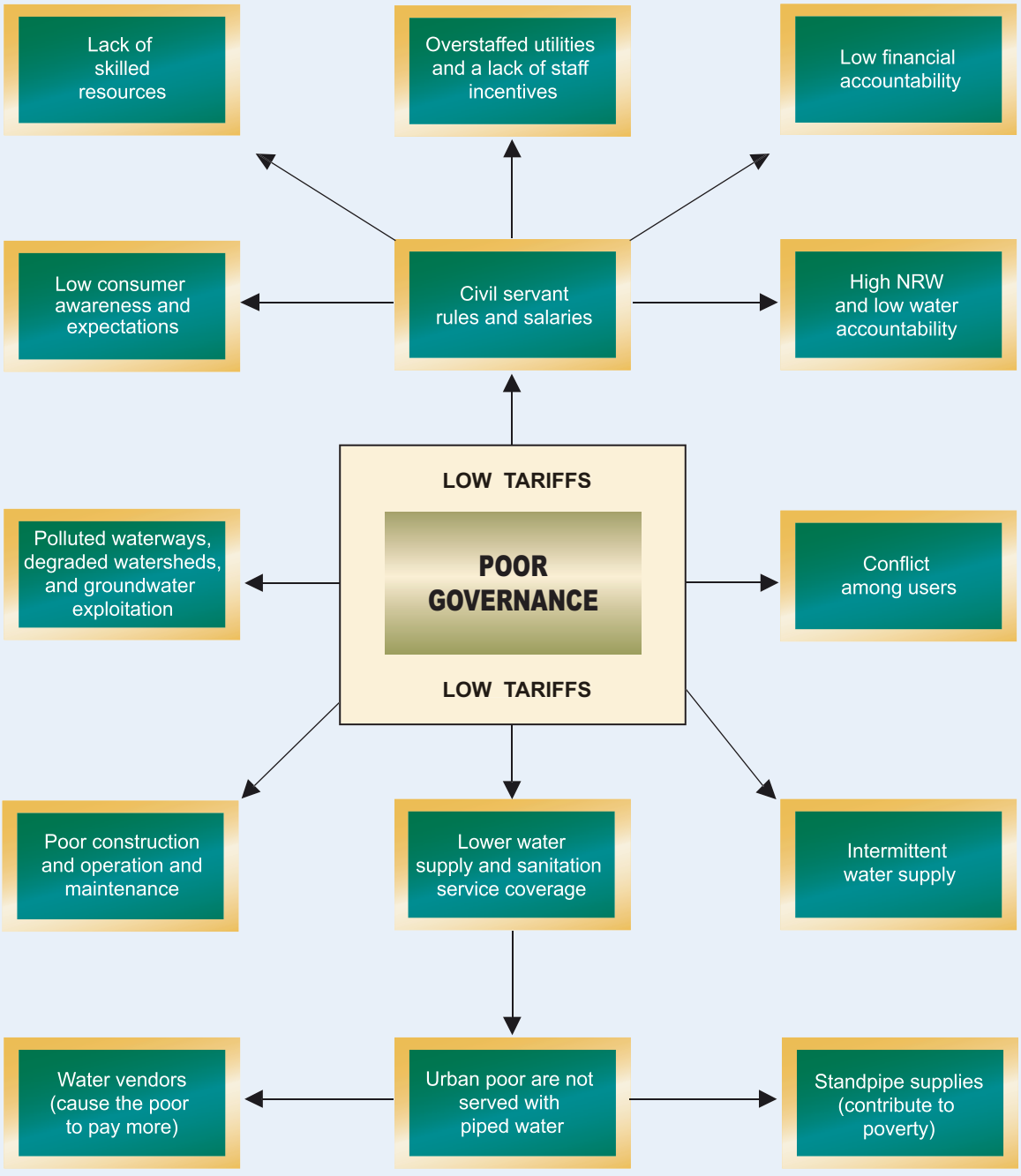
The objective

Low water supply and sanitation service coverage can be traced to low tariffs and a lack of revenue to undertake development. This in turn can be traced to a desire by governments to maintain control of the money trail by providing heavy subsidies. It may also be found that there are those—including utility staff, government officials, and elected officials—with vested interests in maintaining a status quo that allows a considerable amount of informal revenue (the price paid by vendors for water at the source) to enter their pockets. Thus, there is little incentive to connect more people (especially the urban poor) to formal piped systems.

Intermittent water supply often results from elected officials insisting on extending the distribution pipework beyond its hydraulic capabilities. Low tariffs contribute to the lack of revenue available for the modification of this pipework. Strong metering, billing, and collection are needed to overcome intermittent water supply, and they, too, rely on good governance and adequate tariffs.

There is a conflict of interest between rural farmers (who want water for irrigation) and urban water users. A low tariff differential between urban and rural users exacerbates the problem. Poor governance is manifested in short-term and politically expedient development planning, which in turn leads to more frequent conflict among users. Conflict in water use is sometimes resolved in an ad hoc manner by elected officials, rather than through more institutionalized procedures for dealing with water rights.

Figure 2.1 Problem Chart



Alternative source—traditional stone tap

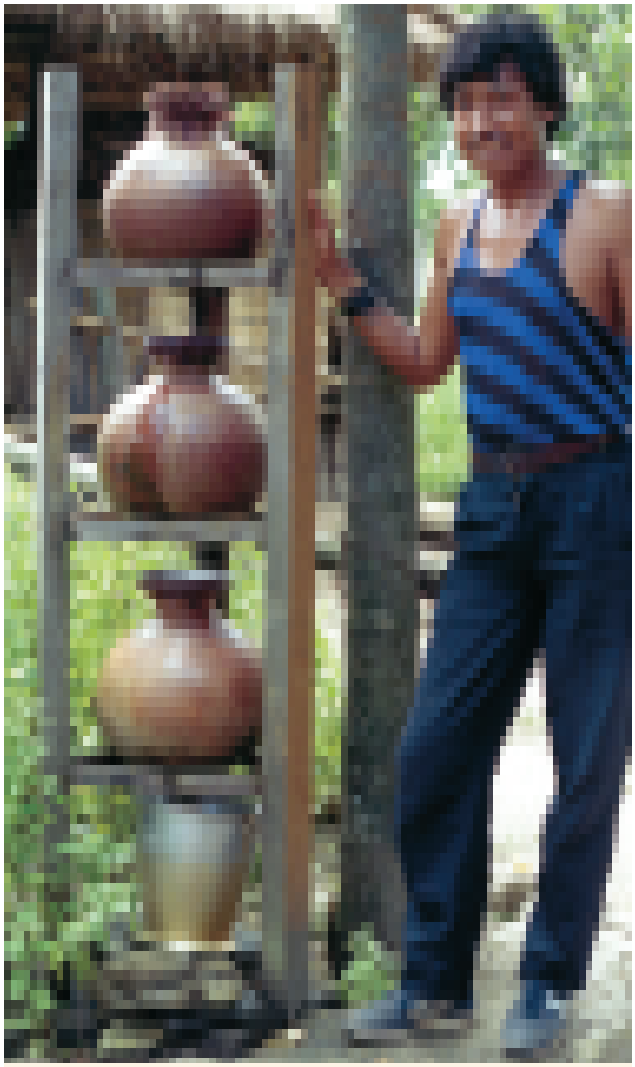
High NRW and low water accountability result from illegal connections, inadequate metering and meter reading, and inadequate billing on the one hand and from leakage of water on the other. As mentioned above, the illegal sale of water by vendors is another manifestation of poor governance. Civil servant rules and salaries, which are also part of poor governance, contribute to these problems. Civil servant rules are complex, outdated, and not appropriate for transparency and decision making. Civil servant salaries are so low, in some cases, that it is very difficult for employees to earn enough to support their families. This situation can result in the bending of the rules (if bribes are offered) and the performance of unauthorized services, including those that facilitate illegal connections.

Poor construction can result from consultants and contractors being squeezed of their profits after rendering special payments to government or elected officials. Moreover, low tariffs affect the quality of maintenance. In line with this, new projects are commonly proposed before the replacement of meters and old pipes can be addressed, which should not be the case.

Low consumer expectations can also result from low tariffs. Most consumers in South Asia, for example, are unaware that they are entitled to receive a 24-hour piped water supply. Poor governance ensures that consumers are unaware of government policies and that there is no one to keep governments accountable for implementing these policies. Civil servant salaries do not encourage staff to help consumers.

Indirect consequences of poor governance and low tariffs also abound. Low financial accountability is linked to civil servant rules. The overstaffing of utilities is mostly due to nepotism and outside interference. A lack of skilled human resources is linked to civil servant salaries. Standpipe supplies (a feature of poverty) often go hand in hand with intermittent water supply. Poverty results, in part, from low water supply and sanitation service coverage. Always, it is the poor who are last served. The poor continue to pay very high prices for water purchased from vendors, and they use meager amounts of this resource as a result.

The lesson to be learned from all this is that it is indeed futile to attempt to resolve an isolated problem like high NRW without addressing first its root causes, which are poor governance (mostly corruption and outside interference) and low tariffs (which feed on poor governance).



How people cope—traditional filter

B. Solution Chart

Figure 2.2 places transparent policies, regulatory bodies, the involvement of civil society, and a paradigm shift in tariffs at the core of the new solutions.

Good governance equates to transparent policies, regulatory bodies, and civil society involvement—not necessarily to passing laws. There are examples in many countries, including the Philippines, showing that the existence of laws is no guarantee that they will be implemented. In most cases, when the public is ignorant of a law, that law cannot be implemented. What is needed is something more in the public eye, like a government policy statement on the subject (in this case on urban water supply and sanitation). An active civil society can ensure that government policies are kept in front of the public. Civil society can be assisted in monitoring the implementation of government policies by more formal and independent regulatory bodies. Civil society can also insist on being involved in consultations to formulate or change government policies. A paradigm shift in tariffs is part of the solution for three reasons. First, this will place the consumer more in the driving seat and reduce the amount of corruption. Second, it will quickly lead to improvements in coverage with piped water and a reduction in intermittent water supplies. And third, it will cause a reduction in demand and further reduce the need to fund the development of new water supplies.

Higher tariffs will automatically lead to demand management and the consideration of a range of new options for water source development, including trading water rights, rehabilitating watersheds, rainwater harvesting, and wastewater recycling. Good governance will lead to improved operation and maintenance (O&M) efficiency, pollution control, organization development, accountability, and consumer education and awareness. In combination with higher tariffs, it will provide incentives for private sector investment. Good governance will also provide incentives for improving water utility performance, including staff sourcing from the open market, and it will lead to sustainable developments, including improved coverage with water supply and sanitation facilities for the urban poor and 24-hour water supply for all. In addition, higher tariffs for water supply will allow development agency and government funds to be diverted to urban sanitation improvements.

What the solution chart highlights is that there cannot be isolated solutions. It shows that a whole range of specific solutions is possible, if the core problems of governance and tariffs are addressed first.

C. Chapters and Appendixes

The chapters that follow deal with specific topics that often attract a lot of attention by themselves. Many are interrelated, such as private sector participation and tariffs, subsidies, and development funding. A few important points will be repeated in more than one chapter, but this will allow many chapters to be read alone.

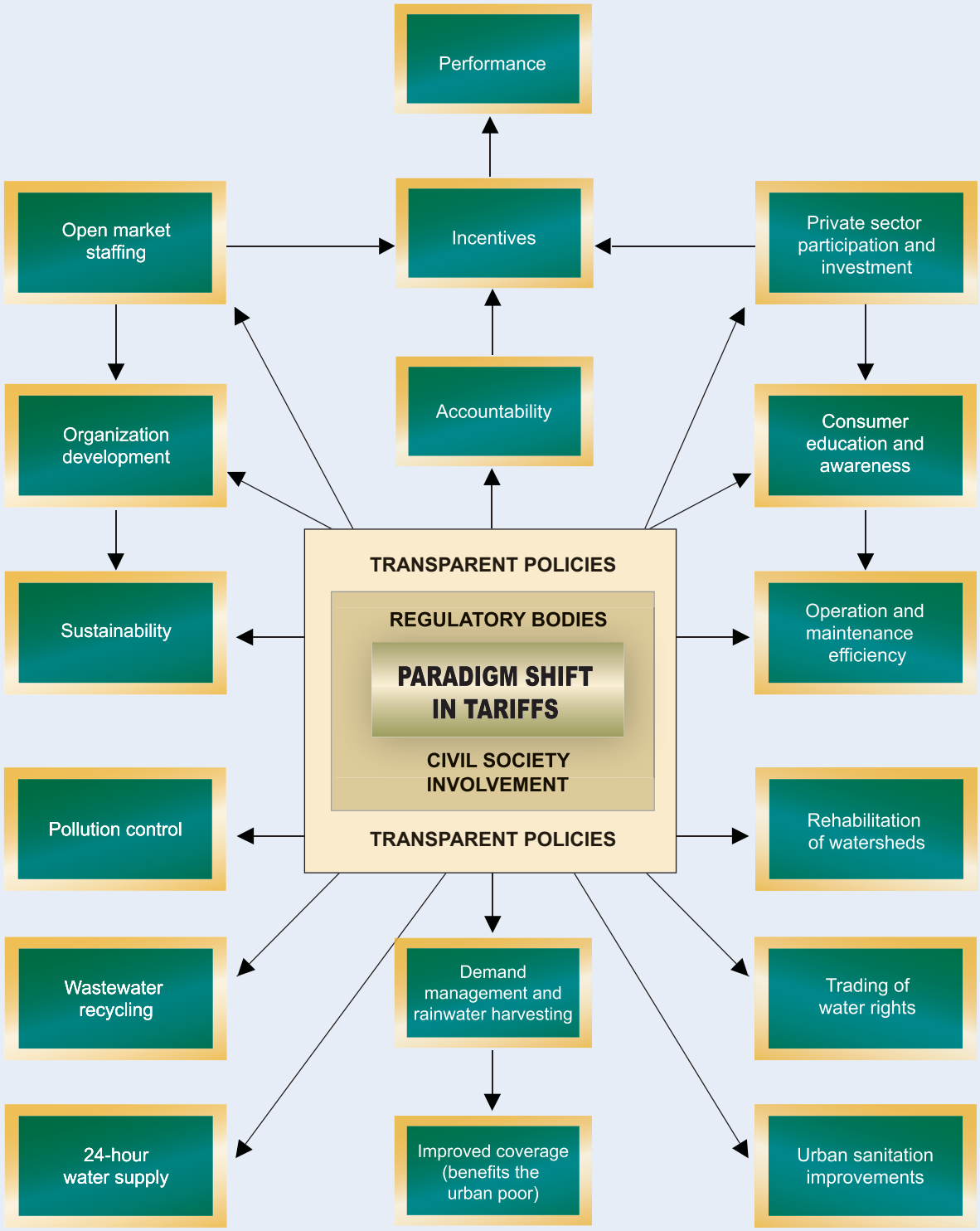
The city water profiles in **Appendix 1** provide thumbnail sketches of the situation in each city examined with respect to water resources, policies and regulations, PSP, tariffs, service levels, and sanitation. Some comments from civil society and my own remarks are added. The purpose of Appendix 1 is to tie the problems presented in this book to the reality of what is happening throughout Asia.

The six case studies presented in **Appendix 2** (Malé, Phnom Penh, Manila, Kathmandu, Colombo, and Dalian) illustrate lessons learned relating to regulation, willingness to pay for water, leadership, PSP efficiency and investment, water shortages, intermittent supply, NRW reduction, autonomy of utilities, and investments funded from tariffs. These case studies are especially important because they were written by experts closely associated with the water utilities described. In line with that fact, these studies are evidence from the field showing that many views expressed in this book are similar to views held by key stakeholders in developing countries.

In **Appendix 3** there are six studies that shed some light on the activities of small-scale water providers in Cebu, Delhi, Dhaka, Ho Chi Minh City, Kathmandu, and Manila. These illustrate the nature and extent of these operations, which should encourage others to want to learn more. They also highlight the great inequities in urban water supply in many parts of Asia.

At the end of the day, the problem and solution charts will tie this guide and sourcebook together.

Figure 2.2 Solution Chart



Problems and Solutions in a Nutshell

- An individual problem, such as NRW, cannot be solved in isolation. It can only be addressed after the core problems have been resolved.
- The core problems are poor governance (including corruption) and low tariffs.
- The core solutions include a transparent policy, an independent regulatory body, a paradigm shift in tariffs, and the involvement of civil society.

Chapter 3

Water Resources Management

Water supply does not exist in isolation. There are many factors that affect city water supplies, including social, environmental, and economic impacts. Water resources management is one of the most important environmental dimensions. A sustainable supply of water to a city will depend on the quantity and quality of the water available and its distance from that city. Other major factors are population growth and the wise use of the water resources available. This chapter deals with the latter by considering the supply aspects, the demand aspects, and policy and management.

A. Supply Aspects

This section examines water supply by looking at sources, sustainability, and rights of users.

Groundwater Sources

Cities are usually located near adequate or once adequate water supplies—mostly near groundwater, but sometimes near surface waters. Looking around Asia, many examples (Bangkok, Jakarta, and Manila) of groundwater overexploitation can be seen. These examples show that what could have been a finite but long-term sustainable resource has been destroyed through the depletion of aquifers, which has caused salinization and land subsidence. The excessive use of groundwater has been a short-term expediency that is becoming a long-term disaster (Figure 3.1 shows the extent of surface water use in major cities in Asia). Watersheds have been allowed to become denuded, which encourages flash runoff that erodes fertile soils and results in the loss of steady water flows in the dry season. Industrial wastewater and domestic sewage have been allowed to pass untreated into major waterways, thereby endangering water supplies of downstream users. Asian cities cannot continue to go to other water catchments without first ensuring that they have optimized water availability and use within the vicinity of urban demand.

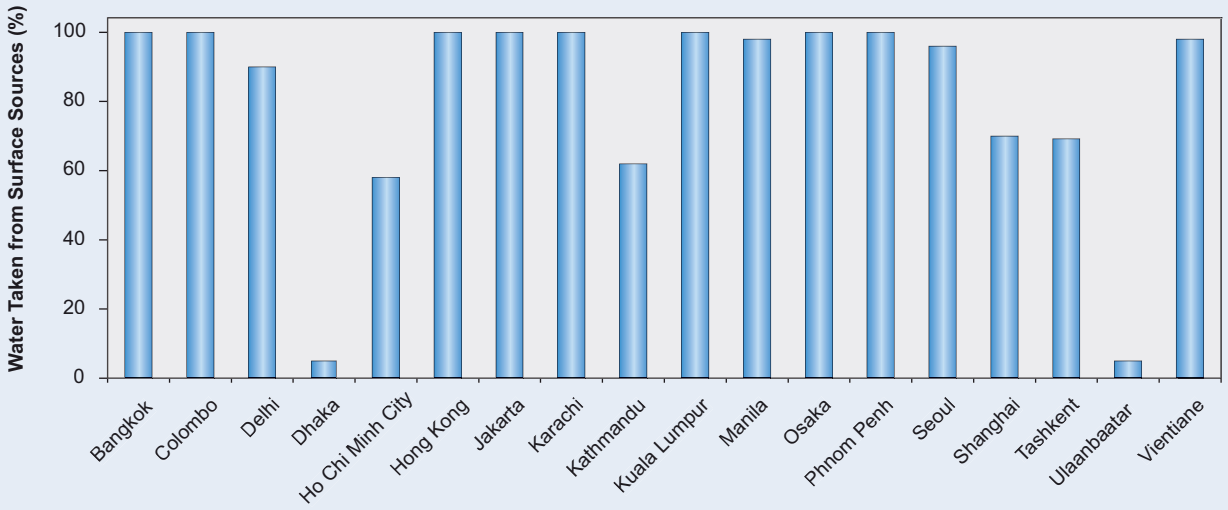
Over the last hundred years there have been two major shifts in water management. First, the people have given over their role to governments. Second, people rely less on using rainwater and have instead exploited rivers and groundwater through the use of dams and tubewells. This second fact has led to a growing and in some places unbearable stress on water from these sources. In India, the exploitation of groundwater has been encouraged, but little has been done to recharge it. As a result, groundwater tables nationwide are falling. In years when rains are low, this problem becomes an emergency. The poor, who depend on dug wells (which dry off first), are the first to suffer. (Agarwal, 2001)

Many still rely on groundwater

Watershed Rehabilitation

One difference between developed and developing countries is that catchments for water supplies in developed countries are strongly protected. They have good vegetation cover, and human, animal, or agricultural uses of that land are prohibited. In developing countries, especially those with large populations, the governance associated with the use of watersheds for

Figure 3.1 Surface Water Sources (2001)
[piped supplies only]



other purposes is invariably quite weak. Furthermore, the rehabilitation of watersheds is a long-term undertaking that does not find much support when measured against the need for short-term political gains.

When watersheds are denuded of trees, through logging and cutting for firewood, rainfall rapidly becomes runoff, which causes the erosion of fertile land and reduces the time during which this water can be used, unless it is stored using dams. This situation is of course exacerbated by the wet and dry seasons that dominate the climates of many Asian countries. Watershed rehabilitation will facilitate the retention of rainwater, which will help river flows become perennial. The National Water Supply and Drainage Board (Sri Lanka) has been experimenting with watershed rehabilitation in different topographical and soil regions with a view to determining in each region the appropriate amount of integrated ground cover that would also give farmers the potential for revenue generation.

It is possible to reforest more than 100 million hectares of degraded and unproductive land in India. Watershed development of 100 million hectares at the present norm would cost about $10 billion. At $1 billion per year, assuming a 10-year completion period, the cost is insignificant compared with the enormous benefits that would be derived. In terms of water storage, flood control, reduced soil erosion and loss of nutrients, and additional agricultural crops, fuel, timber, and other produce, the value of India's reforestation in monetary terms would be much more than the total value of all the country's current industrial assets.[1] *If even a tiny fraction of the value of this great asset was spent on its upkeep, and if traditional (village) rainwater storage systems are revived, India's economy would improve more rapidly than by any other means.* (IEI News, 2000)

Promotion of rainwater harvesting

[1] This may be a matter of opinion, rather than fact, but it is worth careful consideration.

Potential for rainwater harvesting

Rainwater Harvesting

Why is rainwater harvesting important? It is often said that water should be free, because it is a gift from nature. That is true if the user of that water collects it as it falls from the sky or draws it from a spring, before it has been treated or delivered, because it is the treatment and transport of water that have associated costs. Water tariffs must be raised to meet the costs of water supply, which continue to increase due to more advanced treatment, greater distances to be traveled, lower groundwater tables, and more costly distribution in densely populated areas. As tariffs rise, rainwater harvesting and other options become attractive.[2] To collect water off the roof of a home or office and store it for future use is efficient. While there are some constraints, such as the room for storage in very densely populated areas, there is tremendous potential not yet harnessed. What is required is for local authorities to amend the bylaws so that no new home is built that does not have rainwater collection from the full roof area and storage for that water on-site. In addition, for the owners of existing houses to also comply with these bylaws, time frames of 5–10 years can be given for the modification of the roofs and grounds of all existing homes. Chennai (India) is an example of a city making good progress in rainwater harvesting (see www.geocities.com on the Internet). Once again, governance is important.

It does not matter how much rain you get, if it is not captured you can still be short of water. India receives most of its annual rainfall in just 100 hours. If this water is not captured, there will be shortages. When water harvesting and watershed development programs are handled well, it has been shown that rainwater harvesting is the starting point for meeting drinking water needs, eradicating rural poverty, generating massive rural employment, and reducing distress migration from rural areas to urban areas. Because smaller catchments give much more water than larger catchments, one state is planning to construct 10,000 check dams (one dam with a catchment of 10 hectares will collect much less water than 10 smaller dams, each with a catchment of 1 hectare). If the Government puts its mind to it, drought can be banished completely in a maximum of 10 years. The problem is one of mindsets. Rainwater harvesting demands a new approach to governance, a participatory form of governance instead of a top-down bureaucratic one. (Agarwal, 2001)

Check Dams and Wetlands

There is no doubt that one major frustration of water resources management in Asia is the failure to capture the wet season runoff so that it can be used throughout the dry season. In the past, too much attention was given to building large dams. Now, more attention is being turned to small (check) dams. Kathmandu Valley in Nepal is an example of a location where many check dams might be used to store water during the wet season. When urban water supply tariffs are raised to around $0.40–0.50/m³, it may become attractive for the private sector to build check dams that would divert wet season flows into Sri Lankan style "tanks," or even artificially constructed underground storage, so that the water collected can be sold to the utility for urban supply purposes in the dry season.

The dams of the estimated 200 million beavers that once lived in the continental United States made meadows out of forests, as wetlands slowly captured silt.

[2] I once had a conversation with a man from Frankfurt, Germany. The cost of water was discussed, and the man said water cost $2/m³ and sewerage cost $3/m³ in his home city. Then he said, "but I don't pay that—I collect rainwater off my roof." These days, Frankfurt is well known as a city that uses rainwater harvesting.

These dams resulted in a remarkable and uniform buildup of organic material in valleys, a checkerboard of meadows throughout the woodlands, and a great deal of edge (the fruitful zone where natural communities meet). Beavers are a keystone species. Their dams create wetlands that provide homes and food for dozens of other species, including ducks, moose, fish, frogs, and great blue herons. Wetlands clarify water and prevent soil from washing downstream. When beavers make a series of dams and ponds within a drainage basin, the water cycle in an entire watershed is affected. Wetlands are like sponges. They soak up water during storms and release it slowly in drier times. Water detained in wetlands behind beaver dams is more likely to percolate down to groundwater, raising the water table and creating springs and small streams throughout a watershed. A tenth of the total land of the United States was once beaver built wetland. Now the beavers and these wetlands are gone. (Outwater, 1996)

Pollution Control

Water availability can drive economic growth. And, along with a ready source of labor and ready markets or transport to markets, water availability has encouraged industries to spring up in cities. Industries, however, damage waterways through pollution, discharge of raw sewage, and disposal of garbage. Incentives must be created for the relocation of industries to industrial estates, preferably downstream of cities, where their effluents can be treated before they are discharged. Town planning rules must be transparent to the public and implemented. Industries that are water intensive should be closely monitored, like they are in Singapore, not only for pollution but also for their conservation measures. In line with this, relatively high tariffs can encourage conservation. The "polluter pays" principle can be applied in urban areas, and this can be regarded as trading for the right to restrict other uses. This more than anything is a question of governance. Others may argue that one could also consider a "beneficiary pays" principle. Perhaps there is room for both. As noted at the Third World Water Forum, which was held in Japan in March 2003, national actions should be more focused on pollution control at the source instead of simply building more and more advanced water treatment plants at high cost.

Trading Water Rights

While there have been many advocates of trading water rights (mostly on economic grounds), the expected advantages of allowing the market to determine water resources management have not always resulted. The following learning experience from Australia is a timely warning that theory is not always manifested in practice.

The legislative basis for water markets in Australia is almost complete, and water trading for irrigation is now possible in 87% of its river systems. It was expected that managing water demand, including environmental needs, would lead to a reduction in water usage and increase efficiency as water moved (via trade) from low value to high value users. Contrary to expectations, increased prices have increased water usage overall. And most of the water sold interstate was not originally used by the sellers. Moreover, this water is being transferred to land that was not previously irrigated (leading to increased risks of salinity). One outcome of the operation of water markets is that rice and cotton crops, those that have the greatest impact on Australian rivers, are showing no signs of decline. Instead, rice is on track to break production levels, and the top nine private water holders are in the cotton trade. (Isaac, 2002)

Current conflicts among water users are governed mostly by ad hoc political decisions. If, however, they were governed by the free market value of water, and if customary and legal water rights were freely traded, then such conflicts could result in win-win situations freely chosen by all parties. What we need to precipitate this is a paradigm shift in urban water supply tariffs. The options for the farmers are then considerable. They can sell the whole of their customary water rights. They can improve irrigation efficiency or plant crops that are less water intensive and sell the water saved. Or, they can sell their water rights only for the dry season. While it is important to secure economic gains for farmers, the question of job losses cannot be ignored, so alternative employment should be secured as part of the solution.

Subsidies and having the money trail run through governments are impeding the trading of water rights. More effort must be made to recognize the customary water rights of farmers and others. More awareness of this matter needs to be developed through the Internet and other media outlets. Records and documentation related to trading water rights should be more transparent for the public. We must explore, through surveys, the willingness of farmers to trade water rights. It is quite possible that more private sector development and management of water would result from freely trading these rights.

It is an unreasonable situation that Asia is now facing, one in which new water sources to satisfy increased demands—resulting from rapid urbanization—are now often secured on the basis of a 10-year design horizon, instead of design horizons of 50 or 100 years, which would be acceptable to secure water for basic human needs. The problems must be sorted out now, before they become even more acute and civil conflicts and wars emerge over water use. Two keys to resolving these issues are recognizing water as an economic good and trading water rights. For example, Angat Dam in the Philippines represents the next major source of water for Manila, but only if the water rights can be traded (see Box 3.1). When water supply tariffs rise to approximate the real cost of water, that is to say in the \$0.30–0.40/m³ range for many Asian utilities, other options for water security present themselves, such as trading water rights.

B. Demand Aspects

This section examines demand by looking at water use and access to this resource.

Irrigation

About 90% of all water use in Asia is for irrigation. Yet, when we talk of a "water crisis," it seems that the gains that can be made from this sector in terms of efficiencies and recognizing water as an economic good have to a large extent been ignored. Low efficiencies result from water losses in canals through evaporation, leakage, and pilferage. They come from irrigation methods that waste water. They come from growing crops that are heavy water users, such as paddy crops, when

Box 3.1 Trading Water Rights—Angat Dam Irrigation versus Manila Water Supply

Economic Justification

- Five million of the 12 million people in Manila are not connected to piped water, 5 years after PSP in water supply.
- Two reasons for the high number of people not connected are given. First, the tariff is too low to allow concessionaires to invest. Second, there is an inadequate water source.
- The farming population of 22,000 also relies on water from Angat Dam to irrigate (mostly paddy) crops. Yet, in times of drought, they can lose all water to Manila.
- Most of the land being irrigated from Angat Dam will in all likelihood become urbanized within the next 20 years.
- There can be a win-win situation for the urban poor in Manila not connected to piped water and the farmers, if the whole of the water rights of the farmers are traded to the urban dwellers over time (say, for example, 10 years).
- If a price of \$0.03/m³ is paid to farmers, they have the potential to triple their current income, as long as they also plant new crops (like potatoes) that do not need irrigated water.
- When compared with developing a new source, payment of \$0.03/m³ by the water utility for a guaranteed source of 21 m³ per second represents a much cheaper and faster solution to providing piped water to the 5 million people in Manila without access to piped supplies. This should translate into an increase in the water tariff of no more than \$0.06/m³.
- An average domestic tariff of \$0.40/m³ in Manila is clearly feasible and affordable and should ensure that all the urban poor not connected to piped water get connected as quickly as possible.

Political Reality

- Water rights are held by the National Irrigation Administration. And this organization, in response to rapid urbanization, encourages irrigation of more land.
- Owners of the land have no water rights.
- Tillers of the land (farmers) have no water rights.

Government Options

- Produce a transparent policy or plan for land and water use in the future.
- Buy the land or require private developers to buy the land for controlled urban development and lease back to farmers in the interim.

for the purpose of generating income other crops will do just as well on much less water. They come from the salinization of soils caused by the use of too much water. They come from the lack of mechanisms to trade customary water rights in a free market. And they come from national policies on subsidies and food security that are often in conflict.

Continuous irrigation, without proper drainage, gradually destroys land and nearby streams and rivers through salinization. The sun's heat evaporates irrigation water, leaving salts behind. This water also flushes salts out of mineral rich soil, leaving these to dry on the surface or dissolve in groundwater and poison plant roots. Furthermore, where rainfall is limited, crops must be carefully chosen. Sugarcane is just about the worst crop choice in terms of water needed—whereas potatoes would be much more beneficial. (Time International, 1990)

Subsidized irrigation is one reason for waste. Farmers rarely pay more than one fifth of the cost of operating public irrigation schemes, let alone capital costs. In most cases, farmers can cut their water use by 10–50%. It has been shown that an investment in irrigation efficiency is usually an investment in crop and soil productivity. Better water management often leads to increased yields, a reduction in erosion, and a reduction in the amount of fertile cropland that becomes water logged, salted, or sapped of nutrients. (Postel, 1997)

Demand Management and Water Conservation

Although average domestic water consumption in European cities is only 130 liters per capita, many cities in Asia use around 200 liters per capita (for those connected to piped water). This can be traced primarily to low tariffs and a lack of public awareness concerning the importance of conserving water as a scarce resource. When tariffs are raised in many Asian cities (Chennai, Colombo, and Manila are examples) there is no drop in demand, indicating that there is no price elasticity of demand at these levels. Standpipe water is in many cases free to users, and it is common to see water being wasted at standpipes in South Asian countries. Water is also wasted through poor plumbing in homes, leaks in distribution systems, and overstorage on a 24-hour basis, which is related to users' attempts to adjust to intermittent water supplies. In Asia, unlike Europe, there is little attempt to conserve water through toilet or shower retrofitting. Singapore is an exception, and the PRC offers some good examples of industrial and domestic water conservation. The block tariff systems employed by Asian utilities invariably have large volumes at lifeline rates, thereby providing subsidies to all, including the rich.

Little effort is going into rehabilitating watersheds to secure future supplies. It is a waste of funds to treat and distribute water if it is lost or wasted. As urban populations continue to expand, there is sometimes a need to go farther afield (more than 100 kilometers) to harness new water sources, and this is becoming very costly, not only in capital costs but also in operating (pumping) costs. Unfortunately, this fact is seldom reflected in tariffs. Much can be done to have more efficient use of water in the urban context. In some cities, including Bangkok, Jakarta, Kathmandu, and Manila, NRW is around 40% of production or more. The tariffs for piped water are so low that there is little demand management.

Water Scarcity

Water scarcity is a relative term. It depends on location, climate, season, and potential use by humans. The scarcity value of water is determined by the quality of water, the quantity of water, and the number and type of water users. It is greatly influenced, therefore, by the integrity of watersheds, overexploitation of groundwater, cost of water transport and distribution, density of populations, and water pollution levels. What is being seen (and is clearly demonstrated by the rapid rise of bottled water use) is that the urban issue is one of scarcity of clean and potable water, which is also a reason behind rainwater harvesting becoming more and more relevant for cities. But water scarcity in Asia is not manifested across the board. It is characterized more by unequal access to water. For example, half the population in a city might get piped water and half might rely on vended water. Another example, involving irrigation, is where farmers at the head of a system might get plenty of water and farmers at the bottom of a system might miss out altogether on water for their crops. The challenge, then, is to overcome this lack of equality.

Grossly underpricing water perpetuates the illusion that it is plentiful and nothing is lost when it is wasted. Many of the world's water shortages stem from failing to value water at anything close to its true worth. (Postel, 1997)

Most of the world does not treat water as a scarce resource. The foremost challenge related to water scarcity in developing countries involves inefficient water use in agriculture and urban areas and by industry. Inefficient use is linked to subsidized rural and urban water use. In line with this, irrigation water is essentially

not priced. The price of water in cities does not cover the cost of delivery. And capital investment decisions in all sectors are divorced from the management of this resource. It is not uncommon for water subsidies to go disproportionately to the better off (irrigation farmers and urban water users connected to public systems). (Rosegrant, 1995)

Industrial Water Use

Water utilities in cities often rely heavily on revenue from industrial users to stay financially viable. In Greater Colombo, for example, the average industrial tariff is six times the average domestic tariff. Yet industry is invariably not controlled in terms of location and type, so polluting industries, like carpet factories, are located upstream from domestic water users. There are very few industrial estates (where some collective treatment of effluents can be made). There are almost no incentives for industries to relocate to areas where they will have less effect on residential zones. There is heavy exploitation of groundwater (normally without charge) by industry, and there is little knowledge of or control over water use by industry in terms of water needs and conservation measures. In addition, it has been noted that some major industrial users of public piped water are using armed personnel to guard illegal connections. Moreover, in Sri Lanka, the sand mining of rivers—a livelihood for many and a cheap resource for construction—is allowing seawater to move far inland, which is upsetting the water supply intakes for several towns. In short, governance is a real issue in the industrial use of water in Asian cities.

Water for the Environment

The need for minimal "environmental flows" for water left in rivers during the dry season is now beginning to be recognized. These flows are still very low and probably inadequate, but recognition is at least a start. There is a need to consider the whole ecological regime of rivers, including fishing as a livelihood; fishing as a sport; recreational needs, such as swimming, sailing, and white-water rafting; flood and fertility regimes; artificial lakes with tourism potential; garbage control; and storage of wet season flows.

C. Policy and Management

This section examines policy and management by looking at different approaches and challenges.

ADB'S Water Policy

ADB's water policy (see Box 3.2) addresses approaches to water management and development. It seeks to promote the concept of water as a socially vital economic good that needs increasingly careful management to sustain equitable economic growth and reduce poverty. The conservation and protection of water resources in the region through a participatory approach are at the heart of the policy. References are made to specifics of the water policy throughout this book.

Management Principles

The following ideas reflect some of the latest thinking from South Asia.

- *Three sets of stakeholders—managers, users, and social auditors—need to interact.*
- *Society's ability to respond to local water management needs is primarily an issue concerning information, governance processes, and the structure of civil society.*
- *Watershed management has to do with afforestation and check dams as much as with livelihood issues concerned with irrigated agriculture.*
- *History suggests that an effective approach to water management may be to allocate equitable shares among stakeholders.*
- *Absence of clear water rights results in inequitable access to water resources, and the establishment of water markets and rights will create incentives for users to make efficient use of their water entitlements.*
- *The most effective instruments to reduce water demand may be agricultural price policies and subsidies.*
- *Management issues are rooted in interactions between complex and interdependent water resources and economic, environmental, cultural, institutional, and social systems.* (Moench et al, 1999)

Box 3.2 The Water Policy of the Asian Development Bank (in a Nutshell)

Promote a national focus on water sector reform. Developing member countries (DMCs) will be supported to adopt effective national water policies, water laws, and sector coordination arrangements; improve institutional capacities and information management; and develop a national action agenda for the water sector. Throughout, the needs of the poor will be specifically factored into legal, institutional, and administrative frameworks.

Foster the integrated management of water resources. Integrated management will be based on conducting comprehensive water resources assessments and concentrating interlinked water investments in river basins.

Improve and expand the delivery of water services. Focusing on water supply and sanitation (rural and urban), irrigation and drainage, and other subsectors, support will be provided for autonomous and accountable service providers, PSP, and public-private partnerships emphasizing equity in access to water for the poor and underserved.

Foster the conservation of water and increase system efficiencies. Packages that combine water use and resources management charges to recover costs, improved regulation and increased public awareness, and provisions to ensure that the poor are not excluded will be supported.

Promote regional cooperation and increase the mutually beneficial use of shared water resources within and between countries. The primary focus will be on the exchange of information and experiences in water sector reform. Support will be provided to enhance awareness of the benefits of shared water resources, create sound hydrologic and socio-environmental databases relevant to the management of transboundary water resources, and implement joint projects between riparian countries.

Facilitate the exchange of water sector information and experiences. Socially inclusive development principles will be supported to promote stakeholder consultation and participation at all levels, increase the access of poor consumers to basic water services, and enhance water investments in DMCs through public-private and community-nongovernment organization (NGO) partnerships.

Improve governance. This will be accomplished by promoting decentralization; strengthening monitoring, evaluation, research, and learning at all levels, particularly in public sector institutions; and building capacity. (ADB, 2001a)

River Basin versus Local Management

On the one hand we learned at Dublin[3] that water should be managed at its lowest practicable level, but on the other hand we are now told that comprehensive water resources management on a river basin basis[4] is best. There is potential for conflict. This has to do as much with local versus national politics as with anything. We are seeing (in Sri Lanka) how it is very difficult to get various water users to agree on development and management on a more comprehensive basis. Allocation of water rights is still an issue. In many countries, irrigation authorities do not willingly share information with water supply authorities. In default of the desired trading of water rights, however, we see other mechanisms, such as compensation and water levy payments, that mimic this type of trading. The Melamchi Water Supply Project in Nepal provides such an example (see Appendix 2, Kathmandu case study).

Managing Water Resources to Meet Megacity Needs

Some findings of a regional study and consultation on this subject—in the cities of Bangkok, Beijing, Delhi, Dhaka, Jakarta, Karachi, London, Manila, Seoul, Singapore, and Tokyo (ADB,1993)—are presented. Ten years later the findings are still valid.

[3] International Conference on Water and Environment held in Dublin, Ireland, in January 1992.

[4] Management on a river basin basis is the management of water from the top to the bottom of its catchment of rainfall in an integrated manner, rather than the management of water within the confines of local authorities.

Problems

- Growth rates are explosive.
- The use of resources causes conflicts.
- Rivers and the living environment are polluted.
- The urban poor are marginalized.

Main Findings

- Controlling pollution is the top priority.
- Demand management by pricing is needed.
- Water must be treated as an economic as well as social good.
- Scope for recycling and reuse in industry and agriculture must be identified.
- Water is a priority need of the poor, and they are willing to pay.

Urban Planning

- Development strategies should have a horizon of 15–25 years.
- Urban zoning with industrial estates is needed.
- Development in flood plains should be avoided.
- Urban planning should integrate water planning with land use, housing, drainage, and environmental protection.
- Equitable sharing of water resources can be based on a basin development plan addressing social, political, and economic aspects of various options.
- Water resources planning and management should include monitoring the quantity and quality of sources.
- Investment cost analyses should include public and private expenditures, as the latter can be very high if the supply is intermittent.

Wastewater Disposal

- In dense areas of megacities, the long-term solution to wastewater disposal is piped sewerage and treatment with separate sewage and drainage pipes.
- Effluent discharges should be downstream from water supply intakes. Discharge standards should be consistent with water uses in catchments.
- Sanitation schemes that achieve local improvements in one area at the expense of others are not appropriate in megacities.
- Wastewater should be regarded as potentially having value for reuse in agriculture, maintaining surface water flows, and groundwater recharge.

Institutions

- Roles of agencies should be carefully defined.
- Water and sanitation utilities in megacities should be able to act as bulk suppliers to urban poor areas. Utilities and local governments should adopt flexible approaches to the provision of water to unauthorized settlements and base their decisions on commitments to pay for services.

Economic and Financial Aspects

- Demand side should receive more attention, and increased efforts need to be made to estimate demand and understand its determinants in an economic sense. Financial revenue estimation should increasingly be made on demand information, rather than simply estimating required revenues based on future financial costs.
- Subsidies, when used, should be explicit and transparent and target the urban poor. They should be directed at the demand side rather than the supply side.

Conflict of Water Users

The main users of freshwater in Asia are farmers (through irrigation), next come the urban water utilities that serve domestic, commercial, industrial, and some gardening and stock raising needs. Hydropower facilities are, strictly speaking, not consumptive users, but their activities do influence others. The environment needs a certain amount of water to be reasonably well maintained. And recreation and tourism also rely on freshwater.

By far the greatest potential for conflict among users involves irrigators and urban water utilities, as urbanization continues to grow at rates of around 5% per annum. First comes the desire to take over the water used by the irrigators, as it is the next nearest source of water to develop. Next comes the sale of farmland for subdivision and estate construction. But there is also great conflict between farmers for water. Those at the bottom end of the irrigation network invariably miss out in times of drought. Then there is the conflict that arises when water is taken from one locality or river basin and transferred to another for irrigation or water supply. Certainly the environment is greatly altered. Livelihoods (water wheels, irrigation, and fishing) are affected, and

aesthetics are impaired. Hydropower often involves dams for storage of potential energy, and these dams severely alter the regime of rivers for other users. When industrial and domestic water users mine groundwater, they are in conflict with future users, because access will be deeper and more costly, and the risk of saline intrusion will often be ignored until the damage has been done. Pollution of waters, especially by industrial users, affects other users of the water downstream as well as groundwater users. Religious use of water is greatly impaired by such activity. Finally, there is the potential conflict of use that results from local management of water versus comprehensive water resources management on a river basin scale. Watersheds involve the conflict between urban water users and inhabitants who live in or near watersheds and cut down trees for much needed fuel for cooking. When it comes to interbasin transfer, governments often state that water belongs to the nation, but more and more now the customary rights of the settled people are being observed. In line with this, their past and future use of water must be considered.

Unfortunately, where these uses conflict, it is not easy to compare apples with apples. The nearest we can come to that is (sadly) to put a monetary value on such uses and allow market forces to determine proper rewards and penalties. This means that we must recognize customary use now and in the future and allow current and future beneficiaries to participate in determining equitable sharing. Once trading water rights becomes a reality, conflict resolution by politics can be eliminated. But the impetus for trading water rights must come from domestic urban water users. When they pay tariffs of around $0.40/m^3, instead of roughly $0.05/m^3, there will be something with a realistic value to trade. But as long as domestic tariffs remain low, there will be little incentive to transfer water rights.

The case of water transfer from Melamchi Valley to Kathmandu Valley for domestic water supply is interesting, as the water levy is to be charged to consumers in Kathmandu Valley and paid to the people living in Melamchi Valley. In essence this is trading water rights, but it does not go under that name because legally the people of Melamchi Valley do not own the rights to that water, the nation holds the rights.

Chile has been a pioneer in introducing tradable water rights. In 1981, Chile's water code allocated (without charge) property rights to existing users of water. Property rights for new users were sold by auction. Property rights can be used for loan collateral and are assigned for consumptive and nonconsumptive uses. Agriculture was and remains the largest consumptive use. The city of La Serena initially planned to construct the Puclara Dam to satisfy its rapidly growing water requirements. With the introduction of a water code, many farmers in the region recognized that the water rights they held had a higher value than their water's current agricultural use. Farmers put in place more efficient irrigation systems requiring lower water volumes and sold all or part of their water rights to the city at good prices. The transfer of the agricultural water rights to La Serena has led to the indefinite postponement of the dam's construction. The reduction in water use in the agriculture sector has helped control salinity, which was primarily caused by excessive use of water. Introducing an economic value for water rights has also had positive impacts on water utilities. For example, Chile's main water company chose to invest in the reduction of NRW rather than pay for additional water rights to meet its customers' growing demand.

Groundwater use by industries should first be examined to decide whether it is in the best interest of cities and their environments to relocate these industries. However, if it is found that these industries provide essential services, like the services provided by tourist hotels, their use of groundwater should be monitored in an effort to control extraction, and they should pay for the water used, as the water belongs to the nation and industrial use prevents or restricts other uses.

D. Conclusion

In most cases, but especially in South Asia, water is treated as a social rather than an economic good. The most pressing need is to get entire populations in urban areas connected to 24-hour supplies of potable piped water. Without tariff levels being appreciably raised, however, this is unlikely to happen. Yet affordability is not preventing such increases, as there are very few cases in which those connected to piped water pay more than 3% of their household income for the service.

Just as the past 20 years has shown that NRW cannot be reduced by dealing with this problem in isolation, it can be seen that water conservation and demand management cannot be introduced in the same way. They are part of the bigger picture of governance, policy, regulation, accountability, and transparency (see Figure 2.2). Conflict between water users is as much about governance as anything else. In the absence of clearly defined and transparent policies, ad hoc interventions or prevention by elected officials will continue to promote this kind of conflict. We need transparent

government policies covering watershed rehabilitation and protection; reduction of NRW; the increase of tariff levels, so that these curtail excessive demand; and regulatory bodies to see that policies are implemented. Such policies should include measures designed to educate schoolchildren on the need for and the ways and means of water conservation. And they should include provisions stating that utilities and regulators must create, through media, public awareness on these matters so that to some extent positive peer pressure can come into play.

Computerization will help everyone involved analyze the effects of tariff increases on demand and fine-tune this relationship over time. Carefully structured block tariff systems can ensure that the poor are not penalized and that demand is controlled. Gradual tariff increases matching service improvements are best.

In the end, it will be relatively high urban water supply tariffs that put pressure on nearby irrigation systems to either greatly improve efficiencies in water use or trade their water rights to cities.

The recent modeling of water demand and supply in Kathmandu Valley shows the value of comprehensive water resources management, which is not an exact science. Balancing economic, social, and environmental concerns is very much time dependent and influenced by outside considerations. Creating the Kathmandu Valley Water Authority, however, will give local governments some control over their environment and at the same time facilitate comprehensive water resources management at arm's length from these considerations. This study has highlighted the need for constructing good databases and maintaining them over many years.

More recently, the concept of managing water where it falls is being emphasized around the world, especially in regard to rainwater harvesting, control of storm-water runoff, and wastewater management. There are good lessons to learn from the beavers who gave America their wetlands by creating millions of small dams. We should think about floods and fertility. We need to think more about the morality of transferring water from one river basin to another. We should share good case studies through the Internet. We should learn from history. And we should learn to be proactive and not reactive in managing water.

In the years ahead we may come to judge our success at water management by our ability to share water equitably, to do more with less of it, and to restore life and integrity to the earth's rivers. (Postel, 1997)

Water Resources Management (Problems) in a Nutshell

- Watersheds are degraded—the trees have been felled and wet season rains are lost.
- Groundwater is overexploited because it is free.
- Irrigation is often a wasteful use of water—both in terms of crop types chosen and poor water delivery mechanisms.
- Urban water supplies have high rates of NRW.
- Underpricing water does not help conservation.
- There is conflict between urban and rural water users.
- Water pollution results from ineffective governance.

Water Resources Management (Solutions) in a Nutshell

- Water policies and social auditing are needed.
- Have long-term planning horizons.
- Introduce demand management through awareness and pricing.
- Plant more trees to rehabilitate watersheds.
- Plant crops that use much less water than do rice, cotton, and sugarcane.
- Do not subsidize water management.
- Remember the triple bottom line: environmental, social, and economic development.
- Develop rainwater harvesting in cities.
- Remember the beavers—build check dams.
- Trade customary water rights.

Chapter 4

Water and Sanitation Service Coverage

No piped water

Not enough of this

It is reported that coverage with improved water supply in urban Asia is 93%.[5] But what does "coverage" mean? In Manila, coverage is calculated on 9.2 persons per connection, yet the 2000 census states that there is an average of 4.6 persons per household. In many cities in South Asia, more than half the people rely on standpipe supplies. Is that considered coverage? Likewise, intermittent water supply is considered the norm in many South Asian cities, and this type of service is classified under coverage. This chapter explores the real levels of water supply and sanitation service in Asian cities. For greater insight, the city water supply profiles in Appendix 1 may be reviewed.

A. Water Supply

The best measure of good water supply service in a city is 24-hour piped supply to the home. This is because 24-hour piped supply is linked to water quality and quantity, as well as to price, reliability, and convenience. Why is the percentage of people receiving piped water supply in many of Asia's major cities (see Figure 4.1) so low? First, in some of these cities there are domestic wells—dug wells, shallow tubewells, and deep tubewells)[6]—but as groundwater levels fall from overextraction, and the groundwater becomes either salinized from overpumping or contaminated by polluted surface water, this water use will be threatened. Second, there are, especially in South Asia, extensive intermittent water supplies due to low tariffs, low metering, and the extension of distribution systems beyond their 24-hour hydraulic capabilities (see Figure 4.2). Third, there are many people in areas of cities where there is no piped water. There is a failure of water resources and water distribution to keep up with demand. It is the people living in areas of cities where there is no piped water who deserve the most attention, because they are forced to pay the vended price for water. Most say a lack of funds has caused this situation. But in most of these cities, tariffs are low and well below affordable limits (5% of household income). If tariffs were raised, there would be money available to extend services to the urban poor who are not being served. It is all a matter of equity of services and good governance.

During the Indonesian Water Sector Reforms Seminar in 2001, the Government identified problems, which included low urban coverage, low tariffs, high debt service, low development agency support, and a lack of

[5] (World Health Organization et al, 2000).

[6] Postevaluation findings of World Bank and ADB projects over the last 20 years have shown that water demand is invariably overestimated. Mostly this is because people already have access to alternate water supplies, such as wells, and this has not been properly factored into designs.

Figure 4.1 Access to Sewerage and Piped Water Systems (2001)

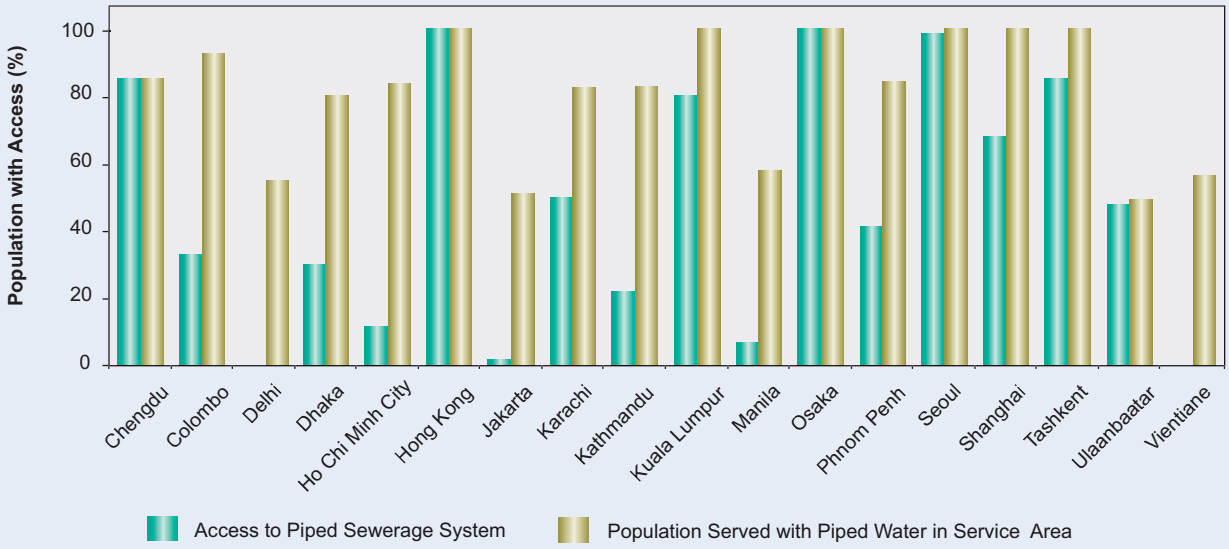
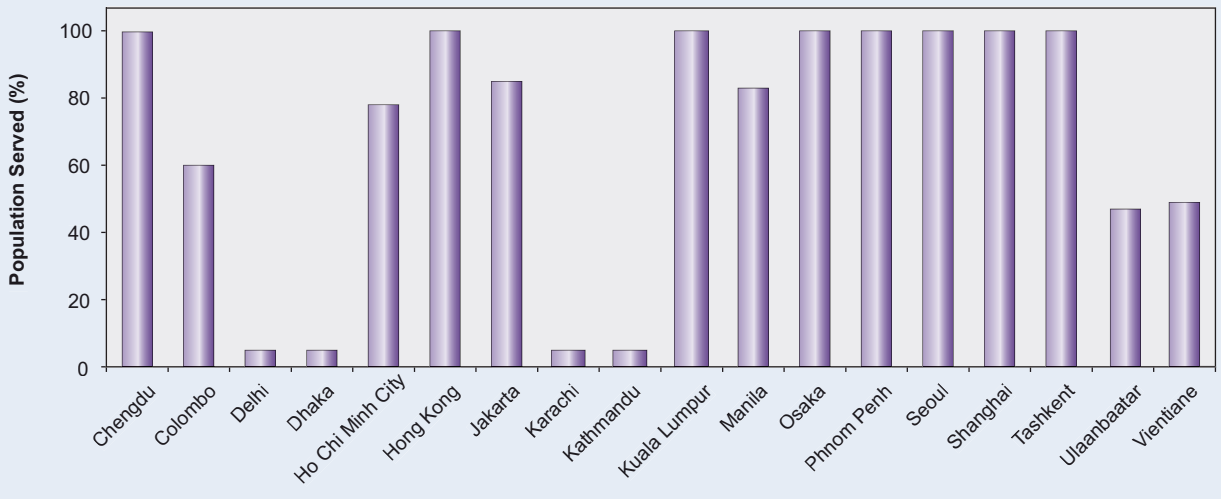


Figure 4.2 24-Hour Water Availability (2001)
[among population served]



coordination. Per capita consumption varies enormously (see Figure 4.3). What needs to be examined is the equity of supply. For example, some households get 6 m³ per month and others get 30 m³ per month. Appendix 1 gives more specific figures for per capita consumption from house connections.

A more objective way to look at coverage with piped water is to evaluate the population per connection for a given city. Table 4.1 examines this situation for some Asian cities and shows the increase in the number of connections from 1996 to 2001. Some disturbing results surface: In Delhi, Dhaka, and Manila the increase in connections over these 5 years is 15%, 11%, and 10%, respectively. It is apparent that the rate of increase in connections to piped water does not match the population increase in these cities, which would be at least 2.5% per annum. The other disturbing result is that the "effective coverage," using five persons per household, is close to 30% or below in 5 of 11 cities

Figure 4.3 Average Domestic Per Capita Consumption (2001)

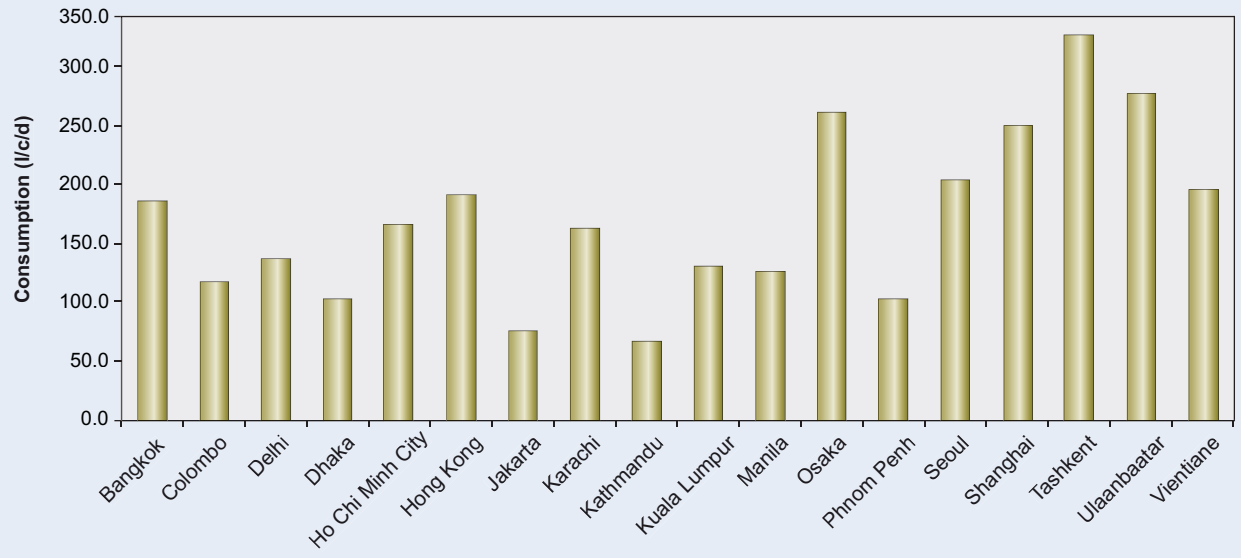
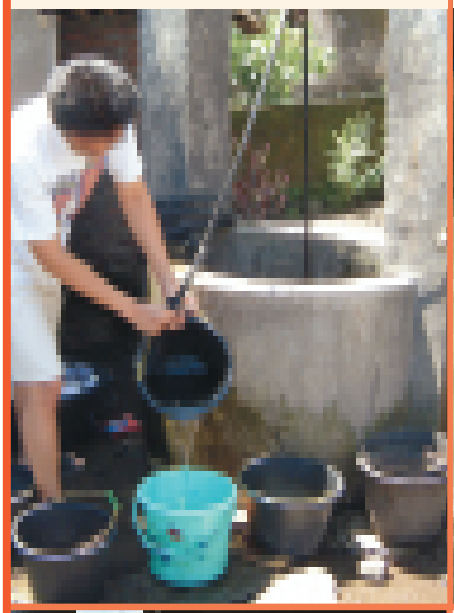


Table 4.1 Effective Coverage with Piped Water (based on connections)

City	Domestic Connections (1996)	Domestic Connections (2001)	Increase (%)	Population (2001)	People per Connection (2001)	Coverage[a] (%)
Bangkok	951,543	1,090,786	15	7.6 million	7.0	72
Delhi	1,096,916	1,266,303	15	13.8 million	10.9	46
Dhaka	160,000	176,823	11	9.0 million	50.9	10
Ho Chi Minh City	236,433	337,500	43	5.3 million	15.7	32
Jakarta	312,168	564,527	81	9.0 million	15.9	31
Karachi	830,366	1,280,000	54	13.5 million	10.5	47
Kathmandu	92,600	119,891	29	1.1 million	9.2	54
Manila	719,878	794,827	10	12.4 million	15.6	32
Phnom Penh	27,387	62,970	130	1.0 million	15.9	31
Shanghai	1,753,190	2,909,053	66	10.5 million	3.6	100
Vientiane	22,273	36,121	62	0.4 million	11.1	45

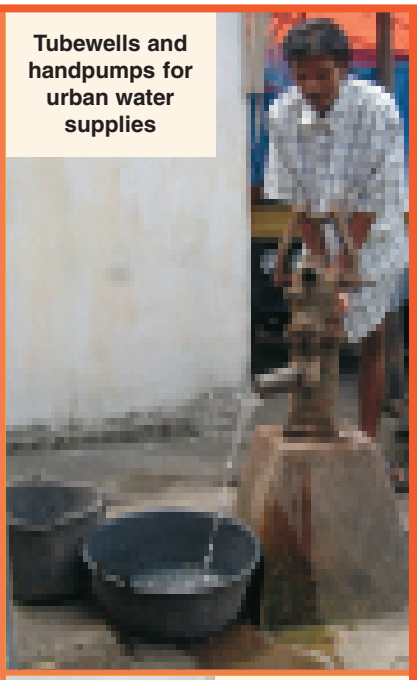
[a] Based on five persons per household.

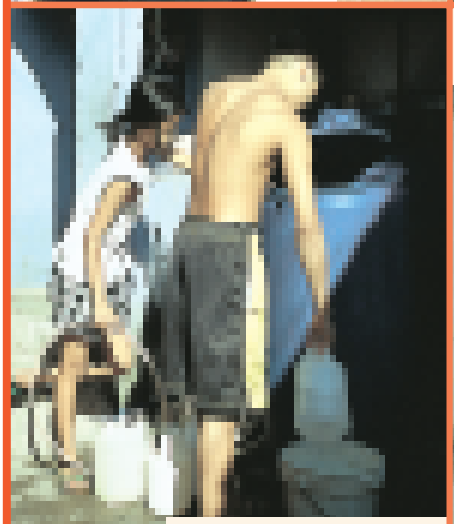
Dug well use in an urban community



Not enough of this

Tubewells and handpumps for urban water supplies





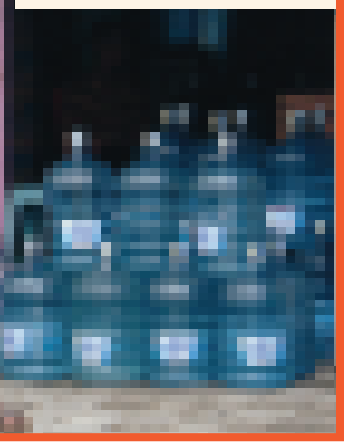
Shared water

Carrying water home (reaching the poor)

Stored water

Low pressure

Carting water home (reaching the rich)



and is under 50% in 8 of 11 cities. It is time for all concerned to have a good look at what is going on. Shared connections, neighborhood resale of water, vended supply of water, standpipes, and intermittent supply are not good enough. It is time for Asia to set its sights on 24-hour piped water in all homes and design a road map to get there. The first step will of course be to more accurately determine the facts from the field, preferably through an independent public audit of water sources, levels of service, and the number of people not served with piped water.

B. Sanitation

In the 1980s, the focus was on sewage treatment. More recently, it has turned to wastewater treatment. Everyone would agree, however, that too little is being done to improve urban environmental sanitation, especially considering the rapid urbanization that is taking place in Asia's developing countries. The poor who are living in unauthorized settlements, located on generally low-lying land that is subject to flooding, are the most vulnerable. Hygiene education is needed, but water without sanitation still leaves the poor vulnerable to waterborne diseases. With good water supply as the top priority, there are just not enough funds left for major investments in sanitation. Catch-up is being played in water supply. So, when will attention be turned to sanitation? That question has been asked for the last 10 years and nothing much has happened. Without a doubt sanitation needs more advocacy. Does another epidemic like the cholera epidemic that hit Peru in the early 1990s have to occur before action is taken? When disease strikes, the cost can dwarf the amount that should have been spent on prevention. In Peru, in the first 10 weeks of the epidemic, losses in agricultural exports and revenue from tourism were greater than three times the amount spent on sanitation in the whole of the 1980s. Cities need to provide sanitation services to the entire population. Figure 4.2 shows that on average only 30% of the people in Asian cities have access to sewerage.

There are many factors to consider in sanitation: these include the needs of people (privacy, convenience, health, etc.), available resources (space, skills, financing, responsible agencies, etc.), and the local situation (climate, soil, surface water and groundwater, traditions, culture, religion, hygiene awareness, proximity of other people, leadership, and institutions). (Pickford, 1995)

Water and Sanitation Service Coverage (Problems) in a Nutshell

- There is inadequate reporting of service levels.
- Coverage in terms of 24-hour access to piped water in homes is very low.
- Alternate sources (especially groundwater) are often ignored.
- Intermittent water supplies are the norm in South Asia
- Standpipe water supplies are prevalent in South Asia.
- Little attention is paid to sanitation.
- The urban poor not being served are the main victims.

Water and Sanitation Service Coverage (Solutions) in a Nutshell

- Compare the number of connections with the number of people.
- Examine the extent of intermittent water supply.
- Examine the extent of standpipe supply.
- Examine on-site sanitation versus sewerage versus treatment.
- Undertake independent professional audits of service levels.
- Analyze root causes of inadequate coverage.
- Promote awareness of the situation among civil society.
- Address as a priority the needs of those with no access to piped water.

Chapter 5

Intermittent Water Supply

Intermittent water supply may be defined as a piped water supply service that delivers water to users for less than 24 hours in 1 day. It is a type of service that, although little found in developed countries, is very common in developing countries, especially in South Asia. Changes in water supply can be effected by Asia's growing middle class and its small but very powerful rich group, if they use their influence, but they do not do this because they secure their water supply as individuals through the use of tanks, pumps, and in many cases private wells. This chapter examines the consequences of intermittent water supply and suggests how this problem can be tackled.

A. Prevalence

Many South Asian cities provide less than 10% of the people in their service areas with 24-hour piped supply. In contrast, most Southeast Asian cities provide 80% or more of the people in their service areas with 24-hour piped water supply, but often large proportions of their populations are not served. Neither of these situations is satisfactory. In South Asia, the prevalence of intermittent water supply is so high that most people regard it as normal and are therefore not greatly motivated to do anything about it. In Kathmandu, in the dry season, most people get water for about one hour every other day. In Indian cities, two or three hours of water a day is considered good. See Figure 4.2 in Chapter 4 for the prevalence of 24-hour supply in some Asian cities.

B. Causes

The primary cause of intermittent water supply is extending distribution systems beyond their hydraulic capacities to provide 24-hour service. This is usually done at the behest of elected officials. In Kathmandu, for example, they continue to add 5,000 new connections a year, despite an inadequate distribution system. Other causes of intermittent supply are a failure to meter completely and accurately and a failure to charge and collect on sufficiently high tariffs. It is often said that there is not enough water for 24-hour supply. This is not valid, because much of the water available is wasted. What is needed is demand management. One city where this practice has been successful is Malé, where people get about 34 l/c/d and have a 24-hour piped supply. What determines their consumption is a high tariff ($5/m^3) and strict metering, billing, and collection (see Malé case study in Appendix 2). NRW, in terms of leakage and illegal connections, contributes to intermittent water supply by lowering water pressure in the distribution system. One reason given for designing systems to provide water intermittently is the high cost of pumping for 20–24 hours. What is probably not understood is that pumping times are drastically reduced when balance storage is constructed and metering, billing, and collection controls are set. Very low tariffs add to problems related to excessive pumping, since utilities that lack funds struggle to meet O&M costs if there are long pumping hours.

One hour a day—no tap

Diverting supply to one location

Coping Costs of Intermittent Water Supply

Queuing for water

Underground storage

Rooftop storage

Buying bottled drinking water

Booster pumping

C. Consequences

Households with intermittent water supply must invest extra money in pumping, storing, and treating this resource. In Kathmandu, for example, as much as one half of an average power bill can be attributed to the operation of a pump. Consumers without access to a 24-hour supply tend to use more water than others. Because they are never certain when they will next be served, they throw away the surplus "old" water from yesterday to make way for "fresh" new water today. Intermittent supply causes anxiety, and generally one person from each residence has to devote time to ensuring that water is received when it comes. Valve operators can extract bribes from consumers who wish to ensure that they will receive adequate service. Sometimes females must venture out into the dark at 2:00 a.m. to retrieve water from standpipes, which can make them vulnerable to assault. No water from an intermittent water supply system is safe to drink, because under vacuum conditions foul water can be drawn into the pipes. Certainly hygiene education is important under these conditions, which put at risk people connected to an intermittent supply. Most meters do not register accurately under intermittent supply conditions, raising doubts as to the validity of metering at all. Constant valve manipulation increases the need for more frequent valve maintenance and replacement. Another consequence of intermittent supply is overexploitation of groundwater, particularly by industries (see the Kathmandu case study in Appendix 2). Last, the quantity of water to be made available over 24 hours has to be made available in fewer hours in an intermittent system, which requires distribution pipes with larger diameters. The findings of a conference on intermittent water supply held recently in Mumbai (India) are shown in Box 5.1.

Experience has shown that, once intermittent service becomes the norm, the hours of service continue to decline. The high costs of intermittent supply are paid by the utility, which incurs higher investment and operating costs; the customers, who pay to cope with unsatisfactory service and to protect themselves against unsafe water; and the population as a whole, as the risk of epidemics increases due to the consumption of contaminated water. (Yepes, et al, 2001)

Box 5.1 Intermittent Water Supply
(Mumbai Conference, January 2000)

Advantages *(perceived)*

- *Leakage of water is reduced.*
- *Available water is distributed equally.*
- *There is time for repairs and maintenance.*

Disadvantages

- *Systems do not operate as designed.*
- *Reservoir capacities are underutilized.*
- *There is frequent wear and tear on valves.*
- *More manpower is needed.*
- *Contaminated water requires consumer treatment or the use of bottled water.*
- *Higher doses of chlorine are needed.*
- *Oversizing of networks is needed to supply the necessary quantities in a shorter time.*
- *Inconvenient supply times mostly affect the poor.*
- *Consumers have to pay for storage and pumping.*
- *Water meters malfunction, which can lead to a loss of revenue and customer disputes.*
- *Accountability per subzone is not provided.*
- *In case of fire, immediate supply is unavailable.*

(Indian Water Works Association, 2000)

D. From Intermittent to 24-Hour Supply

To move from an intermittent to a 24-hour supply, it must be accepted that governance and tariffs are at the core of the problem, and those issues must be addressed first. Then it will be necessary to embark on extensive stakeholder awareness programs to convince people that 24-hour access to piped water in the home is possible for all. For this type of service to become standard, moratoriums must be imposed on new connections while distribution systems are

being hydraulically improved. This is best done by starting with 24-hour supply zones and gradually expanding these. Higher tariffs can be imposed on those with 24-hour supply, and the extra funds can be used to improve systems. When tariffs are sufficiently high, there will also be less water used in 24-hour zones, making more water available for use when these zones are extended. Twenty-four-hour zones must be 100% metered, and meters must be accurate (if they are found to be inaccurate, they must be replaced). District metering can be installed to pursue NRW goals, and full computerization of accounts in 24-hour zones should be accomplished. Illegal connections must be pursued in the field—this is a fundamental governance issue.

Intermittent Water Supply (Problems) in a Nutshell

- There is a high prevalence of intermittent supply in South Asia.
- Intermittent supply is caused by extending distribution networks beyond their hydraulic capacities, often at the behest of elected officials.
- Low tariffs and poor collection contribute to intermittent supply.
- Compared with 24-hour supply, intermittent supply uses more water.
- Intermittent supply leads to higher costs and greater inconvenience for consumers and utilities.
- When the supply is intermittent, consumers risk contracting diseases from using water that is not potable.
- Intermittent supply can lead to the exploitation of the poor (who often have to use bribes to get adequate service).
- Expectations of consumers (due to a lack of awareness) are low.

Intermittent Water Supply (Solutions) in a Nutshell

- Promote awareness among stakeholders.
- Address governance issues related to the autonomy of utilities.
- Introduce higher tariffs for 24-hour zones.
- Place moratoriums on new connections.
- Invest in hydraulic modification of distribution systems.
- Start with 24-hour zones, and then expand these.
- Enforce strict metering and collection.
- Reduce NRW.

Chapter 6

Water and Poverty

There are many links between water and poverty, and some of these are identified at the start of this chapter. One of these links—the economic link—is best illustrated by the dramatic effect it has on the poor getting connected to piped water. Disposable income can increase by up to 20% as a result of moving from vended water to piped water. This chapter discusses the access of the urban poor to piped water, how connection fees act as a constraint, and affordability and willingness to pay. The issue of environmental sanitation and how it affects the poor is also discussed. Comparisons are made between those connected and those not connected in terms of the volume of water used and its cost.

A. Links

There are many links between water and poverty.

(1) Water and poverty are linked by access to potable piped water. There are two parts to this. The objective is 24-hour access to potable piped water in every home. **Poor people either have no access to piped water and must buy water from vendors or they have access but service is very poor** (like standpipe water that is 500 meters away from the home and available for one hour each day).

(2) Water and poverty are linked by **the economic effects of inadequate service**. If a poor family in Manila pays 900 pesos each month for vended water, but would only be paying 100 pesos each month if connected to piped water, that family is greatly affected economically. That extra 800 pesos each month, out of a total monthly household income of 6,000 pesos, could be the difference between a family of six living in a building made of temporary materials (without windows) that rents for 1,000 pesos per month and living in a house made of permanent materials (with windows) that rents for 1,500 pesos per month. It could be the difference between buying rice or electricity on credit with effective interest rates of 20% per month or buying those commodities at normal prices.

(3) Water and poverty are linked by the people who are **last in line to get piped water**. Private concessionaires are not too eager to connect the poor because they do not buy much water, cannot pay for connection fees up front, and often lack the security of land tenure (see Box 6.1). Concessionaires fear that the poor will not pay and that they will not be able to afford to connect properly in unauthorized settlements. Elected officials often tell these families that "piped water will be available next year," but often nothing happens. The poor do not have access to reliable information.

(4) Water and poverty are linked by the **quality of water that the poor receive**. The cheaper vended water cannot be used for drinking, and it

Waiting for water

Box 6.1 Difficulties Encountered in Serving the Urban Poor

It was realized that land tenure is complex and an issue. The reason for this is that supplying water will alter the status of the land. Moreover, regularization of land tenure before introducing water and sanitation is important. Tap water in every home cannot be seen as an aim in itself. A transition period will be required to achieve this goal.

- ***Problems in equipping poor neighborhoods:***
  - *(a) Connection costs are too high.*
  - *(b) There are high percentages of unpaid bills.*
  - *(c) There are high rates of unbilled or fraudulent consumption.*
  - *(d) There are low levels of individual consumption.*
  - *(e) Network maintenance costs are high.*
- ***Problems related to equipping areas of spontaneous and temporary housing:***
  - *(a) Authorities will not legalize/recognize settlements.*
  - *(b) Crime and vandalism are rampant.*
  - *(c) It is impossible to draw up a customer file.*
  - *(d) Billing methods are inappropriate.*
  - *(e) The situation is precarious.*
- ***Solutions regarding connection fees:***
  - *(a) Spread out payments over several months.*
  - *(b) Labor participation.*
  - *(c) Extend grants where town councils supply materials.*
  - *(d) Welfare connections.*
  - *(e) Microloans.*
  - *(f) Pooled investments.*
  - *(g) Municipal tax compensation.*
- ***Neighborhood resale:***
  - *(a) A person connected to a network sells water to a person who is not connected (this is regularized in Jakarta, Phnom Penh, and Ho Chi Minh City).*
  - *(b) In Jakarta, 30% of the people buy water from street hawkers.*
  - *(c) Is believed to make a considerable contribution to making potable water more widely accessible in disadvantaged areas, which justifies its gradual regularization in developing countries.*
- ***Conclusion:***

Disadvantaged areas need a special approach that leaves concessionaires some flexibility.

It is best to spread the cost of the work in disadvantaged areas among customers who are already connected, municipalities, developers, future customers, and any donor institutions. (Lyonnaise des Eaux, 1998)

often stains clothes during washing. The **reliability** of supply is not good, and new sources sometimes must be found at a day's notice.

(5) Water and poverty are linked by **intermittent supply**. The extra costs related to this type of service can be seen in terms of **distance to access**; **inconvenient** times of supply (in Kathmandu water could arrive at 2:00 a.m.); uncertainty and **anxiety** over when water will come; **bribes** to ensure that water will come; **sleep disorders**; waiting in **queues**; **conflicts** with neighbors; the **burdens** of carting water, in-house storage, and boiling and filtering water for drinking and cooking; and finally the **security** risk for women sent to retrieve water at night (see Box 6.2).

(6) Water and poverty are linked by the poor who rely on groundwater and household or community wells. Water and poverty are also linked by the always increasing and real threat of **falling groundwater tables,** which require water to be pumped or the unaffordable deepening of wells. Saline intrusion, caused by overextraction of

Box 6.2 Poor Water Supply Service in Kathmandu

In a letter published in the Kathmandu Post on 17 June 2002, Paliza Shrestha stated the following.

The supply of water in Kathmandu city is grossly irregular. There's literally no schedule, whatsoever, for when the water comes and goes, and on several occasions we (Bansbari tole) have no supply of water. Water is a daily necessity. It is impossible to carry out household activities without water. Also, it becomes very annoying to get up early in the morning every time to check whether water has come or not. Due to this we have had to put up with sleep disorder. Almost every day the issue worries us. Most of the time since there is no water supplied to our taps, we have to walk long distance to collect water from waterspouts and at other times from the neighborhood. We use our store of water cautiously as we are afraid there won't be enough water for the next day. Add to this the pain of going to a Dhungedhara (waterspout) waiting in long queues, washing clothes, and bringing them back to our houses. Sometimes there are conflicts between landlords and tenants over sharing water. I see many people at Dhungedharas fighting.

It is the responsibility of the Government to provide a reliable water supply. The Government should take our plight seriously. Why on earth can't they just provide a regular supply of water? I don't think we are asking too much. A fixed timing of water should be printed in the newspapers (both in English and Nepali) as well as posted on radios and TVs. Perhaps this will make the life of the urbanites a bit easier.

groundwater by industries, can also wipe out a cheap source of water for the poor.

(7) Water and poverty are linked by the possibility that the poor connected to piped supplies can be exploited. If one family manages to get a connection and shares the water received with several neighbors, all are charged at high consumption penalty rates, because of **block rates** tied to consumption.

Even the water vendor is poor

(8) Water and poverty are linked by the whole **inequity** of a situation in which the poor get the worst service—intermittent water supply through standpipes, no service at all, or vended water in lieu of piped water—while the rich or better off get relatively inexpensive piped water. Invariably, the poor consume around one fifth (6 m^3 per month) of what those directly connected to piped water consume and pay five times the amount the rich pay. Subsidies benefit the rich more than the poor.

(9) Water and poverty are linked by private sector contracts not being based on a policy of connecting the poor, which leads to **regulation by contract**. This situation has made it necessary for concessionaires to increase tariffs to invest in connections to the poor, and this has proved hard to do.

(10) Water and poverty are linked by **private operators** with concessions promising to bring investment funds to the table to improve coverage, which they have not done, and water and poverty are linked by the poor suffering as a consequence.

(11) Water and poverty are linked by the status quo and vested interests working against the poor. **Water vending** is a very big business, and elected officials and utility staff have been

known to receive a share of the profits**.** It is not in the interests of such persons to help the poor get connected to piped water. Some of the so-called NRW can be bought by water vendors with the permission of certain authorities, and these authorities would then collect money from its distribution.

(12) Water and poverty are linked by the **poor suffering more than others from corruption**. In Bangalore (India), a study on governance (Paul and Sekhar,1999) concluded that one poor household in four pays bribes for getting its problems solved at public agencies. Moreover, evidence indicated that the poor pay a higher price for corruption than others. While government subsidies are high and the money trail runs through governments, the poor will remain underserved or not served with piped water, because there are not enough funds to invest.

(13) Water and poverty are linked by the **lack of transparent government policies** that target water service to the poor. Sometimes these policies are made for development agencies but are later ignored or forgotten.

(14) Water and poverty are linked by the rich being able to afford to protect themselves from disease by buying **bottled drinking water** and the poor not being able to afford this luxury.

(15) Water and poverty are linked by the poor being made to suffer in regard to sanitation as well as water service. Many underprivileged citizens have no access to **formal sanitation facilities** and must defecate in the open or in hanging latrines. Women in particular suffer ill health as a result of not being able to use public sanitation facilities.

(16) Water and poverty are linked by **very low consumer expectations** in regard to water services. In parts of South Asia, people are happy to get water from standpipes for one hour every day. They do not know that they are entitled to a 24-hour piped supply in their homes, like that enjoyed by others elsewhere in the world.

(17) Water and poverty are linked by the rich being able to afford to pay bribes to get **illegal connections** and the poor not being able to do the same.

(18) Water and poverty are linked by **connection fees** being often over $100 and the need to pay these up front. The poor cannot save that amount of money, especially when paying for expensive vended water.

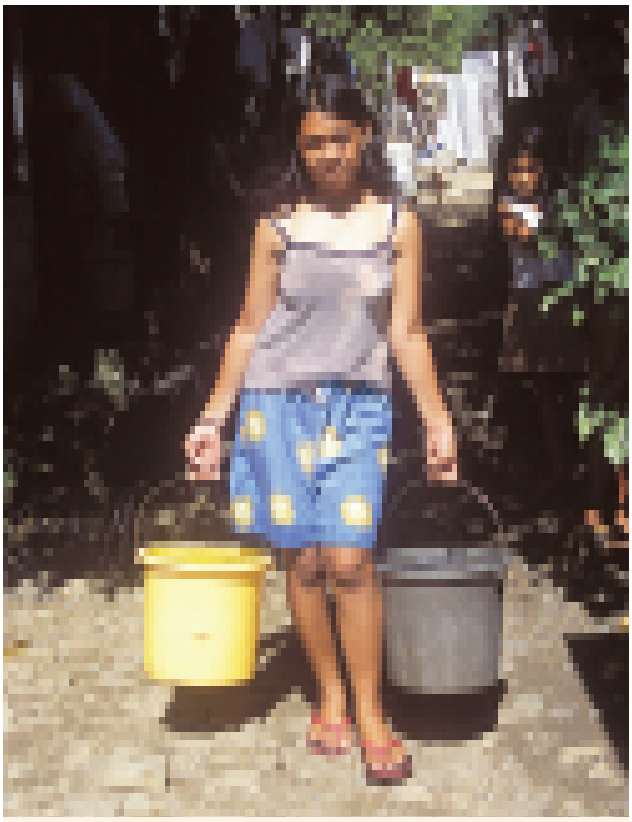
(19) Water and poverty are linked by connected consumers having a collective voice and **the poor who are not connected having no voice**.

B. Water Policy

ADB's water policy is linked to its poverty reduction strategy. The policy specifically provides for the involvement of the poor in water conservation and management. It recognizes that the specific needs and vulnerabilities of the poor are central in formulating sound and equitable water strategies. The poor must be enabled to influence decisions that affect their access to water for both consumptive and productive uses. The policy also reflects the considerable potential that exists for mobilizing community efforts to directly contribute to pro-poor water development, and it requires the development of knowledge bases related to the water needs of the poor.

C. Connection Fees

Connection fees in many Asian countries can be as high as one fifth of a poor household's annual income, thereby making it difficult if not impossible for



Burden of carrying water

Should be in school

the poor to connect. In most cities there is no option apart from up-front lump sum payment. A survey of 20 Asian cities revealed that half require the connection fee to be paid up-front in a lump sum.[7] Phnom Penh officials say that the problem the urban poor face is the connection fee being too high, which inhibits connection and therefore demand. Formal water supply is one fourth the informal cost in terms of the tariff but higher in terms of the connection fee**.** In Andhra Pradesh (India), when the Government dropped the connection fee from 4,000 to 2,000 rupees, more than 5,000 households registered. Using the cash inflow, the municipality extended its distribution lines to other areas that were not served. One-off connection charges may impede access, so these costs should be recovered by monthly charges over a period of up to 5 years. In the case of new development, these charges can be included in financing the total cost of the undertaking.

[7] I have found from field experience that, even if the official policy is to allow connection fees to be paid in installments with the tariff, often the people are unaware of that policy.

D. Low Coverage and Low Service Levels

Notwithstanding PSP in water supply in Manila, there are still about 5 million people in the city who do not have direct access to piped water. This would be reasonable if they have an acceptable alternative supply, such as tubewells with handpumps or dug wells, but in most cases they do not. Instead, many pay up to 20% of their household income to buy water from vendors. A typical example would be one quarter of a family's water (sourced from the utility) purchased at high cost for drinking and cooking and three quarters of its water (sourced from groundwater) purchased at lower cost for washing and bathing. The situation that pertains to Manila is repeated in other cities in Southeast Asia. In South Asia, the situation is somewhat different. In general, coverage with piped water is more complete, but the service levels are lower than in Southeast Asia. Intermittent water supply is the norm, with many people receiving water for only one hour every other day in the dry season. Furthermore, there are many people served only by standpipes, which results in queues for water and the burden of carting it home, when and if it comes. It is important to note that it is mostly the urban poor who do not have 24-hour access to supplies of piped water. The more fortunate rich often enjoy 24-hour piped supplies. The experience of a standpipe user in Delhi is described in Box 6.3. This illustrates that, even though standpipe water may be nominally free, the cost of transport to get this water home makes it effectively very expensive ($2.50/m^3).

It seems that increased scarcity of water results in those who control it taking advantage of the poor. For example, a valve operator in Kathmandu once confessed (with a grin on his face) that he worked 18 hours per day, 7 days per week, because the bribes he received paid him to do so.

The cost of intermittent water supply to the consumer is considerable. A group of consumers in Kathmandu was asked to compare what they paid for water with what they paid for electricity. The finding was that their electricity bills were almost 20 times higher than their water bills. This was unusual, because the average ratio in Asia is around 4:1. Upon further discussion, however, it was revealed that half of the cost of the electricity bills resulted from pumping water. So, from this example, it can be seen that pumping can be a major cost associated with intermittent water supply. Storage and treatment (boiling and filtering) costs are also appreciable.

Box 6.3 Standpipe Supply in Delhi

A family of five people living in an unauthorized settlement uses groundwater for washing, bathing, and cleaning, but travels 1,500 meters to a standpipe each day to get 40 liters of water for drinking and cooking. The water is available at the standpipe for just six hours each day and is free. The journey on foot takes about 25 minutes, and depending on the season (summer or winter) it may be necessary after arrival to queue for water for 15–60 minutes. The journey home is by rickshaw and costs $0.10 per day (this equates to buying water at $2.50/m³ or a monthly water bill of $3). At home the family has 500 liters of storage, which is used mostly for groundwater. The standpipe water is used for drinking without boiling or filtering. The family members are happy enough with the water utility, because they can access good water. But they say nothing can be done to get them a house connection to piped water, as the utility has not planned to provide water to this unauthorized settlement. When asked about the worst thing related to collecting water, the answer was "the long distance to be traveled and the long queue."

The unsatisfactory state of water supply in Asia (many people not served or poorly served) is the consequence of numerous forces interacting to reach a comfortable situation for the controlling stakeholders. The status quo is a natural state and has its own inertia. Moving from that state requires considerable new forces to overcome that inertia.

E. Affordability

People often hear that the poor cannot afford to pay water tariffs. This is not the case, and proof of this comes from Manila, where a typical household connected to a piped supply pays around $4 each month for water and uses 30 m³ per month, while the urban poor not being served pay around $20 each month for their water and use 6 m³ per month. Having to pay an up-front lump sum of around $100 for connection fees, however, is more than can be expected of the poor. Other arrangements are needed.

If a ceiling of 5% of household income is imposed for combined water supply and sanitation affordability, there will be plenty of revenue. In cities like Manila the income profile is wide ranging, so the tariff structure can be fine-tuned to optimize this state. Utilities must, however, become better informed about that profile before they do the fine-tuning. They must also not ignore alternative water sources and services.

It was recently found in India that households in Dehradun receiving the existing intermittent water supply were willing to pay more than twice the prevailing rate to receive a continuous water supply. It was further discovered that, on average, households were paying up to five times the prevailing rate in coping costs, which arise from the existing irregular and unreliable supply. In Delhi, in 1998, households paid up to 2,000 rupees per year in direct and indirect coping costs resulting from existing intermittent supply. This revenue source was not tapped by formal providers, as it was paid directly to smaller and unregulated private sector interests. It was also found that if tariff increases are implemented without increases in service, consumers are not likely to be convinced to accept future proposed increases. (Water and Sanitation Program, 2001)

F. Environmental Sanitation

City slums are often located in areas where the installation of water systems presents engineering problems. For example, several such areas are on steep slopes and at higher elevations than storage reservoirs. Water must therefore be pumped, resulting in additional costs. Invariably it is the poor who live on marginal lands

Health risk

Unsanitary conditions

that suffer from flooding one time and poor drainage the next. Land tenure has been an issue, so the poor are often forced to be unauthorized settlers and still pay an informal rent to those who control even public lands. Toilets are often hanging latrines. Hygiene education is lacking for many of the poor, so they suffer from bad hygiene as well as bad water service. The matter of the right of the poor to live and work in our cities is addressed in Box 6.4.

G. Government Policy and Governance

The issue of water and poverty is about governance, including the lack of transparent and implemented policies directed at getting the poor 24-hour access to piped water. The poor are willing and able to pay for piped water, but governments are in general unwilling to increase tariffs to a level that would provide the funds needed to invest in connecting the poor. A large underground economy involving water vendors is flourishing, but vested interests (including governments, utility staff, and the private sector) are not eager to change the status quo.

Everything begins with policy—let us not forget that. But policies must be developed after consulting with stakeholders, and the policies must address the main issues. Most of all, policies must be transparent and kept in the public eye. They must specifically target the urban poor in terms of (i) piped water access in homes; (ii) 24-hour supply; (iii) affordability, willingness to pay, tariffs, and tariff structure; (iv) priority of service; (v) water quality; (vi) alternative sources; (vii) water quantity; (viii) private sector obligations; (ix) sanitation facilities; (x) information; (xi) water vending; (xii) bottled water; (xiii) connection fees; and (xiv) the right of access to water. In line with this, policy makers may want or need to do the following.

- Look at how water vendors can be turned into distribution caretakers.
- Require an assessment of subsidies to determine tariff policies.
- Consider the income profile of a city first.
- Consider a ceiling on affordability set at 5% of household income.
- Consider that hiking tariffs helps the poor, not only by having the funds to invest in connecting them to piped water but also through reducing water demand and releasing the water to serve them without the extra costs of source development.

Box 6.4 Mega Slums—The Coming Sanitary Crisis

Too often in the past development policies have failed because those whose lives were supposed to be transformed were not consulted, and their views and wishes were not heard. Policy makers must therefore recognize that the energies of the poor are a resource that can be tapped to help find solutions to the problem of squalor. A fundamental change in public attitudes is needed. Instead of simply using the poor as a source of cheap labor, the right of the poor to belong to a city, and to become permanent residents in every meaning of the term, must also be acknowledged. In line with this, more modest types of urban settlements and amenities, within the scope of building and other municipal regulations, must be accommodated. And it must be recognized that appropriate service delivery systems need to belong to their own consumer context, not to standards of technological excellence set in Europe that come with a corresponding price tag. What poor communities need is freedom from extreme commercialization generated by water scarcity in their neglected and underserved localities. They also need help in overcoming the many disadvantages they experience due to their relative lack of socioeconomic and political clout. NGOs have a special role to play in facilitating change. (Black, 1994)

- Consider that those with piped water should be obliged to pay a little more, so that those without piped water can get connected.
- Encourage NGOs to form consumer societies that look after the interests of the poor, especially those not connected to piped water.
- Consider direct subsidies to the poor, such as those subsidies introduced in Chile (see Box 6.5).
- Consider installing public toilets, such as those used in Pune (India).
- Consider recognizing water vendors and other small-scale water providers.
- Look at rainwater harvesting as a way of helping the poor.
- Encourage the media to bring information to the urban poor.
- Encourage a consumer service targeted at the urban poor.
- Require that the plight of the urban poor is benchmarked, monitored, and published regularly through a public audit of water service levels.
- Insist that policies for the poor are regulated and that social auditors are appointed.
- Consider whether bulk sales of water to the poor and neighborhood resale comply with policies.
- Consider hygiene education for the urban poor.
- Target the schools first.
- Look at how one connection can equitably serve several families.

The PRC has some good (safety net) policies related to water and poverty. For example, in the city of Zhangjiakou, Hebei Province, poor families (those that receive welfare from the Civil Affairs Bureau) are entitled to receive a cash rebate on 5 m³ of consumption per month.

Civil society can help create the necessary public awareness to pressure governments into enacting the right policies (those that will ensure equitable water service for all) and the proper strategy (increase tariffs significantly) to achieve this. Civil society should include all stakeholders, including served consumers, the urban poor not being served, utilities, the private sector, unions, government officials, elected officials, NGOs, journalists, and academics.

H. Raise the Tariff to Help the Poor

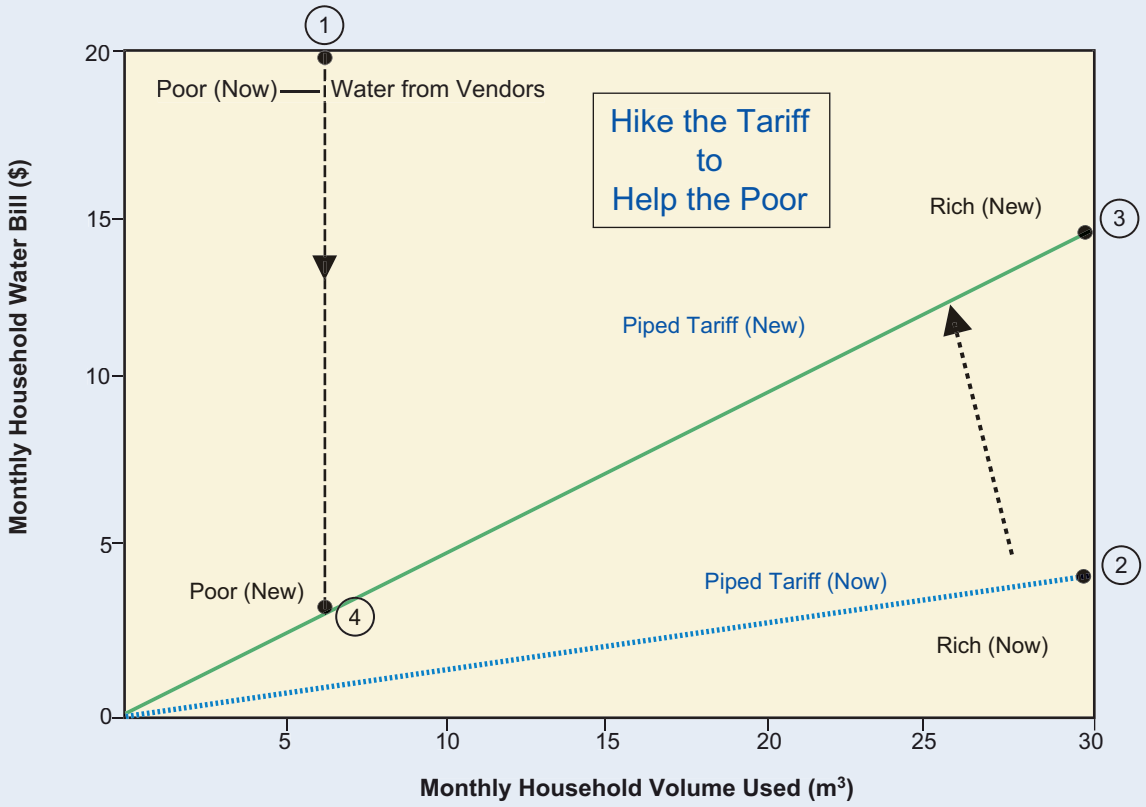
The irony of the situation is that the main way to help the poor is to substantially raise tariffs. This will free up funds for investments designed to connect the poor and turn intermittent water supply into 24-hour supply (without standpipes). A hypothetical example is shown in Figure 6.1, and an actual example is related in Box 6.6 (see also the Colombo and Phnom Penh case studies in Appendix 2, which illustrate the ability of consumers to pay for water).

Box 6.5 Output-Based Subsidies for Water Consumption

- *Chile introduced an individual means-tested consumption subsidy a decade ago. Although the public authorities determine how the subsidy is applied, the mostly private companies deliver the service.*
- *An important part of the reform was a new tariff setting methodology aimed at raising water prices to the true economic cost of the service.*
- *The Government reimburses the companies for the subsidies based on the actual amount of water consumed by each beneficiary.*
- *By law the subsidy can cover 25–85% of a household's water and sewerage bill for consumption of up to 15 m³ per month, with the client paying the rest. All consumption above that limit is charged at the full tariff.*
- *An eligibility scoring system is the main instrument used in Chile for distributing means-tested subsidies. It produces a score for each household wishing to be evaluated, which is based on a personal interview and the answers to 50 questions. The score is valid for 2 years and can be used to avail of other subsidies, including pensions, family benefits, and health benefits.*
- *Metering is essential, and it requires a strong institutional capacity at the municipal level. It is expensive to apply output-based subsidies just for water, but when combined with other benefits it is more cost-effective.*

(World Bank, 1999)

Figure 6.1 Effect of Tariff Increase on Rich and Poor



- For the Poor (1) $20 → (4) $3 (6 m³)
- For the Rich (2) $4 → (3) $15 (30 m³)

Average Tariff (Now) = $0.13/m³
Average Tariff (New) = $0.50/m³

Water queue for the poor

Bottled water for the rich

Box 6.6 Hiking Tariffs to Help the Poor

Winnie Flores (shown on front cover) lives at the Manggahan floodway in Metro Manila. She is one of about 5 million people who still have no access to piped water. She pays almost as much for water as she does for rent. Winnie could greatly improve her quality of life if she could get connected to piped water. "It's coming next year," she has been told. But she has listened to that line for the last 5 years.

Recently, when her husband lost his job, they and their four children had to move to cheaper accommodations, costing 1,000 pesos a month. Yet Winnie pays 900 pesos a month for 6 m^3 of water, while many connected to piped water pay about 160 pesos a month for 30 m^3. She gets her water from two sources: the first is an entrepreneur who drilled a well to pipe water to some families in the neighborhood. Winnie buys eight 16-liter jerry cans per day from this vendor for 10 pesos. The water is of poor quality. Her second source of water is another vendor, who comes twice a day to deliver 16-liter jerry cans of drinking water sourced from a water main about 2 kilometers away. She buys four containers a day at 5 pesos a container.

Why are Winnie and so many others in this deplorable situation? It is not a question of land tenure—the neighborhood has concrete streets and many homes built with permanent materials. It is all about where the funds are to bring the urban poor piped water. When PSP was introduced, many said that the private sector would invest funds in water supply and improve efficiency by reducing NRW, etc. In reality, after almost 5 years, NRW has not been reduced greatly and new funding has been much less than expected. What happened?

The "water crisis" in Manila in 1996 was the rationale for the introduction of PSP, which was completed in just 18 months. Unfortunately, two mistakes were made. First, the contracts with two different concessionaires were not based on a formal and publicized government policy that might have included serving the urban poor. There was no independent regulator to monitor the implementation of the policies and to see that the contract conformed to these. Instead, the former Metropolitan Waterworks and Sewerage System was appointed as a regulator, but it ended up acting as a contract administrator. The second mistake was having concessionaires compete to provide water based on the lowest tariff. The winning bids were 57% and 26% of the pre-bid MWSS tariff. The signal most likely sent to consumers was that water was very plentiful and ready to be used. It lulled consumers into a false sense of security.

When El Niño and the Asian currency crisis came along, one of the concessionaires started asking for a major tariff adjustment. When would they get the money to get on with the efficiency measures and connect the millions without access to piped water? The answer was, "Sorry, it is not in your contract." Of course, had the contract been based on a policy of connecting the poor, it would have been easy for the two parties to get together to amend the contract and align it with the policy and agree on a tariff hike. After all, both concessionaires are guaranteed a certain rate of return based on the whole contract. But there was no policy, only a constricting and restrictive contract. So, for a couple of years, the Government (not the regulator!) fought to resist the tariff increase. Who was this hurting? Without a doubt the poor, like Winnie, who are still not connected.

One of the mysteries is why NGOs did not assist the poor by demanding a tariff increase. In the end, the poor asked for the tariff increase themselves. The logic was simple: If the tariff for those people connected was raised from an average of 5 pesos/m^3 to 10 pesos/m^3, and if that allowed the concessionaires to connect the poor, the poor would go from paying 150 pesos/m^3 to 10 pesos/m^3 and be much better off. Is it too much to ask those connected to piped water to help pay for those not connected to get the same access? The Government finally capitulated and gave the tariff adjustment to both concessionaires.

What are the lessons to be learned? First, policy is everything, but it must be in front of the public at all times. Second, counter intuitively, hiking tariffs can help the poor who are not yet connected to piped water. Third, in the future, investments in large city water supplies should be financed directly from tariffs.

Note: This material was originally produced by the author for ADB and UN-Habitat newsletters.

Water and Poverty (Problems) in a Nutshell

- The poor are willing to pay but governments are unwilling to charge.
- The poor often pay $20 per month for 6 m^3 of water. The rich often pay $4 per month for 30 m^3 of water.
- Up-front lump sum connection fees are an impediment to the poor getting connected to piped water.
- The status quo is determined by those with vested interests who profit from the plight of the poor.
- Intermittent water supply exploits the poor.
- The private sector is not very willing to connect the urban poor—there are few incentives.
- The poor have no voice.
- Standpipe supplies are not an adequate service.

Water and Poverty (Solutions) in a Nutshell

- Public audits are needed to obtain the facts about service levels.
- Policies are needed that focus on providing the poor with piped water.
- Raise the tariffs to connect the urban poor.
- Employ a block tariff structure, but watch the sizes and prices of blocks.
- Soften the terms of payment for connection fees.
- Eliminate standpipes wherever feasible.
- Encourage civil society (NGOs) to champion the poor.
- Detach land tenure issues from access to piped water.
- Governance is at the core of the solutions.
- Develop knowledge bases related to the water needs of the urban poor.
- Enable the poor to influence decision making.

Chapter 7

Small-Scale Water Providers

An ADB-funded survey was conducted in 2002 to gather and analyze information about small-scale water providers (SSWPs) in eight cities: Cebu, Delhi, Dhaka, Ho Chi Minh City, Jakarta, Kathmandu, Shanghai, and Ulaanbaatar. An independent survey by the Water and Sanitation Program was conducted in Manila, and the author also conducted field surveys in this city. Appendix 3 provides brief examples from Cebu, Delhi, Dhaka, Ho Chi Minh City, Kathmandu, and Manila.

Evidence suggests that a large percentage of urban poor populations is still without access to water and sanitation services, despite improvements in this sector. Many surveys done in Africa and Latin America have demonstrated that a significant number of urban populations are served by SSWPs that provide competitive and appropriate service to households without access to utility connections. There is little data on this phenomenon. For this reason, nobody has a clear picture of the role played by SSWPs in water supply, particularly with respect to the urban poor. This chapter looks at that role.

Water vendor in Manila

A. Limits of Conventional Responses

Over the past decades, governments have favored large water utility companies, and results remain unsatisfactory. With existing tariffs and management structures, these companies have been unable to provide piped water coverage to whole populations. For example, in some unauthorized settlements, a large percentage of people draw (or illegally receive) their water from "spaghetti networks" that connect to the edge of a municipal grid system. Others remain without service for one or more of the following reasons.

- Connection fees are too high, and lump sum upfront payments exclude the poor.
- Total available water is not always sufficient to cover whole populations, and vulnerable groups are the first to be left out.
- Even when water supplies are sufficient, tariffs and low volumes of water consumption may not make it attractive for utilities to deliver services in low-income areas, where the minimum cost of extending services is relatively high.
- When people occupy land illegally, it can mark them as not eligible for public services (otherwise, the provision of public service could provide de facto a proxy for legal status).

Even if water companies are allowed or mandated to serve poor households, they often do not have the know-how to do so, which leads to the following.

- Service levels are often not tailored to demand, but are instead based on technical standards and therefore are not affordable for low-income families.
- Payment systems are at times not adapted to the particular conditions and constraints of the poor (irregular income).
- Employees of main operators do not always communicate well with residents of low-income areas, which only exacerbates the risks of being overcharged or penalized in the case of improper billing.

B. Alternative Water Supply Services and Local Initiatives

Because of the failure of conventional utilities to serve many low-income households, a large number of people rely on alternative forms of service, which are either run by community groups or delivered by local entrepreneurs. Yet sector reform and modernization have focused exclusively on large-scale operators and have ignored the potential offered by community-led initiatives and local private operators. Private sector involvement now increasingly includes SSWPs.

Surveys have highlighted the comparative advantages of SSWPs over large utilities in periurban areas, low-income neighborhoods, smaller towns and centers, and consolidated inner-city neighborhoods. Low-income households buy their water from these operators because they provide the right service at the right price. Even if the cost of water from SSWPs is higher than the nominal tariff charged by utilities, poor consumers may prefer the former because the supply is reliable and flexible (particularly in terms of quantity and hours of supply) and there is no excessively high connection fee.

C. Types of Small-Scale Water Providers

SSWPs can be small companies, cooperatives, individuals, and community-based organizations. They are independent to the extent that some are self-employed entrepreneurs or artisans. Most work without formal recognition from local authorities and are not usually subcontracted by major water distribution companies. Unlike multinational companies, such operators enter markets freely, take risks, and invest without an agreement with the public sector. Small-scale investors and local entrepreneurs have always supplemented trunk concessions and public companies in serving hard-to-reach parts of towns and in tailoring services to the poor. They account for a significant share of the market. There are three main types of SSWPs.

- **Partners of water utilities**

  Some local operators work with water utilities, whose water they distribute at kiosks or standpipes. These operators buy water from water companies at a flat rate and sell it on to end users at a profit. They do not receive a salary.

Small-scale water provider

No need to regulate (yet)

- **Vendors and resellers**

  Vendors include mobile water truckers, carters and water carriers, and household resellers. They provide water (most often drawn from water company taps) at times and places that water utilities are unable to serve.

- **Pioneers of small piped networks**

  Pioneers bring piped water from their own sources (often groundwater) to communities where water utilities have not yet expanded their networks. The level of investment and the initiatives and financial risks taken by these various types of water providers are quite different (see Table 7.1). The level of service provided fits with urban population demand. Due to the dynamism of this service and the strong existing barriers for these private operators, there is a need for more in-depth analysis.

Table 7.1 Types of Small-Scale Water Providers

Type of Provider	Level of Investment	Level of Initiative	Link with Water Utility	Financial Risk	Level of Service
Partners of Water Utilities	Very Low	Very Low	Strong	Very Low	Low (water outside home)
Resellers	Very Low	Low	Strong	Very Low	–
Carters and Water Carriers	Low	Low	Weak to Strong	Low	Average (water delivered to home)
Truckers	Medium to High	High	Weak to Strong	Medium (water trucks can be used for construction activities, etc.)	Average (water delivered to home)
Pioneers of Piped Networks	Medium	High	Weak to Strong	High	Average to High (water delivered to home by hose or household connection)

D. Scope and Scale of Small-Scale Water Providers in Asian Cities

The role played by SSWPs in water supply in selected cities is strongly linked to the water service provided by water utilities. For example, in Shanghai the utility provides good service with a low connection fee. Apart from bottled water businesses, there are no SSWPs in Shanghai. In cities like Delhi, Dhaka, and Kathmandu, about 5–10% of all households are served by SSWPs. The high level of subsidy and the policy of providing "free" water to the poor in South Asian countries, combined with good access to groundwater, have limited the niche market for SSWPs, despite the low level of service provided by water utilities. Currently, the most important input of SSWPs is in Southeast Asia, where the coverage of piped systems operated by water utilities is about 50% with medium-to-high connection fees. Roughly 20–45% of households in Cebu (Philippines), Ho Chi Minh City, Jakarta, and Manila may rely on water supply services provided by SSWPs. Table 7.2 shows the types of services provided.

E. Small-Scale Piped Systems

Apart from real estate developers who have installed piped systems for their own residential areas, few local entrepreneurs have installed piped systems in low-income areas to provide household connections. The number of people served by each system is still limited in the cities studied (100–700 connections). In Manila, a small local company—Inpart Engineering—operates 12 systems and serves today around 30,000 households in low-income areas (see Appendix 3).

Nevertheless, local entrepreneurs have implemented low-cost technology and proposed low connection fees to customers. The connection cost is limited to the cost of the needed materials (pipes, meters, etc.). The materials generally fit the settlements they serve, and these entrepreneurs adapt billing to the customers' forms of income (from daily to monthly payments). In Ho Chi Minh City, entrepreneurs have invested in a water treatment unit to serve safe water to customers. In most cases, SSWPs support the total amount of their investments through privately sourced loans with high interest rates of up to 5% per month. They do not have access to commercial loans and do not receive any financial support from local authorities or external support agencies.

Table 7.2 Services Provided by Small-Scale Water Providers in Study Cases

Service	City	Main Location of the Service		Population Targeted	Origin of Water
		Within Utility-Operated Piped System	Outside Utility-Operated Piped System		
Household Connection	Cebu Delhi Dhaka Ho Chi Minh City	–	X	All people	Groundwater
	Cebu	X	–	Medium-income to poor families who cannot afford the ($100) connection fee	Groundwater
Standpipe	Cebu	–	X (in areas with limited access to groundwater)	All people	Groundwater and water utility
Kiosk	Ulaanbaatar	–	X (in *Ger* area not served by utility kiosk)	All people	Groundwater
Tanker	Ho Chi Minh City	–	X (in an area with quality issues concerning groundwater salinity)	All people	Water utility and surface water
	Ulaanbaatar	–	X (in *Ger* area not served by utility kiosk)	All people	–
	Delhi Kathmandu	–	X	High- and medium-income families (to supplement the low water quantity provided by the utility)	Groundwater, spring, and surface water
Pushcart	Dhaka	X	–	Medium- and low-income families (to supplement the low water quantity provided by the utility)	Utility standpipe
	Delhi Jakarta	–	X (in area near the utility's piped system)	Low-income families	Utility standpipe
Reseller	Cebu Ho Chi Minh City Jakarta	X	–	Poor people who cannot afford a household connection	Tap
Water Carrier	Dhaka	X	–	High-income families (to supplement the low water quantity provided by the utility)	Utility standpipe

Their legal environment is poor, and generally they work under an illegal framework (due to water distribution monopolies of utilities). This situation is particularly true in Delhi and Dhaka. In Cebu, however, operators have received authorization from the local authority (chief of the *barangay*), and in Ho Chi Minh City some entrepreneurs have signed contracts with the water utility that define the water tariff.

The tariff charged by SSWPs is lower when they operate in a friendlier environment. In Delhi, Dhaka, and Kathmandu, where SSWPs operate in an illegal environment, the water tariff is 6–10 times more than the utility tariff (which is strongly subsidized). In Cebu and Ho Chi Minh City, where SSWPs have received official authorization, the multiplier is respectively 2.6 and 1.7.

F. Examples of Small-Scale Water Providers[8]

Cebu

The water utility serves only about 30% of the 1.5 million people in this city. Several SSWPs provide water services, mostly based on small distribution networks connected to privately owned and maintained wells. These systems are of various sizes, serving up to 500 households. Average consumption is in the range of 12–15 m^3 per month, and the monthly water bill is $6–8. In comparison with the utility service, which is not available in locations served by SSWPs, connection arrangements are simpler and cheaper but the tariff is higher.

Delhi

About 60% of Delhi's 14 million people live in slums, resettlement colonies, and low-income clusters. Most of these are not served by household connections. Instead, they get water from public standpipes, tubewells (with handpumps), and water tankers. The utility—Delhi Jal Board—operates about 1,000 tankers delivering 23,000 m^3 per day. Supply by tanker costs close to $1/$m^3$, while supply through the piped system costs only $0.10/$m^3$. The utility's tankers must provide free water to the poor who have no other source of water. These tankers, when requested, also serve middle- and high-income households. The role of SSWPs in Delhi is very limited because the utility's water price is low and water is provided free to the poor. There are, nevertheless, a few private pipeline providers who supply connections using their own tubewells. The users pay $4–10 for about 15–30 m^3 per month. There are also tricycle services. These involve payment for the cost of transporting water from standpipes to homes, which equates to about $4–6 for 1.2 m^3 per month of drinking or cooking water per household. The bottled water industry is also strong, with 24-liter bottles of treated water costing around $0.80.

SSWPs often use meters to manage

Dhaka

The need for water of people living in informal settlements prompted the establishment of one SSWP business in Dhaka. It serves 9,100 households through 100 individual connections and 15 standpipes, and it is located about 1.3 kilometers from the utility network from which it sources its water without charge. The whole operation is illegal, but it provides a basic human need to the people. The business charges $0.86/$m^3$ for water, compared with the utility's $0.12/$m^3$. Only about 300 m^3 of water is supplied to the neighborhood each day, which equates to about 1 m^3 per household per month. It would seem that this water can only be used for drinking and cooking.

Ho Chi Minh City

About 19% of the households in Ho Chi Minh City use SSWPs. Most providers (about 60%) are resellers (households with connections from the water company, which resell water to 3–5 other households in the neighborhood). The rest are tanker operators, providers using small pipeworks, and bottled-water providers.

[8] For details see Appendix 3.

Bottled-water provider

Water tanker for people not being served

Average consumption from household resale is 17.5 m^3 per month, which can be compared with 36 m^3 per month from the water utility. The average tariff for household resale is \$0.56/m^3. Average consumption from water tankers is 6.6 m^3 per month, and the average tariff is \$0.90/m^3. A network provider on the outskirts of Ho Chi Minh City uses groundwater from his own well. His system has a design capacity of 720 m^3 per day, but presently only 100 m^3 per day is provided. The designed number of connections is 2,000, but only 400 households have been connected in the first 2–3 years. Water is sold at \$0.22/m^3, and household use is about 7.5 m^3 per month. This provider has a license to operate for 3 years and a tax exemption for 5 years. What is unique about the Ho Chi Minh City case is the real partnership and spirit of partnership created between the water utility (Ho Chi Minh City Water Company) and SSWPs.

Kathmandu

More than half of the city's 1.1 million people depend on sources other than the utility to meet their water needs. About 31% rely on their own wells, 15% on community managed systems, 6% on SSWPs, and 5% on neighbors' connections. Most SSWP services are provided by about 65 tankers operated by 36 providers. The quality of the water depends on the source, which can be natural springs or groundwater. Consumers prefer one company over another based on its source of water. In general, this service is provided to the more affluent members of the community (who can afford to pay \$1.30/m^3 for delivered water).

Manila

It is estimated that millions of people in this city receive water from SSWPs. About 2 million receive water (by resale) from neighbors' connections or from neighborhood kiosks, another 2 million from pushcart water vendors and tanker deliveries, and a further 1 million from direct connection or hose. The average consumption volume per household is 6 m^3 per month, and the monthly water bill is \$10–20. By contrast, those on the utility supply get about 30 m^3 per month and pay \$3–6 per month. In most cases, the source of water is the water utility.

G. Conclusions

"Water for All" is the catch cry of governments, development agencies, and operators alike. Yet in many deliberations over the years, SSWPs have been to a large extent ignored. But in terms of the total revenue turnover from water in megacities, like Jakarta or Manila, SSWPs are responsible for more revenue turnover than formal utilities. This alone is justification for taking a much closer look at SSWP operations. When their operations are seen as intimately linked to the urban poor, because of low rates of effective coverage with piped water (often less than 50%), there is another powerful reason for further investigating their operations.

The main issue with SSWPs is the great lack of equality between those connected to piped water and those not connected. There are people with vested interests (which might include utility staff, utility owners, local authorities, and government and elected officials) who are keen on maintaining the status quo. It should be noted that the only vested interests of SSWPs relate to employment and the operation of small businesses. The studies to date appear to show

that SSWPs make little profit and do not exploit their clients (who are mostly the urban poor).

Is there a need to regulate SSWPs? Evidence suggests that there is not. That would probably drive many of them out of business. To a large extent, the market promotes regulation through customer choice concerning price and quality of water. Competition is strong. There is, however, a need to recognize SSWPs officially. Then it will be important to undertake comprehensive, independent audits of water and service levels to ascertain the facts from the field. Water utilities need to be regulated and guided by clear policy statements from governments on piped water service coverage and SSWPs. Any water supply study strategy for a city must consider the role of SSWPs. Finally, financial assistance should be made more readily accessible to SSWPs so that more investments can be made to bring good-quality piped water to the urban poor.

Small-Scale Water Providers in a Nutshell

- Services provided include distribution pipework for utility water and/or groundwater, kiosk sales, pushcart and tanker vendor deliveries, and neighborhood resale of utility water.
- Water sources (whether legal or illegal) are mostly water utilities, but also groundwater.
- SSWPs sometimes generate more revenue than formal water utilities.
- In default of the water utility, SSWPs provide the urban poor with essential services. Many SSWPs are also poor.
- The great inequity: the connected can pay $4 for 30 m^3 and those not connected (supplied by SSWPs) can pay $20 for 6 m^3. The status quo is maintained by those with vested interests.
- In many cases, SSWPs are not formally recognized by utilities or local governments.
- Tariffs are higher than those charged by utilities but connection fees are lower.
- SSWPs provide more flexible arrangements for connections and payments than water utilities, leading to better relations with customers.
- Officials need to learn more by auditing existing utilities and SSWPs, so that SSWPs can be registered and recognized but not regulated (yet).
- Residents need to have clear policy statements from governments on piped water coverage and SSWPs. Governments should include SSWPs in water supply strategies.
- SSWPs need access to financing.

Chapter 8

Management

This chapter examines the problems associated with managing water utilities responsible for major urban water supplies in Asia's developing countries. It identifies the lack of autonomy of water utilities as one of the core problems leading to secondary problems, such as the caliber and skills of management and staff, the overstaffing of utilities, and the lack of accountability and incentives (including remuneration) to perform. Of course, autonomy is also linked to the ability of a utility to set tariffs in accordance with government policy—and that degree of autonomy is rarely attained. This chapter looks at solutions in the context of good governance, higher tariffs, organization development, reducing NRW, ending intermittent supply, and effective metering of water use.

A. Current Situation

Autonomy

The lack of autonomy extended to the management of most Asian water utilities is the strongest factor affecting their performance. This means that matters concerning staff numbers, staff remuneration, and staff recruitment are not decided by service providers. This also means that matters concerning tariffs, on which the financial viability of each utility depends; investment, including extensions of supply (often beyond hydraulic design limits); and disconnection for nonpayment of bills are not decided by the people who are probably most qualified to make these decisions. In short, it means that managers of many utilities are not being allowed to manage.

Caliber and Skills of Management

The civil servant rules in Asia's developing countries result, in most cases, in seniority or longevity of service leading to promotion to management positions, not management skills or merit and performance. The lack of autonomy extended to management encourages this state of affairs. Men and women who do not rock the boat are supported. Even if managers had the autonomy to manage, many would not have the skills to do so. Most senior positions in water utilities are filled by staff with little, if any, management training.

Caliber and Skills of Staff

What is found in water utilities in Asia is a heavy predominance of engineering professional staff, many of whom have degrees from universities in developed countries. What is lacking is more qualified professional accountants and financial managers, because the market rates for such people are well above civil servant salary rates. There is a need for more professional staff with backgrounds in sociology, information technology, public relations, and environmental studies. When it comes to professional staff preferences, development (with its associated perks from development agencies) is much more attractive than O&M functions. Indeed, at the field level, O&M staff are often inadequately trained for their jobs. Training is given more to professional staff than to field workers. As a consequence, the quality of repairs and maintenance is not great.

Number of Staff

Many water utilities are heavily overstaffed, mostly as a consequence of the involvement of elected officials and nepotism. In 1996, for example, the utilities of Delhi, Dhaka, and Faisalabad (Pakistan) had 21.4, 18.5, and 25 staff per 1,000 connections respectively, whereas Singapore, Seoul, and Hong Kong had 2.0, 2.3, and 2.8 staff per 1,000 connections. Overstaffing lowers staff morale, because some staff do much more work than others. Output or productivity is low. Many professional staff also moonlight as freelance consultants, to augment their income. Unions tend to be strong and active when it comes to staff being laid off (regardless of the reason, even wrongdoing).

Incentives to Perform

There are examples of bonuses given to water utility staff, but this often has more to do with the tariff level and financial performance of a utility than the merit and performance of its staff. In general, there is little incentive with civil servant bureaucracy and civil servant salaries for staff to extend themselves. Promotion, after all, is usually based on seniority, not merit. NRW reduction is often seen as a necessary evil that provides justification for employment. It is not seen as

a challenge associated with bonuses for meeting goals. Incentives relate also to accountability. If there is no accountability for performance, there can be no incentives. In fact, staff incentives often relate to illegal connections, meter reading manipulation, and valve operation for intermittent supply, all of which are associated with staff receiving bribes from the public.

Measurement of Performance

Some attempt is being made nowadays by water utilities in developing countries to measure indicators of performance, such as NRW, collection efficiency, operating ratio, etc. If, however, managers are not inspired to act on the information collected, staff soon become less enthusiastic about collecting data. Today we have computerization and the ability to carry out in-depth analysis, which can then lead to action, but these tools are not being adequately employed.

Delegation and Micromanagement

A consequence of the lack of autonomy extended to water utility management is the lack of delegation extended down the line by management to staff. It is not an uncommon sight in South Asia to see the head of a water utility seated at his desk with as many as six telephones at his side. He must answer all questions, even if these pertain to matters that are trivial and should be answered by a division manager. In other words, true management is rare. Good examples of utility management can be found in Bangkok, Malé, Phnom Penh, and Singapore (Malé and Phnom Penh may be further reviewed in the case studies in Appendix 2).

Billing and Collection

Billing and collection may be improved in many places by making it very easy to pay bills. One way to do this is to have many local outlets where customers can pay bills without having to queue for a long time. In addition, utility fees could be paid daily, weekly, biweekly, monthly, bimonthly, or quarterly, depending on each customer's earning cycle. Another option, which is used in Bangkok and elsewhere, is to encourage consumers to read their own meters and pay on that basis each month. From time to time, those readings must be checked by utility employees.

Financial Management

Annual audited reports of water utilities have a tendency to surface for public consumption about 3 years after the year of reporting. They are then useless as management tools and of little interest to the public. The annual report of the Metropolitan Waterworks Authority in Bangkok, however, is always in public hands within 6 months of each fiscal year's end. Internal audit offices are often ineffective and inadequate, and external audits, conducted under the auspices of an auditor general's office, tend to concentrate on minor offences and ignore the big picture. It is indeed an unfortunate state of affairs when this situation can apply to $100 million per year businesses being controlled by only one or two qualified accountants. Much more attention needs to be given to utility and project accounting. More transparency is required.

Water Management

There are often major deficiencies in measuring water production and consumption, but estimates of NRW indicate figures of 30–60% for most Asian cities. As for the breakdown of NRW into its component parts and committed strategies to deal with each of them, few utilities embark on such tasks.

If you can't measure...you can't manage

Working Environment and Incentives

Through transparent policies and independent regulatory bodies, Asia must ensure autonomous water utilities. Then it must obtain free market remuneration for water utility staff, based on accountable, incentive-based, and merit-based performance. While Asian water utilities have many very well-educated professional staff who have been trained in developed countries, their potential has not been realized. The Singapore Public Utilities Board, perhaps the best water utility in the world, gives us a very strong example of how to do it right. It offers strong incentives for staff to perform. Managers are paid more than $150,000 annually. In Bangkok, Metropolitan Waterworks Authority managers are also paid relatively high salaries, which are at least commensurate with those in the private sector. Only when utilities have this type of enabling environment can they go to work on organization development. An example of a successful reform program is shown in Box 8.1.

Box 8.1 Indonesian Water Utility Rehabilitation

In 1998 many of Indonesia's 300 municipal water enterprises were, due to rocketing costs of electricity and chemicals, putting untreated water through mains, which could have led to large epidemics. The situation was so bad that some enterprises were planning complete shutdowns that would have devastated the urban poor. The Water Efficiency Team (WET) project quickly created a database and used the information gathered to diagnose the major problems of these enterprises. WET helped small entities create recovery plans and understand the Government's stance. Seventy engineer trainers were trained under the project. These trainers learned about re-rating water treatment plants to increase efficiency, which saved money by eliminating the need for new construction. In one plant, capacity increased from 100 liters per second to 170 liters per second. The savings totaled about $240,000 (roughly four times the cost of the WET project). WET's emphasis on transparency and self-help, instead of capital infusion, has helped the Government shift its water sector development priorities toward full commercialization. The project demonstrated that even small enterprises can become self-funding if proper systems and procedures are implemented. (Woodcock, 2001)

B. Organization Development[9]

New organizations are formed and old ones are energized through organization development. Resources are directed to high priorities. Goals are established and translated into jobs that people do every day. Efforts are balanced with available resources. People are rewarded for achievement and initiative. In short, organization development embodies the principles of modern management.

Leadership skills and management skills are important, and they are not the same. In managing change, leadership skills will be more important. Once the organization is up and running, management skills will become more important. Leadership must emanate from the governing body, move to the management group, and filter down into the ranks of the organization. Leaders inspire others and set a good example. The Director of the Phnom Penh Water Supply Authority is an example of such a leader (see case study in Appendix 2). A governing body leads through policy, planning and budgeting, delegation, oversight, and advocacy. An organization must have a clear mission and objectives. It must have a strategy to implement policies. It must start off by analyzing what function it needs to be able to perform and determine what organizational structure is best for that purpose. Then job titles and job descriptions need to be defined. Clearly, the number of employees necessary to do the job will be a key consideration. The management culture needs to include planning, delegation, and management by results. Employee development must be a cornerstone of the organization. This will include professional human resources management, compensation and rewards, training, and creating a pleasant work environment.

Information is needed for management (see Box 8.2 for Bill Gates' views). For a water utility, managers should be provided with data relating to revenue and expenditures, accounts receivable, water production, water consumption, new connections, water availability, number of staff, etc. There is a need to computerize information about every dwelling in a utility's area of responsibility, and whether each dwelling has an official connection. Managers need to know how many people (adults and children) live in the service area, what alternative sources of water

[9] Special acknowledgement to Barnes, 2003.

Box 8.2 Business @ the Speed of Thought

(This advice is just as applicable to selling water as any other product.)

- *No one is using information well.*
- *Turn passive data into active information.*
- *You are competing.*
- *Customer service will become the primary value-added function in every business.*
- *Be proactive, not reactive.*
- *It is all about public awareness and transparency.*
- *Knowledge is power.*
- *Companies should focus on their core competence and outsource everything else.*
- *Web lifestyle eases geographic constraints. Knowledge workers can live where they like.*
- *Competition in hiring the best people will increase in the years ahead.*
- *Historical consumer data are a valuable asset.*
- *The speed with which you respond to bad news is critical. Focus on the consumer's definition of good service.*
- *Collect detailed data on consumers and nonconsumers.*
- *Analysis should lead to action.*
- *Use data mining (where computers look for patterns).* (Gates, 1999)

they use, their average monthly consumption from the utility, whether that consumption is metered, how long ago meters were installed, the state of internal plumbing, etc. For this information to be fed to computers, on-the-ground caretakers are needed for zones of up to 500 connections. These caretakers should also maintain detailed information on those not served with a piped supply, including whether or not those without service have applied for connections, what sources they currently use, what their constraints are, when they were told they would be connected, etc. Interface between staff and consumers is important, especially in the field. Performance indicators need to be developed. Utilities can benchmark their performance against other utilities regionally or nationally and also against their past performance. Information technology needs to be introduced to make reporting systems easy, transparent, and able to incorporate feedback. Utilities need strong public awareness and customer service units. Interactive Web sites are nowadays expected. Public and employee safety issues should be addressed.

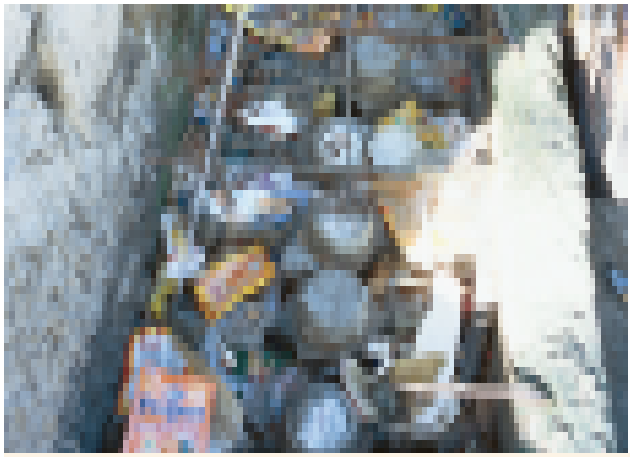
A culture of continuous improvement needs to be inculcated. The Singapore Public Utilities Board, for example, was not satisfied when it had NRW down to 7%. It continued to work on reducing this figure, and it is now less than 5%. Bearing in mind the current culture, a special effort will be required to build up prestige in O&M. Much more effort will be needed in training the hands-on people in organizations and helping them take pride in their performance. Utilities should be encouraged to network informally among themselves. Country, regional, and global water partnerships are flourishing. It would be healthy to take advantage of these to improve utility performance by implementing integrated water resources management, which is the theme of these partnerships. Utility staff can learn a great deal straight from the Internet. For example, reading the articles on a Web site such as *www.watermagazine.com* can be very enlightening. Yes, there is a need for governments to create enabling environments, but there is also a need for professionals to behave responsibly. This will be done when they promote learning, share information with government agencies, and inculcate professional ethics.

There is probably nothing so guaranteed to lift the morale of water utility staff as tariffs being high enough to ensure that utilities are financially viable. There are also few excuses for not having excellent information, on which management decisions can be based. Computerization has made all of this possible.

C. Metering

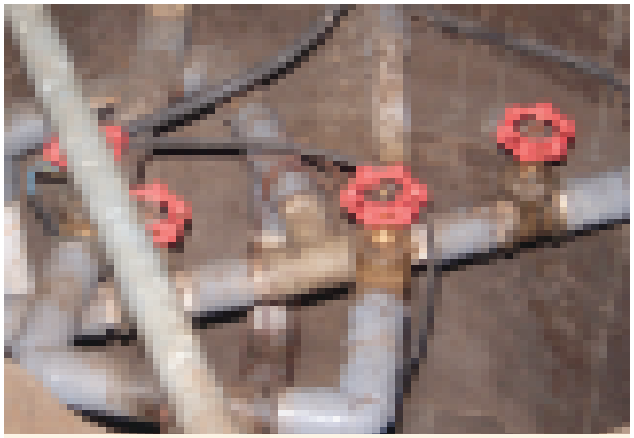
It has been said that if you cannot measure, you cannot manage. Moreover, if a job is worth doing, it is worth doing well. These statements are true in water and metering. So, wherever there is 24-hour supply, there should be 100% metering, and all meters should be in working condition. Where intermittent water supply exists, a plan to gradually increase 24-hour coverage should be set in motion. Likewise, all groundwater extraction by industry should be metered and charged if that resource is to be controlled and maintained.

Are these read?



Water meters—how many are working?

Meter all or nothing



A need for construction standards

Meters must be of good quality and should be replaced regularly (about every 5 years). The large users of water should be accurately metered, and the meters used might need to be replaced every 2 or 3 years. To some extent, it must be acknowledged that when tariffs are very low (as they are in most of South Asia) metering is somewhat irrelevant, as the cost of maintaining and reading meters may be more than the water bill itself.

When it comes down to estimating consumption where metering is absent, such as on standpipes, it is quite simple to meter a number of standpipes for a short time and extrapolate the results for others. The same holds true for household connections that are not metered. Pump hours run compared with the pump performance curve is often used to estimate production volume. This, however, is not a long-term recommendation. When it comes to production, there are almost no excuses for not having good metering. The accuracy of any assessment of NRW is important, especially when the result is to be used for monitoring improvement in performance.

It is estimated that two thirds of household water consumption and almost 100% of industrial consumption in Organisation for Economic Co-operation and Development member countries are now metered, and meter penetration continues to expand in most other countries (OECD, 1999). Certainly, in countries like Australia and New Zealand, metering consumer connections has recently been deemed necessary in reducing water use.

Management (Problems) in a Nutshell

- There is a lack of autonomy of utilities.
- Revenue (tariffs) is affected by political considerations.
- Utilities are overstaffed.
- Management skills are lacking.
- Accountability is needed (annual reports + 3 years).
- Civil servant rules and civil servant salaries are ineffective.
- Public relations are poor, and there is a lack of awareness among consumers.
- O&M functions are treated as "project" capital works.
- High rates of NRW, intermittent supply, and standpipe service need to be addressed.
- Construction standards are poor.

Management (Solutions) in a Nutshell

- Policies must provide autonomy and revenue (tariffs).
- There should be accountability through regulatory bodies and annual reports.
- Organization development is necessary.
- If you cannot measure, you cannot manage.
- Incentives must be linked to performance.
- Use open market salaries for professionals.
- Give O&M prestige.
- Interface between staff and consumers should be given importance in the field.

Chapter 9

Non-Revenue Water

The terms unaccounted for water (UFW) and non-revenue water (NRW) have been widely used in the past. The use of these terms, however, has been confusing. The International Water Association (IWA) recommends the use of NRW (IWA, 2000). IWA "Best Practice" Water Balance and Terminology for NRW and its components is explained in Box 9.1 and Box 9.2. In these, UFW equates to Water Losses. Accordingly, throughout this book, reference is made wherever possible to NRW, not UFW.

Spaghetti network repairs and leaks

A. Components of Non-Revenue Water

Unbilled Authorized Consumption can include water used for fire fighting or free water distributed at standpipes or provided to religious institutions.

Apparent Losses comprise unauthorized consumption and metering inaccuracies. It is estimated that in Asian cities 50–65% of NRW is due to apparent

Box 9.1 International Water Association Water Balance

The following are definitions of principal components of IWA water balance.

- ***System Input Volume*** *is the annual volume put into the part of a water supply system that relates to water balance calculation.*
- ***Authorized Consumption*** *is the annual volume of metered and/or non-metered water taken by registered customers, water suppliers, and others who are implicitly or explicitly authorized to do so for residential, commercial, and industrial purposes. It includes water that is exported.*
- ***Water Losses*** *can be identified by calculating the difference between system input volume and authorized consumption. They consist of apparent losses and real losses.*
- ***Apparent Losses*** *result from unauthorized consumption and all types of inaccuracies associated with metering.*
- ***Real Losses*** *result from losses at mains, service reservoirs, and service connections (up to the point of customer metering). The annual volume lost through all types of leaks, bursts, and overflows depends on their individual frequencies, flow rates, and duration.*
- ***Non-Revenue Water*** *is the difference between system input volume and billed authorized consumption, and it consists of the following:*
  - *Unbilled Authorized Consumption (usually a minor component of water balance),*
  - *Apparent Losses, and*
  - *Real Losses.*

Box 9.2 "IWA Best Practice" Water Balance and Terminology				
System Input Volume	Authorized Consumption	Billed Authorized Consumption	Billed Metered Consumption (including water exported)	Revenue Water
			Billed Non-metered Consumption	
		Unbilled Authorized Consumption	Unbilled Metered Consumption	Non-Revenue Water
			Unbilled Non-metered Consumption	
	Water Losses	Apparent Losses	Unauthorized Consumption	
			Metering Inaccuracies	
		Real Losses	Leakage on Transmission and/or Distribution Mains	
			Leakage and Overflows at Utility's Storage Tanks	
			Leakage on Service Connections up to Customers' Meters	

losses. Unauthorized consumption means illegal use, and this could be (i) sole illegal connections, (ii) illegal connections to properties that also have legal connections,[10] or (iii) illegal connections for the purpose of selling water. Metering inaccuracies can include malfunctioning water meters, estimated water consumption (when meters are not working), and misreading water meters.

Real Losses comprise leakage from transmission or distribution mains, leakage and overflow from utility storage and balance tanks, and leakage in reticulation systems (especially service connections) up to the point of metering. Experience has shown that most leakage results from service connections, and to a large extent this is due to poor construction.

B. Consequences

The issues related to high NRW rates are (i) consumers paying for inefficiencies of water utilities, (ii) a precious and scarce resource being wasted, and (iii) unnecessary investments in production. Another important consideration is that high NRW rates equate to poor governance, which results in low utility staff morale. From the consumers' point of view, those who have illegal connections or have estimated actual consumption below real consumption are cheating those who pay for water. Poor governance is at the root of the problem. See Figure 9.1 for an illustration of the extent of NRW in Asian cities.

Illegal connection in Nepal

[10] I once watched many residents on one street (in Manila) divert water for a short time from their illegal to their legal connections.

Linkage of Non-Revenue Water to Low Service Coverage

Where there is low coverage with piped water there is also likely to be high NRW. It is possible that those with vested interests condone the illegal sale of utility water to SSWPs at high prices (low volumes). The total revenue obtained from this source may be of the same order of magnitude as the official sale of water by utilities. Someone should ask where the revenue generated through illegal sales to SSWPs goes, because the answer to that question might explain why the status quo (the urban poor not receiving service) has remained for so long.

Service connection leakage

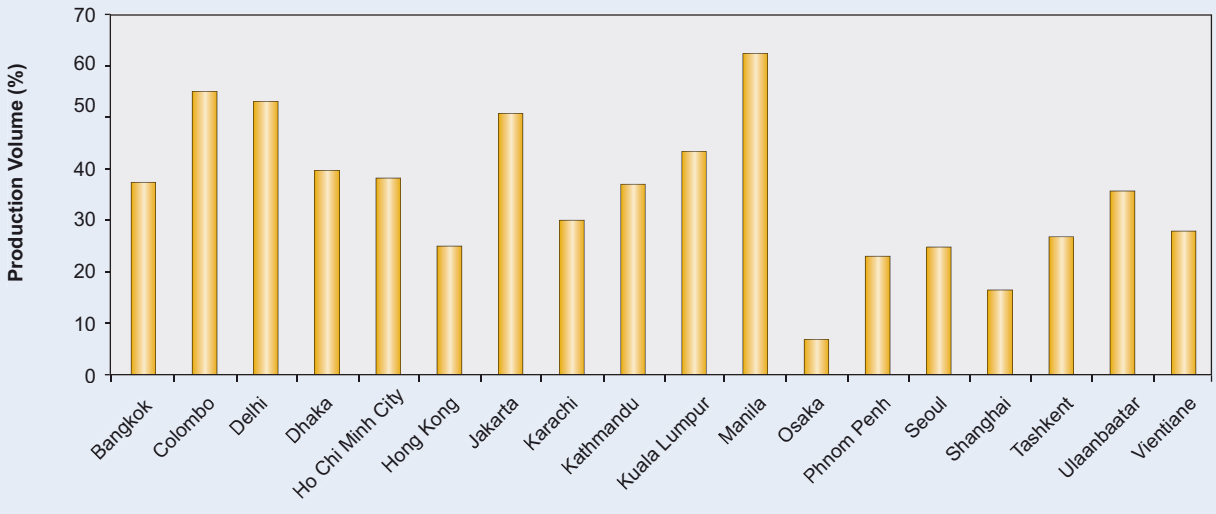
C. Reducing Non-Revenue Water

The benefits of reducing NRW include:

- need for less water to be produced, treated, and pumped, translating into the postponement of the expansion of capacity—producing less water also translates immediately into cost savings on O&M, due to savings in energy and treatment costs;
- reduction in apparent losses, which will result in more water being billed and more revenue for utilities—it has also been shown that water metering and adequate rates reduce wasteful consumption, which will likely decrease total consumption;
- adequate understanding of consumption patterns, which will allow utilities to optimize distribution systems;
- better knowledge of real consumption, which will improve demand projections; and
- reduced sewage flows and pollution.

These benefits depend on adequate pricing of water resources and services. Subsidies for water extraction, discharge of wastewater, capital investment, and operation of water supply systems lower the cost of water as perceived by utilities and thus remove an incentive to reduce physical losses. Low

Figure 9.1 Non-Revenue Water in Asian Cities (2001)



water rates for consumers do not encourage utilities to meter their water consumption and detect and deter unauthorized water use. Moreover, low rates fail to provide consumers with an incentive to deal with leaks and wastage beyond their meters.

It is often said that there is no point in reducing NRW below about 20% of production, because the costs outweigh the benefits. An example from Singapore seems to disprove that theory (see Box 9.3).

Mapping

The distribution systems of most Asian cities are very poorly mapped. Only when these are well mapped can the hydraulics be properly calculated and limitations on extensions to the distribution systems be properly controlled. Now, with global imaging tools and computerization, this work can be more easily accomplished and maintained. Good records and public scrutiny (with the help of neighbors) will help eliminate illegal connections.

Control Measures

Programs for controlling NRW should tackle at least the following three main causes of loss: (i) metering inaccuracies, (ii) unauthorized consumption, and (iii) leakage. Methods of controlling leakage include passive control, regular sounding, district metering, waste metering, combined district and waste metering, and pressure control. Selecting the most appropriate method would depend on the level of leakage, the cost of leakage, and the cost-effectiveness of each method.

System leakage

Box 9.3 Case Study Singapore (pop. 2.8 million)—Public Utilities Board

- *NRW was reduced from 10.6% in 1989 to 6% in 1994.*[a]
- *Metering of production and consumption is 100%.*
- *Meter accuracy is very high. Production meters are calibrated every month. Domestic consumer meters are replaced every 7 years and industrial meters every 4 years.*
- *Volume of water used for fire fighting is estimated or measured and fire departments are billed.*
- *Commercial system is highly reliable and controls are in place to prevent tampering.*
- *Billing complaints are dealt with promptly.*
- *High and low consumption patterns are investigated.*
- *Average water rates are close to the incremental cost of water.*
- *The entire distribution system is surveyed for leaks every year.*
- *Water districts can be fully isolated to monitor for leaks. Distribution pipes are cement lined to reduce corrosion and are replaced if the number of breaks exceeds three per kilometer per year.*
- *House connections are made of stainless steel or copper.*
- *Certified plumbers do in-house repairs and installations.* (Yepes, 1995)

[a] NRW was reduced to 5% in 2000.

Points to Remember

- Accountability must be high at all levels.
- Water services must be adequately priced.
- Reducing commercial losses is very important, because it helps improve the revenue stream almost immediately.
- Reliable information on production and consumption is necessary.
- NRW is the result of a combination of factors, not of a single one.
- NRW programs must be institutionalized and not be the result of sporadic exercises associated with the availability of grants or loan financing.
- NRW cannot be addressed in isolation. An enabling environment must be created. This means that (i) utilities must have autonomy in terms of management, and they need competent and motivated employees; (ii) tariffs must be adequate, which will result in cost and benefit incentives to reduce NRW; and (iii) good governance must be practiced.

The proportion of all accounts that show an estimated billing amount or a minimum figure is a good indication of the whole discipline of accountability. These days, with computerized accounts, there are few excuses for not identifying and correcting these inadequacies. Amnesties to ferret out illegal connections, public advertising, and convictions in courts of law for those discovered with illegal connections (who did not come forward when amnesty was offered) may be implemented.

It might surprise some to know that in cities of developing countries, under projects assisted by development agencies, the first effort to reduce NRW often involves the purchase of leak detection equipment. This is the developed country approach, and in most cases it has little relevance when solving developing country problems. It is far more realistic to go out and repair all visible leaks (of which there are usually plenty) and carefully scrutinize and accurately meter large water consumers. A caretaker approach to O&M and reducing NRW is shown in Box 9.4.

Pipe Replacement

In Singapore and Tokyo galvanized iron and polyvinyl chloride (PVC) service connections have been replaced with stainless steel service connections, and NRW levels in these cities (4% and 8% respectively) demonstrate the success of this approach. Singapore, Tokyo, and other cities also have programs for replacing asbestos cement pipes in distribution systems, as pipe breaks have increased over time.

Benchmarking

Benchmarking NRW is useful, as it enables utilities to compare themselves with others. Moreover, benchmarking helps utilities compare their performance during one period with their performance during another. The leakage component can be measured in other ways—as water lost per kilometer of distribution and as water lost per connection—but this assumes that NRW does not have a high component of apparent losses.

Summary Remarks

Reducing NRW is not technically difficult. It is, however, challenging in a governance sense. Illegal connections can only be eliminated when utilities have autonomy and discipline, and when they are accountable to regulators and the public. In addition, utility employees need genuine incentives to do their jobs and replace the incentives they have made for themselves through illegal connections, false meter reading, etc. (see Phnom Penh case study in Appendix 2). The status quo needs to be overturned. Comprehensive audits of water and service levels are needed and links between NRW, low service coverage, and SSWPs need to be explored. When tariffs are much higher, consumers will put pressure on operators to eliminate leaks and chase illegal connections. Good organizational development is needed to take advantage of autonomy and deliver accountability.

Box 9.4 Caretaker Approach to Operation and Maintenance and Reducing NRW

Rationale: Legal and technical approaches to combating NRW have met with limited success. Generally, utility staff will only appear when called out in an emergency or a crisis situation, rather than show a daily presence in a given locality. The proposed caretaker approach would add a social dimension to addressing the problem. It is based on managing water supplies at the lowest practicable level and on maintaining a good utility and consumer interface. It is particularly suitable for those developing countries without shortages of relatively cheap manpower.

Definition: The caretaker approach is essentially one in which the whole of a distribution system is divided into zones, each containing about 500 connections. A caretaker is appointed to be responsible for all water supply activities within a given zone. The concept is not new. In fact, it is employed in Tokyo and is, to some extent, also used effectively by one of the concessionaires in Manila. An SSWP in Manila uses this approach to manage its system by assigning one *aguador* to every 100 connections.

Institutional Framework: A caretaker who lives in the locality is given responsibility for a water distribution zone. The caretaker will report to an O&M supervisor located at a nearby maintenance depot. The caretaker's area of responsibility is small enough that it can be walked in its entirety once per week. This individual will lease an office from a resident in his or her zone of responsibility and have access to a telephone at that point (or will use a mobile phone). The O&M supervisor (an engineer) will be responsible for 10 caretakers and not more than 5,000 connections.

Caretaker Duties: The caretaker is expected to develop a friendly relationship with the people living in the zone of responsibility. He or she will do the following.

- Keep a daily diary of all activities in the zone.
- Be responsible for mapping the distribution system, including all connections.
- Be responsible for accurately metering all consumer connections and arranging for meter replacement when necessary.
- Analyze billing records and collections monthly, investigate high and low consumption and tardy payments, and report total consumption each month.
- Report leaks to be repaired and record the dates the repairs were effected.
- Report maintenance or new work requested and completed.
- Record and follow up on consumer complaints.
- Inspect plumbing in all households and assist with repairs, where feasible.
- Disseminate to consumers notices of interruption of supply for maintenance purposes and information concerning water tariffs, water consumption and conservation, demand management, hygiene education, and utility performance.
- Report alternative sources of water used by both utility customers and noncustomers.
- Report hours of service and pressure to the zone (day and night).
- Report numbers of persons in each household in the zone each year.
- Read district flow meters and pressure gauges daily.
- Inspect the entire zone on foot weekly.

O&M Supervisor Duties: The O&M supervisor is expected to support the caretaker in the following manner.

- Provide timely support and quality control on maintenance and repairs.
- Visit and talk with each caretaker daily.
- Review caretaker diaries weekly and provide comments and guidance.
- Inspect with each caretaker his or her zone monthly.

next page

Box 9.4 continued

- Encourage competition and incentives among caretakers for good performance.
- Comment on all caretaker reports before submitting them to the head office.

Conclusion: In this age of information technology there are few excuses for not having up-to-date data on every connected and nonconnected household in a given water service area. If this information is appropriately analyzed, it will be relatively easy to trace illegal connections, defective meters, and incorrect meter reading. At the same time, with the ability of caretakers to get to know the people in their zones, and with the timely use of amnesty periods, it should be possible to flush out most illegal connections. By examining individual zones and comparing these with others, it should be possible to identify quickly any problem areas.

Non-Revenue Water (Problems) in a Nutshell

- NRW includes water not billed as a result of leakage, illegal use, inadequate measurement, and free (authorized) use.
- NRW averages 30% of production in Asian cities, but ranges from 4% to 65%.
- High NRW is connected to low piped water coverage.
- There is a need to determine whether physical losses (leakage) are maintained to mask the illegal use and sale of water.
- Illegal sale of water from utilities can generate revenue equal to legal sales.
- Consumers pay for utility inefficiencies.
- A precious and scarce resource is being wasted.
- Unnecessary investments in production are made.

Non-Revenue Water (Solutions) in a Nutshell

- Governance and tariffs must be tackled first.
- Leak detection equipment comes last, not first.
- Repair visible leaks.
- Make utility staff responsible for small zones (caretakers).
- Meter all production and consumption properly.
- Add district metering.
- Provide incentives for utility staff performance.
- Explore links to water vendors.

Chapter 10

Sanitation

Conventional wisdom dictates that water should not be supplied without complementary sanitation. This is a development principle. The reality, as many know, is different, because there has not been enough funding for water supply, let alone sanitation.

Given a choice, the needy urban poor will always opt first for water supply, since it will have a direct economic benefit, whereas sanitation will have more indirect benefits related to health. Because sanitation in Asian cities could well be the subject of a book by itself, the function of this chapter is merely to give some indication of the existing status of sanitation in Asia, emphasize its importance, identify some appropriate technologies, and look at what is needed to break out of the status quo.

Improved environmental sanitation also improves economic benefits. Consider the case of investments for sewage collection in Santiago, Chile. The principal justification for the investments was to reduce the extraordinarily high incidence of typhoid fever in the city, but a secondary justification was the need to maintain access to the markets of industrialized countries for Chile's increasingly important exports of fruits and vegetables. (Briscoe, 1993)

A. Gender Issues

World Bank findings from studies indicate that men and women value sanitation very differently. For women, since they are more personally concerned with these issues and more intimately involved in them with respect to their families, sanitation is often the second highest development priority. For men it may be the eighth development priority. To ensure that water sector activities are gender responsive at policy and institutional levels, ADB will promote the integration of gender concerns in policies, plans, programs, and projects. Incorporating explicit gender equity provisions in the objectives and scope of water sector activities will be encouraged.

B. Analysis

Sewerage costs are in the $300 per capita range, septic tanks cost $100 per capita, and latrines cost $25 per capita. The advantages of sewerage are convenience; low health risk; no nuisance from smells, mosquitoes and flies; no problems with gray water (sullage); and no problems discharging industrial wastewater. The disadvantages are high cost, need for access to a reliable supply of piped water, difficulty of construction in high-density areas, unsuitability for self-help, need for pumping on flat ground, difficulty of maintenance, and concentration of pollution. Blockages and the breakdown of pumping equipment pose problems in sewerage systems, especially for low-income communities. There is now, on environmental as well as economic grounds, a growing appreciation of the fact that large sewerage schemes are not necessarily the best solution for some parts of cities, especially those with predominantly low-income communities (see Box 10.1).

In countries where sewerage service costs have risen significantly, industrial users have increasingly questioned whether the public sewer system represents the most cost-effective means of discharging their sewage. There is evidence of a trend toward more use of self-treatment and effluent reuse options. (Organisation for Economic Co-operation and Development, 1999)

Health risk—water pipe in drain

Box 10.1 Rethinking Sewage in Low-Income and Slum Areas

(This material was prepared specifically for this book by ADB's Alex Jorgensen.)

It is quite common for an international consulting firm to use conventional thinking in scoping and sizing various project facilities, including sewage collection and treatment systems. This often leads to the gross oversizing of these systems for a variety of reasons, which are not always the fault of the consultant. Normally it is the city council that insists on "fully modern" sewerage systems, regardless of actual demand. The officials involved have read or believe that such systems are essential for good sanitation, and these men and women are not amenable to a simpler technical solution, such as on-site septic tanks or even pit latrines in low-income or slum areas.

The basic design criteria for water are 24-hour supply and 120–150 l/c/d consumption. This consumption figure ignores NRW (often more than 50%), low pressure, and intermittent supply. Actual water supply is often between one hour every other day and two hours per day, and at low pressure. The real consumption in many areas is more like 30–40 l/c/d. Therefore, the conventional 80% wastewater generation ratio is false. Actual wastewater generation is closer to 50% of the "real" water supply. A related issue concerns individual house or property connections. Due to the cost of these being loaded onto the users, the connection rate is often low. The cost of connections from the street sewer to the property line should automatically be included in the project cost and be financed under the "loan." While the cost of the connection from the property line to the house would normally be the responsibility of the owner, there may still be a case for this being financed under the project when a low-income household is involved.

In addition to the capital cost aspect, there are serious operational problems. Sewers tend to be designed to minimum slopes to reduce pumping. When the actual flow in these sewers is half of that anticipated, or much less (as is often the case in low-income and poor areas), the scour velocity is not maintained and the sewers clog. Having an incoming wastewater volume half or less of that expected exacerbates problems, as the wastewater is much stronger in terms of solids and organic content. Therefore the minimum scour velocity needed is much higher. Operational process problems, with resulting odors, poor effluent quality, and high O&M costs, occur when sewage treatment plants have gross excess hydraulic capacity and the sewage strength is stronger than anticipated. To make matters worse, the income from water and sewerage tariffs ends up as a fraction of that projected, which leads to an inability to pay for O&M costs and a greatly reduced ability to repay capital costs.

The answer is for loan agencies to insist on a careful review of actual water use and wastewater generation at the planning stage as a condition of the loan and likewise at the detailed design stage. Once this is done, low-density, low-income, and slum areas should be converted to low-cost sanitation—septic tanks where space and groundwater conditions permit, dual pit latrines with squatter plates in slum areas (where there is usually no space), and good people-sensitive public toilets (like in Pune). Coverage of sewers and reticulation pumping stations and treatment systems should be reduced accordingly.

Nonconventional sewerage—using smaller pipes, laying pipes on a flatter gradient and at a shallower depth, laying pipes inside plots, reducing the number of manholes, and providing interceptor tanks for the settlement of solids—is a potential solution for low-income communities. Recently, in cities like Yogyakarta (Indonesia), small and affordable sewerage schemes have been seen. These serve 200–500 plots with local treatment facilities underground or landscaped. An NGO in this city says government needs to agree to adopt community-based sanitation. The entry point is giving unauthorized settlers a semilegal status.

Septic tanks are constructed in many areas in Asian cities. Unfortunately, they are often not constructed properly (as in the Maldives, where the effluent outlet feeds almost directly into the water table) or discharge effluent directly into storm-water drains. Furthermore, in areas where there are many septic tanks, desludging and treatment and disposal of sludge are often totally

inadequate. As with sewerage systems, if the system is designed to operate a certain way, it should be operated in that way.

There are many different types of on-site latrines used in Asian cities. These include pit, twin pit, pour flush, and ventilated improved pit varieties. "Overhung" latrines (where excretion is direct to a water body) and bucket latrines (where the excreta is dumped outside the community) are also seen. The type of latrine will depend on local conditions, especially the level of groundwater.

C. "Sanitation Connection"

The selected information that follows was sourced from the "Sanitation Connection" Web site. It is offered here as a guide to addressing sanitation issues in developing countries.

The World Health Organization (WHO), United Nations Environment Programme (UNEP), Water and Sanitation Program (WSP), Water Supply and Sanitation Collaborative Council (WSSCC), and International Water Association (IWA) form an international partnership known as the "Sanitation Connection" to offer a comprehensive Internet resource to environmental sanitation practitioners.

Health risks

Policies and Strategies

- *Provide increasing emphasis on demand responsive approaches where the services provided are closely linked to what consumers want and are willing to pay for.*
- *Minimize the quantity of waste: for example, improve water demand management to reduce the quantity of wastewater generated at source and reduce transfer of wastes to the wider environment through reuse and recycling.*
- *Promote solutions that are, as far as is possible, locally based at the household or neighborhood levels, rather than depending upon "downstream" transfer of wastes.*
- *Develop institutional arrangements, mechanisms, and incentives that stress the participation of users and encourage the involvement of both the formal and the informal private sectors.*
- *Develop procedures for economic and financial analyses and planning of investments that include the consequences of suboptimal development: for example, downstream environmental damage or failing to make the best use of local resources.*
- *Develop mechanisms for cost recovery that provide appropriate incentives to achieve stated policy objectives: for example, with regard to subsidy and financial performance.*

Sanitation is needed, too

Health and Society

The starting point is the household, as people are most likely to be at risk from contamination in the place where they spend most of their time. Health benefits accrue to families who have latrines, even if their neighbours do not; additional benefits then accrue as coverage extends to the whole neighbourhood. Gender equality needs to be promoted through recognizing that women are key providers of health and hygiene services to the family. This household-centered approach rather reverses the way in which planners and engineers view the situation; their starting point tends to be with centralized treatment and primary networks, rather than households. It is important to note

Desludging to the drain

that where wastewater treatment is inadequate, the hazard is moved around rather than eliminated, thereby emphasizing impacts on coastal areas.

Adopting a household-centered approach provides the opportunity to find out what householders think about the sanitation they already have and to explore what they actually want, rather than have other people decide for them. When people are ignored and the local context is not taken into account, sanitation schemes will fail. It is important to build awareness and create the environment to make informed choices. Social marketing is likely to be a key means of stimulating effective demand. This has to be followed up with supporting and facilitating measures to respond to the generated demand: for example, through better access to finance.

Inadequate sanitation impacts on children. Even where facilities are available, there are problems of acceptability and sharing of latrines and of the willingness of children to use them. There is a need for special attention to children's sanitation (including health and hygiene education) both in the home and at school. As well as being essential for a healthy environment at school, there are important opportunities for outreach into households and communities through educating school children.

Environment

- *It is important not to lose sight of the fact that the first environmental priority for most families is a clean household that is an attractive place to live. Next comes the local neighbourhood environment around their house and on their street. Only after these are all satisfied is there likely to be much concern with the area beyond, such as the city or rural environment as a whole.*
- *An important component of sanitation programmes is therefore increasing user awareness of problems of environmental pollution and of local means that can be adopted to minimize adverse impacts of activities.*
- *Wider problems of regional and national water scarcity and consequent environmental degradation have focused attention on the quantity of water used by different sanitation systems, both sewered and unsewered. In addition to moves towards improved reuse and recycling of wastewater, this is leading to calls for sanitation systems that use far less water than is presently the norm. There are a number of on-plot latrine systems that do not require water in order to function, and interest in this area has gained momentum.*

D. Community-Oriented Sanitation in Pune[11]

This now well-known example of urban community sanitation development is presented because it is a success story and as a result is replicated in many parts of South Asia.

The Pune Municipal Corporation (PMC) has been constructing community toilet blocks in slums for more than 30 years. However, the number of blocks built was small and far below the demand for toilets. Moreover, costs were high because of expensive designs and the involvement of contractors. Finally, in the absence of community involvement during project preparation and implementation, existing toilet blocks were abused and became dilapidated, and municipal conservancy staff could not maintain them. As a result, people had to suffer the indignity of having to defecate in the open, and the incidence of diseases like diarrhea was higher in slum areas. The surrounding environment was polluted, leading to the spread of other diseases.

For the first time, in 1999, the Municipal Commissioner wanted to tackle the issues effectively. First, he took up the program at a citywide scale and managed to reach 500,000 people out of a slum population of 600,000. Second, he invited bids only from NGOs so that community participation in construction, design, and maintenance would be ensured. The final partners in the program included the local authority, PMC, Society for the Promotion of Area Resource Center (the

[11] Based on ADB's Impact Evaluation Study on Water Supply and Sanitation Projects in Selected Developing Member Countries (2002), presentations made to ADB in Manila, and numerous Internet links to this case study.

lead NGO), and seven other NGOs. Third, he brought down costs significantly by laying down the condition that the eight NGOs chosen could not bid higher than the estimated cost. The total project cost was $4.2 million, equivalent to about $25 per family. Fourth, he personally reviewed in weekly meetings the implementation of the program of building about 3,500 toilet seats within 2 years, which helped energize all PMC staff and also remove obstacles.

The role of PMC, which has taken the initiative and provided the basic framework for implementing the scheme, is worth recording. What stands out in the program is the willingness on the part of PMC to involve the beneficiaries through NGOs and let them make their own decisions in matters related to the planning, design, and maintenance of the toilets. In limiting its role to providing finances, PMC may have been the first such corporation in India to adapt itself to a new role, that of the state as a facilitator of development, instead of relying on the straitjacket approach of centralized planning. Having made a tangible impact on the urban poor in Pune, the program has all the characteristics of good practice in terms of partnerships, sustainability, replicability, scalability, and empowerment of beneficiaries.

An independent survey by the Human Settlements Management Institute (India) covered eight case study toilets—each toilet block had 30–40 seats serving about 125 adults and children—operated by caretakers providing 24-hour service. The survey has provided an insight into how a community-based approach to the problem of sanitation along with participatory planning and execution can work wonders in a lifeless system. The survey concludes that the Pune program has demonstrated an innovative solution to tackling the seemingly intractable problem of public health and sanitation. The expeditious implementation of the project and the maintenance of the toilet blocks by the community with the guidance of NGOs are the highlights of this achievement. There were no time and cost overruns in the project, and it provided a citywide solution to the sanitation problem. It has also confirmed that people are willing to pay user charges at the rate of $0.50 per month per family for sanitation and that these services would not be a burden on the government anymore. The survey records that the program has opened a possibility for a paradigm shift in sanitation infrastructure development.

This experiment in Pune has attracted many visitors from other Indian cities, governments in other countries, and international agencies. The Pune experiment led to the acceptance of this model in Mumbai on a large scale, as well as in other cities. The Government of India has based its new program for universal sanitation in India on the principles of the Pune program, confirming the replication of this approach.

E. Some Solutions

Worldwide experience shows that sanitation solutions must come from joint efforts of governments and communities. The community must understand the problem and be willing to act. It helps to have a champion of the cause within the community, and members of the community must have a sense of ownership of the project. But no community is an island. Households should pay for on-site facilities, residents of a block for collection, and residents of a neighborhood for treatment and disposal.

It increasingly appears that it does not make sense to mix feces and urine with water to transport and treat these. Eco-sanitation is the process of safely sanitizing and reusing human feces and urine while minimizing water use. Eco-sanitation largely comprises desiccating and composting toilets. These toilets contain and destroy the pathogens, convert the feces into a safe soil improver, and use the nutrients in the urine to grow useful biomass. This approach is being tried in many countries, including Sri Lanka (through an ADB-funded project), with some success. There are cities in the PRC where up to 200,000 households employ eco-sanitation. This process is not a second-rate technology for the rural poor. It is equally, if not more, applicable to periurban and urban habitation at all income levels.

A variation of roof zone technology, the INDION reed bed system, treats and recycles sullage and sewage. Combining physiochemical and biological processes into a single operation, the reed bed forms a complete treatment unit that also reduces energy use and the load on the central sewer system. It can easily be implemented at housing complexes, holiday resorts, schools, hotels, and military camps. It consists of a treatment tank that is filled with proprietary reed bed support and filtering material and planted with wetland plants. Wastewater flows through the medium and around the roots of acclimatized plants and gets treated for organic and suspended impurities by the combined action of plants, microorganisms, and fungi. It can then be disinfected for toilet flushing, gardening and irrigation, or to recharge groundwater. (IEI News, 2000)

Development agencies and governments should funnel development financing away from large urban water supplies (consumers can pay) and into urban

sanitation and rural water supply. The real issue is hygiene education and awareness. Efforts must start with all schools. For pupils to understand this subject and relate to it, they must see good water supplies and sanitation facilities in each and every school throughout a given country. Efforts must ensure that there are good and adequate public sanitation facilities in every town in a given country. The Sulabh (private financed) or Pune (public financed) public pay toilets in India are good examples that can be followed elsewhere. Efforts must address environmental sanitation issues affecting the urban poor residing in unauthorized settlements.

How can this agenda begin to be addressed? The foundation must start with transparent government policies on integrated water resources management. These should include specific policy statements on sanitation. Then independent regulatory bodies (joint water supply and sanitation regulatory bodies) are needed, so that civil society can be assured governments will indeed implement those policies. Development agencies need to partner with one another, and with governments and NGOs, in pursuing the sanitation development agenda. When it comes to "privatization" of services in urban areas, care should be taken to ensure that water supply and sewerage remain bundled. Development agencies can highlight the needs and issues with regional studies and capacity-building efforts. Last, but not by any means least, culture, traditions, and religion must start to be used to inspire people to action on sanitation.

It is important to realize that there is no universal solution. Different ethnic and cultural conditions will affect every approach. Some factors, however, will be involved regardless of other considerations. These factors include understanding that social, cultural, and technical aspects need to be addressed; understanding that small is OK, which means that stakeholders must develop their own approaches; realizing that capacity improvement is needed when considering regional autonomy; realizing that government agreement is needed when adopting community-based sanitation; understanding the need for credit facility, education, and awareness; and knowing that the entry point is giving informal settlers some type of legal status. (Sudjarwo, 2001)

Sanitation (Problems) in a Nutshell

- Funding for sanitation development is a constraint.
- Willingness to pay for sanitation is relatively low.
- Awareness of the need for sanitation is minimal.
- The poor are often in the most vulnerable environments.
- There is a gender issue here—women place a much higher priority on sanitation than men.
- Septic tank design, construction, and maintenance are poor.
- Poor sanitation can lead to cholera or typhoid epidemics.
- The situation is compounded by inadequate solid waste disposal.

Sanitation (Solutions) in a Nutshell

- There is a need for explicit government policies.
- In densely developed areas, conventional centralized sewerage systems are a must.
- In less densely developed areas, it may be possible to construct decentralized small sewerage systems with local, appropriately landscaped, sewage treatment facilities.
- On-site sanitation is OK, if the plot size and ground permeability are adequate and the groundwater table is low.
- Eco-sanitation (not mixing feces with water) has promise.
- Reed bed technology for treatment of wastewater is OK.
- Target the urban poor as a matter of priority.
- Divert development agency and government funding from major urban water supply projects to urban sanitation projects.
- Solutions must be part of integrated water resources management.
- Opt for community sanitation facilities, like those in Pune.
- Get the facilities and education in the schools first.

Chapter 11

Tariffs, Subsidies, and Development Funding

This is a very important chapter. If there is one specific matter that has most constrained the development and management of water supplies in developing countries, it is the issue of tariffs. Some governments have found all sorts of reasons not to approve tariff increases, even though these increases would be strictly in accordance with stated policies and legislation. The consequences have been a low level of development, poor O&M practices, low staff morale, and the facilitation of corruption. This chapter examines tariff levels, tariff structures, affordability, willingness to pay, connection fees, types and levels of subsidies, and the money trail. It describes why there is a need for a paradigm shift in tariff levels and the good things that can happen when this takes place. Last, the most viable source of development funding is identified. In line with this, ADB's water policy suggests that the economic value of water should be recognized and reflected in national policies and strategies by 2005 and mechanisms established by 2015 to facilitate full cost pricing for water services where guarantees for the poor exist.

A. Tariffs

Policy Considerations

Governments of developing countries prepare policy statements, including those on cost recovery and tariffs. Many of these governments go through this exercise at the request of development agencies. Once loans are approved, however, these statements are sometimes considered irrelevant, which is unfortunate because the public does not get to see them, leaving the door open for elected officials to interpret and adjust policies on an ad hoc basis. When tariff revisions are required, the utilities will put them before the relevant government entities for approval. Often the entities concerned, on the instruction of the highest elected authorities, will defer tariff revisions citing (i) pending elections (presidential, national, provincial, or local authority), (ii) high NRW, or (iii) affordability issues involving the poor. Alternatively, tariff revisions are approved, which are only a fraction of what was sought. This undermines the morale of utility staff, perpetuates unnecessary government subsidies, and encourages corruption. Above all, this remains an obstacle to the urban poor connecting to piped water and intermittent water supply becoming a 24-hour service.

Official policies often support tariffs covering O&M costs plus the greater of depreciation or debt servicing (interest and capital repayment) and a contribution to new capital investment. O&M costs are not defined, so there is a gray area between O&M and rehabilitation. Also, depreciation is subjectively assessed, which results in it being invariably greatly underestimated. The area for the greatest subsidy, however, pertains to the contribution by central governments to capital investments that can be in the form of grants or soft loans. Quite unnecessarily some large cities, such as Colombo and Kathmandu, continue to enjoy grant financing of their capital investments. Policies also cover such matters as "apparent" cross subsidies, including those from large domestic consumers to the poor, those from industry to domestic users, and those from large cities to small towns. Policy may also address matters such as service coverage, service levels, demand management, and new connection fees. Most important of all, however, there is often no accountability for the implementation of policies. What we commonly see in terms of tariffs in water utilities is a roller-coaster ride taking the utility in and out of financial viability and a large number of water supply schemes that do not meet even their O&M costs from tariffs. In some cases, like that of Colombo, the average domestic tariff is only about one seventh of the average nondomestic tariff and equates to about 1% of household income. In fact, the tariff is so low that for many people transportation costs are higher than the amount of the bill itself, thus making collection a problem. Certainly the potential for resource mobilization from the consumers has never been fully explored.

In 1985, a World Bank evaluation of projects came up with the following conclusions.

- *The Bank's main concern is that the costs be recovered to the maximum extent feasible.*
- *The study concluded that the majority of public utilities failed to meet their revenue covenants, largely due to inadequate action on approval of new tariffs by governments.*

- *Financial covenants have worked better when linked with detailed action plans.*

In 1990, the World Bank reiterated that the economic analyses of projects and pricing policies have been neglected with adverse results in project design and justification. ADB findings at around the same time were similar (see Box 11.1). Despite these findings, which were recorded many years ago, little has been done to change the situation.

Box 11.1 Water Pricing—ADB Postevaluation Results

Tariffs and recovery rates continue to remain critical issues in nearly all developing member countries, notwithstanding the evidence that in most cases people have been willing to pay for water supply above existing tariff levels and that tariffs can be structured to appropriately blend equity and efficiency objectives. The difficulty has been that there is general political resistance to tariff increases and to maintaining tariff levels in real terms. The tariff structure should be sufficient to cover O&M costs, enable debt servicing, and support development plans while at the same time providing low lifeline rates for low consumption and a penalty rate for high consumption. Experience shows that increasing tariffs and improving billing and collection cannot be achieved solely through loan covenants. (ADB, 1994)

Objectives

The transparent policies of governments must state the objectives of tariffs and the rationale of tariff policies. The main goal may be to protect consumers while achieving and maintaining the financial viability of utilities. Other objectives may include serving the urban poor, using lifeline rates for the urban poor, encouraging demand management, developing schemes that ensure self-sufficient O&M, setting average tariffs for industrial use that are not more than twice the average tariffs for domestic use, and making connection fees payable as tariffs. In addition, tariffs should be based on the full price of water, which includes source development, purchase of raw water, treatment, and distribution costs. Allowable costs (those required for providing an efficiently operated water supply service) should be defined. One objective that should be applied for major cities, but has seldom found favor, is that of funding all capital works directly from tariffs. This is not an unreasonable objective when we consider that on average the monthly power bill in an Asian city is some four times the amount of the monthly water bill.[12] It also is not unreasonable if one considers the potential revenue to be gained if 5% of household income is the ceiling applied to all households for water charges in a city (see Figure 11.1). In setting tariffs, the first consideration must be a transparent tariff policy endorsed by the government. This policy should reconcile economic efficiency, social equity, and financial viability. We need tariff goals. What is to be achieved in 5 years? What is to be achieved in 10 years? We need to examine the need for loans that must be paid with interest against the possibilities of tariff increases to cover capital development directly. As can be seen from the example of Greater Colombo (see case study in Appendix 2), it is eminently possible to fund all major urban water supply developments directly from tariffs. We should not forget that all funding, except grants, must also be paid or repaid (loans) out of tariffs.

It is the reluctance of elected officials to increase tariffs that has, more than any other single factor, constrained water supply development in terms of quality of service and coverage. Also, it is their reluctance to consider funding development directly from tariffs that has, as a matter of policy, further constrained development.

Tariff Levels

Tariff levels should be tied to meeting objectives, and two of those objectives should be connecting the urban poor to piped water and providing 24-hour potable piped water in the home to all. The average domestic tariff in Asian water utilities is \$0.05–0.15/m³, but this is a long way short of meeting the stated objectives. Domestic tariff levels are so low in South Asian countries (\$0.01–0.05/m³) that there is no possibility of achieving price elasticity of demand (see Figure 11.2 and Box 11.2). The tariffs in Jakarta and Manila were less in 2001 than in 1995–1996. European urban water supply tariffs are generally \$1.20–1.80/m³. While Singapore's tariff is about \$1/m³, the average domestic tariff in Asia is about \$0.20/m³. This tells us something.

[12] *Second Water Utilities Data Book—Asian and Pacific Region* (McIntosh and Yniguez, 1997).

Figure 11.1 Ratio of Potential to Actual Revenue from Water Services (2001)
[based on a 5% of household income affordability ceiling
for households earning less than $5,000 per annum]

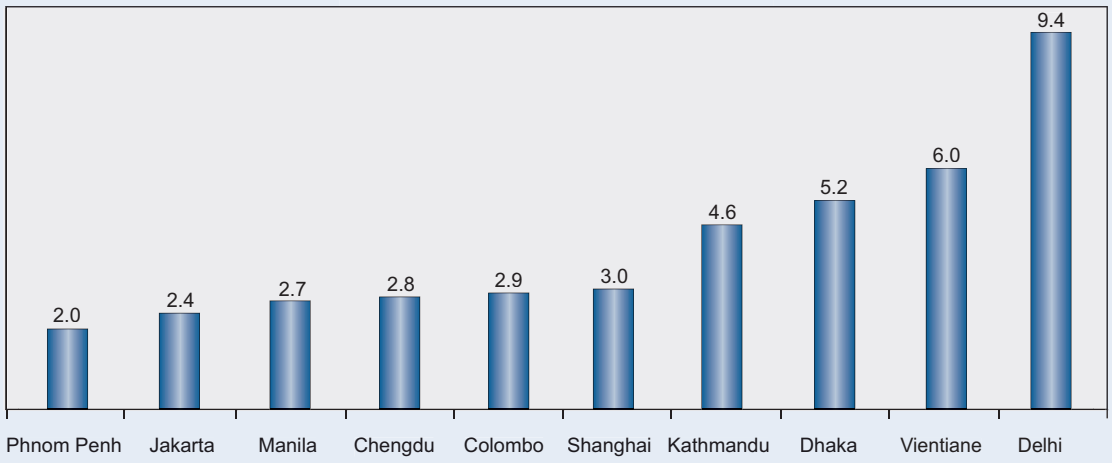
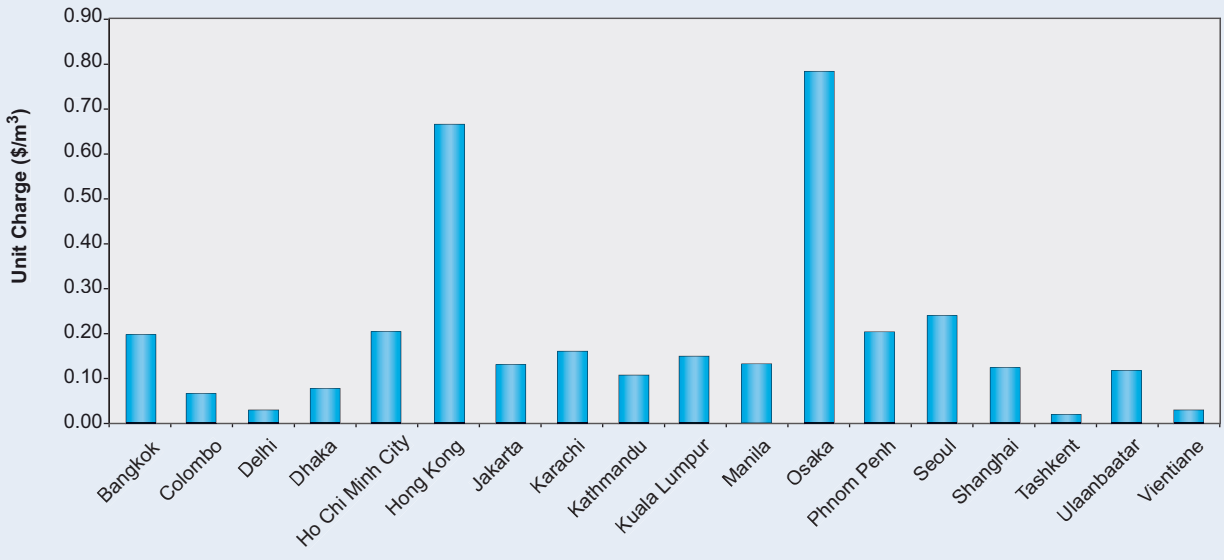


Figure 11.2 Typical Domestic Piped Water Unit Charges (2001)
[based on a consumption of 20 m^3 per month]



Box 11.2 Asian Development Bank's *Second Water Utilities Data Book—Asian and Pacific Region* (1997) Analysis[a]

Average Domestic Tariff (Strong) cents/m³

Malé, 437.0; Hong Kong, 56.0; Cebu, 52.4; Singapore, 47.0; Jakarta, 40.6; Taipei, 39.0; Chonburi, 37.0; Bandung, 29.0; Ulsan, 26.7; Kuala Lumpur, 25.4; Bangkok, 24.7; Chiang Mai, 24.3; Davao, 24.2; Johor Bahru, 24.0; Suva, 23.6; Manila, 22.0.

Average Domestic Tariff (Weak) cents/m³

Almaty, 1.2; Mumbai, 1.4; Bishkek, 1.8; Faisalabad, 2.5; Tashkent, 3.2; Delhi, 3.4; Tianjin, 3.6; Beijing, 3.7; Thimpu, 4.2; Calcutta, 4.8; Ulaanbaatar, 4.8; Colombo, 4.9; Shanghai, 5.7; Hanoi, 5.9; Dhaka, 8.0; Chittagong, 8.7.

Annual Revenues ($ Million)

Seoul, 335; Hong Kong, 327; Bangkok, 272; Singapore, 259; Taipei, 211; Jakarta, 101; Manila, 100; Shanghai, 98; Karachi, 73; Mumbai, 45; Johor Bahru, 42; Kuala Lumpur, 39; Ho Chi Minh City, 22; Colombo, 17; Dhaka, 13; Kathmandu, 3; Ulaanbaatar, 3; Calcutta, 2; Phnom Penh, 2; Vientiane, 2; Malé, 2; Faisalabad, 1.

[a] 1995–1996 data.

Tariff Structures

Graphs derived from the *Second Water Utilities Data Book—Asian and Pacific Region* (Figure 11.3a and Figure 11.3b) show the types of tariff structures typically used by Asian city utilities. The most obvious conclusion is that the lifeline rate is far too broad, offering extensive subsidies to the rich. Also, demand management through penalty rates for excessive use is ineffective to a large extent. This is the case for two reasons: (i) the tariff rate is too low; and (ii) the penalty rate occurs only after high volumes have been used. Much has been said about the failure of the block tariff[13] system to benefit the poor. Most of the poor, however, are not even connected to distribution systems. And when one connection serves multiple households, as is common among the poor, the tariff is normally applied at the penalty rate for high consumption.

[13] A block tariff is one in which the tariff varies for different consumption ranges. It is normally an ascending tariff (for example, 0–10 m³ at $0.10/m³, 10–20 m³ at $0.20/m³, etc.).

Block Tariffs

Although most developing countries readily accept block tariffs, there has been some opposition to these from economists for the reasons cited above (Whittington, 1992). In this age of computerization, however, it should not be difficult to make allowances for individual families with special conditions and allow their use of water at the lower lifeline rate. There is a need to consider that the range of household income in a city like Manila can be as wide as 1:100 (or, in other words, from $500 per annum to $50,000 per annum). In a city like this, a flat rate tariff may be too high for some and too low for others. The best block tariff system might be a three-block system with the lifeline consumption rate at 0–6 m³ (tariff limited to 5% of household income for the lowest 10th percentile), consumption of 6–20 m³ charged at a rate to recover all financial costs, and consumption of more than 20 m³ charged at a penalty rate equal to about $1/m³ (to conserve water). It has also been noted that rising block tariffs is an ineffective means of targeting subsidies, because the income elasticity of household water demand is low. This is true, but it is obvious that when there is no elasticity of demand the general level of tariffs is too low. Care should be taken with the tariff structure in the width and price of the block.

Tariffs and the Urban Poor

The poor are better served by gaining access to piped water than by continuing global subsidies. Subsidy mechanisms targeted at the poorest households can be designed, and these policies can be energetically publicized. This worked in Chile. We know from Manila that most of the poor who are not connected,

One objective—to eliminate this

Figure 11.3a Tariff Structures in South Asia (*ADB Second Water Utilities Data Book*, 1997)

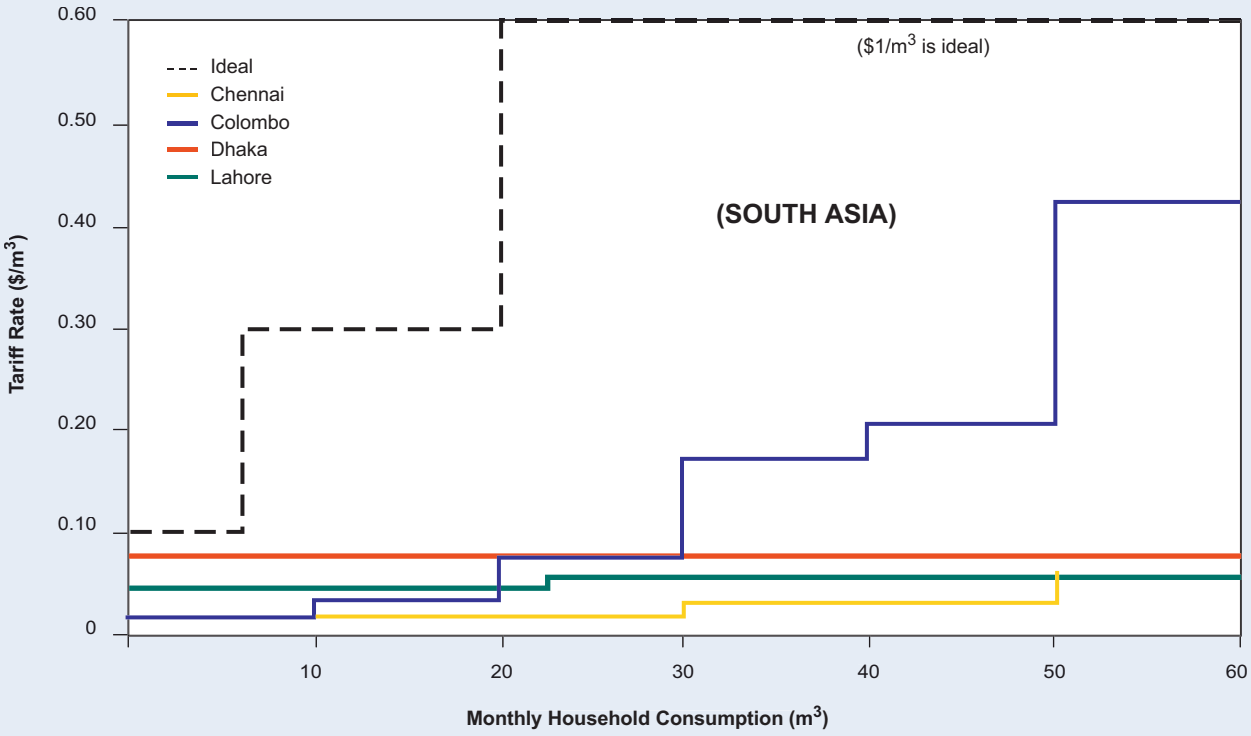
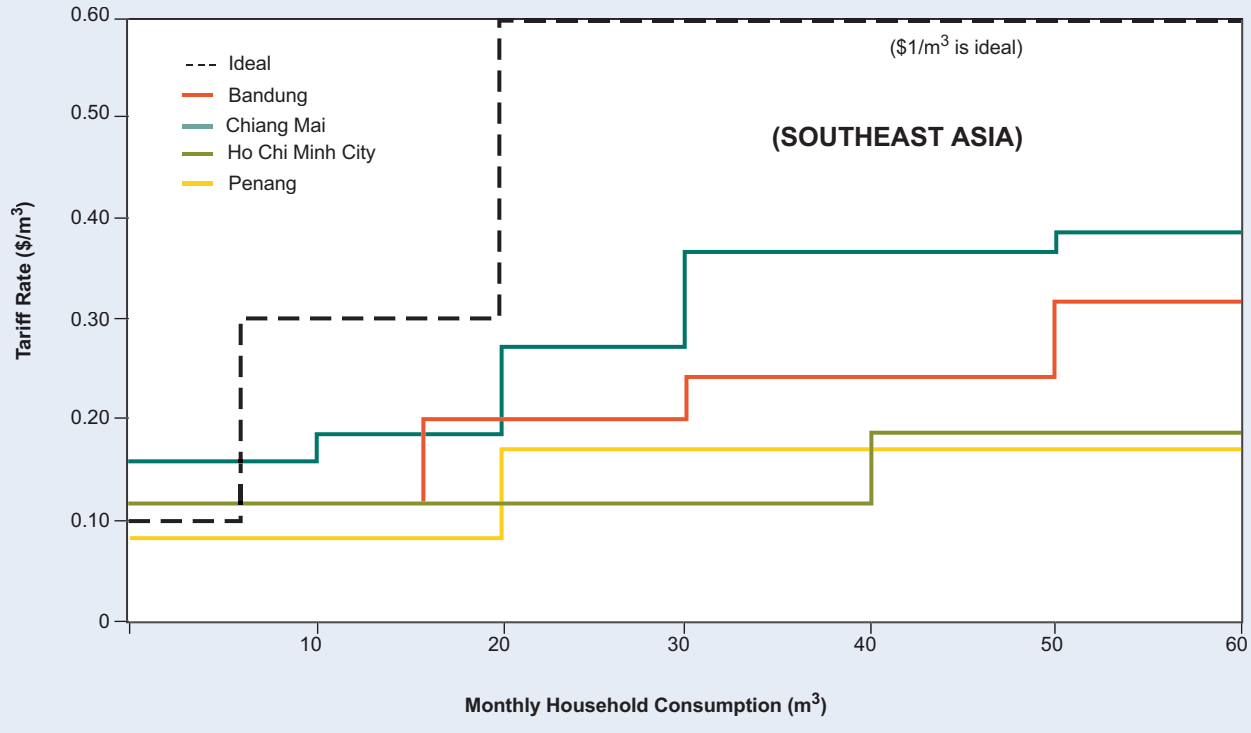


Figure 11.3b Tariff Structures in Southeast Asia (*ADB Second Water Utilities Data Book*, 1997)



who pay up to 1,000 pesos per month to water vendors, would be very happy to pay 300 pesos per month for piped water. Box 11.3 shows that there is plenty of room for financing from tariffs.

In the case of the intermittent standpipe water supply services that are common in South Asia, the poor can have 24-hour direct access to piped water. This can happen if tariffs are raised equitably throughout society, with a ceiling of 5% of household income as the upper limit of affordability. For those already connected, there are considerable savings in terms of water treatment and pumping and storage costs once water is supplied on a 24-hour basis. As an interim measure, those receiving a 24-hour water supply should pay a much higher tariff than those receiving an intermittent water supply. Going from an intermittent to a 24-hour water supply, however, will only be possible when a water utility has full autonomy and is free from political interference, especially regarding pressure for new connections in a system that is hydraulically inadequate.

Box 11.3 The Hidden Economy

In developing countries, households cope with unreliable water supply by building in-house storage tanks, installing booster pumps, and sinking wells. The size of this informal and often hidden water economy dwarfs that of the visible water economy. In a city in an African country, for example, water vendors collect 10 times the revenue collected by the formal utility. The existence of this hidden economy shows that there is a high demand for service that is not being met by the formal sector. While the informal sector provides some services efficiently, the costs related to other services (such as water vending in the urban periphery) can be excessive. The reason for this is tied to the inability of these providers to transmit water by pipe, instead of by person or vehicle. A profound implication is clear: there is an enormous reservoir of resources that can be drawn on at reduced costs for all. This can happen when the formal sector begins to meet consumer demand and provide services in a responsive and accountable way. The bulk of financing, which is needed for improved service, can and should come from users. But this can only happen when supply and demand side factors have been considered. On the supply side, the focus must be on facilitating the provision of responsive and accountable service at least cost, which can be done through developing institutional arrangements. On the demand side, it is important to concentrate efforts on providing the services that people want and are willing to pay for. (Seregeldin, 1994)

Affordability

Some 20 years ago, a figure of 5% of household income was arbitrarily set as a realistic ceiling on affordability for water supply and sanitation services. It was felt that nearly all people in developing countries could pay this amount. Today, this is still a reasonable benchmark. We can, of course, see examples of those not connected to piped water paying up to 20% of household income for water purchased from vendors. That is not a measure of affordability, but rather a measure of willingness to pay where there are few options. However, we rarely see (with the possible exception of Malé) anyone connected to a piped supply paying over 5% of their household income for water. Why? Because they have the ability to adjust their consumption level to fit their income. Box 11.4 shows why an average domestic tariff of $0.40/m^3 is affordable in any large Asian city.

Profiling Household Income

To get a good appreciation of the theoretical potential revenue in an urban area, it would be very useful for the utility to profile the full range of household

Box 11.4 Tariff Affordability

First, assume there is a population of 1 million, with five persons per household and a 5% of household income ceiling. Next, assume that consumption of 0–10 m^3 is billed at 20 cents/m^3, consumption of 10–20 m^3 is billed at 40 cents/m^3, and consumption of more than 20 m^3 is billed at $1/m^3. Last, assume 200,000 people (40,000 homes) have an annual income of $500 and use 10 m^3 per month, 600,000 people (120,000 homes) have an annual income of $1,000 and use 20 m^3 per month, and 200,000 people (40,000 homes) have an annual income of $5,000 and use 40 m^3 per month. This would result in a revenue total of $22,080,000; a total consumption of 52,800,000 m^3, and an average tariff of 41.8 cents/m^3.

income in that whole urban area. A typical profile would give a series of annual income ranges and the percentage of households in each category, for example $0–500 (60%), $501–1,000 (20%), $1,001–2,000 (10%), $2,001–4,000 (5%), $4,001–8,000 (3%), and greater than $8,000 (2%). This information could then be used to structure tariff charges, assuming a ceiling on affordability of 5% of household income. Of course, we should not forget that willingness to pay will depend on (i) household income, (ii) tariff, and (iii) alternative water supplies.

Willingness to Pay

It has been said that the people in Asian cities have a willingness to pay for water but governments do not have a willingness to charge (United Nations Development Programme 1991b). An example of willingness to pay for piped water comes from Malé ($5/m³). Willingness to pay depends on the tariff, the household income, and the volume consumed. But most of all it depends on the option of the consumers to use alternative sources, such as dug wells or handpump-operated tubewells. This is the main reason why ADB and World Bank postevaluation findings on water supply projects conclude that demand is invariably overestimated.

Connection Fee

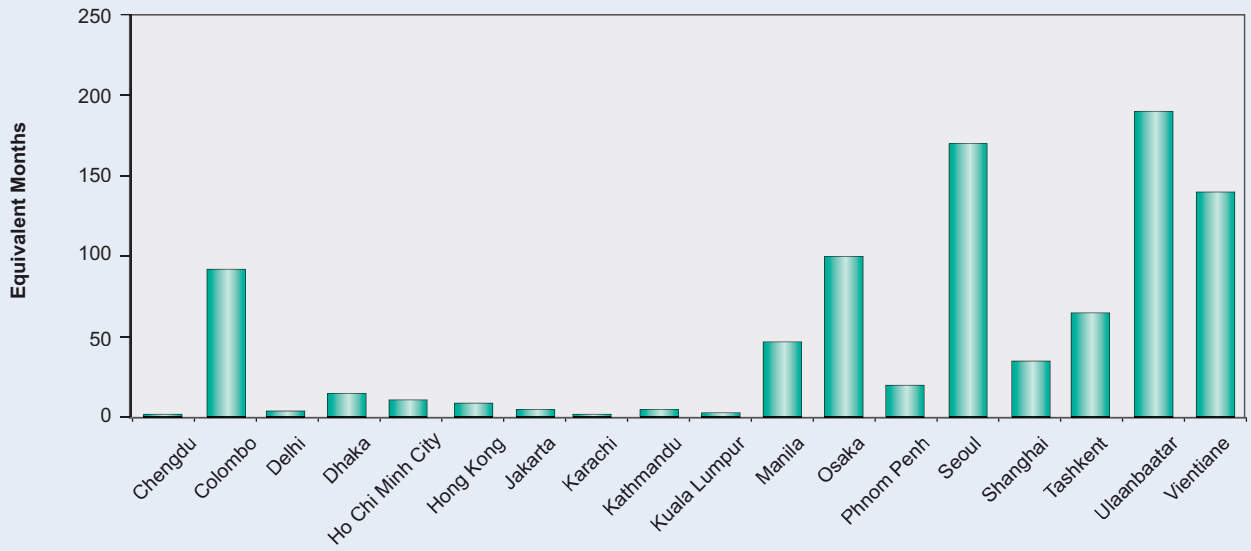
One reason so many of the urban poor are not connected to piped water is that the advance payment of the connection fee is too high (often over $100). Perhaps it has been kept artificially high because potential (rich) consumers have an incentive to approach moonlighting utility staff and ask for the installation of illegal connections. Perhaps it has been kept artificially high so that water can continue to be "informally" sold by utility staff to water vendors. Regardless of the reason, connection fees are so high in some places (Kathmandu is one example) that despite receiving no water consumers continue to pay a minimum charge every month rather than get disconnected (see Figure 11.4).

There is no doubt that this has been a barrier in the past to the urban poor getting connected to piped water from existing systems. It is certainly feasible to allow connection fees to be paid over a period of years by bundling them with tariffs. There is for that reason no need for households to seek microcredit finance to pay these fees. If bundling starts as a matter of policy, it can be implemented without hurting the operator. For new systems, there is no reason why connection costs cannot be included under development loans.

20 pesos a day for clean water

High connection fees keep the poor from being served

Figure 11.4 Connection Fee—Equivalent Months of Typical Tariff
(based on typical consumption of 20 m³ per month)



Private Sector Participation and Tariffs

It is unfortunate that the private sector gets the blame for high tariffs. Much higher tariffs are needed anyway, and if tariffs are increased before "privatization" there would be many more private operators interested in bidding.

Ten years ago, the push for PSP in water supplies of developing countries was spearheaded by the belief that the private sector would bring much needed monies to the table. For a while this happened, and it resulted in the construction of many BOT projects for production and treatment facilities. Malaysia was one of the countries embracing this approach. It was later acknowledged that unsolicited bids, "take or pay" contracts, and dealing with only one component of a water supply system (the easiest) left many problems unresolved. What we now see is very little funding coming from the private sector for concession contracts, despite contractual obligations to expand services. The primary reason for this is low tariffs. In other words, the main problem is still unresolved.

Tariffs and Decentralization

Tariffs are mostly controlled by elected officials holding central government offices. This goes against the principle of managing water at its lowest practicable level. It also prevents true devolution of power to local governments. However, as has happened in Sri Lanka, even when local governments are given the power to run their own water supplies, they find ways to hand systems back to national authorities when it comes time to increase tariffs, and in that way avoid making that unpleasant decision themselves. Later, they often ask for the systems to be returned.

Tariffs and Regulation

Tariff systems cannot exist in isolation. They need to be based on transparent policies that are kept in the public eye. Regulators need to see that policies are implemented as intended. When operators believe tariff increases are necessary, they should make specific references to policies in justifying the tariff increases requested. Regulators then must review requests before approving them, to see if they are needed and that they comply with policies. The intent of policies, such as providing sufficient capital to connect more urban poor, should be paramount. Everyone involved needs to be aware of and educated about tariffs and how the monies from tariffs will be used. It would be healthy for regulators to promote consumer societies. The objectives of the operators, in terms of performance, also need to be agreed upon and monitored by the regulators.

Tariffs and Civil Society

If governments are to change their policies on tariffs, they need the strong support of development agencies and civil society. Central to the debate is agreeing on what the long-term solutions should be and how to effect these. Resistance to tariff increases in the past has come from elected officials. One reason some elected officials do not want to increase tariffs is that the money trail runs through governments, and eliminating subsidies through higher tariffs means that it would not. So the issue here is governance. Three changes are needed: first, transparent policies that include funding investments from tariffs must be developed. Second, independent regulatory bodies to monitor the implementation of those policies must be formed. Third, organization development that includes a step away from civil servant rules and civil servant salaries for commercial operations and remuneration based on the market and accountability and incentives for performance must be implemented. These changes must come about through civil society pressure. Governments will not voluntarily reform themselves.

How to Increase Tariffs

There are a couple of golden rules here that can help assuage the complaints of consumers. First, once goals have been set, tariffs may be increased gradually every month until the goals are reached. This was done once in Manila, when tariffs were doubled over a period of about 15 months, and almost no one appeared to complain. The second rule is to make sure that service improvements, in terms of 24-hour coverage or reduced NRW, parallel tariff increases. Public education and awareness are very important. Today, with the Internet, it is possible to keep many consumers informed of such matters as tariffs. And those without access to the Internet can be informed through radios, televisions, and newspapers. When this happens, the consumer will be more in control. Civil society (NGOs, journalists, and academics) has a role to play. Public relations consultants can also be employed to get the story on tariffs across to consumers. Once major capital investments have been made, and city populations begin to stabilize, it should then be possible to stabilize tariff levels, apart from annual adjustments for the consumer price index. Utilities must be given the right to implement automatic adjustments based on increases in wages or power costs. Utilities should also develop good graphical presentations of past versus future tariff adjustments in relation to the implementation of policies. A cash-needs accounting method can be effective in showing the public where tariffs went or will go (for example, rehabilitation, new works, debt service, interest payments, etc.).

Tariff Management

A dynamic situation is created when tariffs are at a level to induce demand management. This needs careful monitoring to see the effect of tariff adjustment on consumption levels for all types of consumers. In Sri Lanka, for example, very high nondomestic tariffs have forced some businesses to drill their own wells. Such information can then be used to fine-tune the tariff structure to more accurately achieve policy objectives. Monitoring the effects of tariff adjustments is so important that one person could be given this job as a full-time task, and this person's findings should be documented so that others can learn from the experience. Utilities need all the information they can get about consumers and nonconsumers in service areas. With modern computerization it is much easier to collect, for analysis and management, information on consumers. An audit of computerized accounts can show whether or not systems are being properly managed. Analysis of annual information can, for example, reveal that there was a 10% increase in connections but only a 2% increase in revenue. This would need further investigation. Also, care should be taken in the accounting process to record the bulk supply of water to estates.

B. Subsidies

Where there are very high subsidies, the money trail runs through governments, which can be inefficient or even suffer from corruption. This is a major reason for long implementation delays due to procurement issues related to development projects.

In Manila, the urban poor not being served have a monthly water bill up to five times that of those connected to piped water. They buy water from vendors but can only afford one fifth of the volume that those connected to piped water consume. Thus their effective unit price for water (which is also often of inferior quality) is 25 times that paid by those connected to piped water.

The following were some findings of the World Bank in India (2001).

- *Residential and commercial consumers are willing to purchase water from tankers at 50 times the price that households are charged.*
- *Commercial and industrial consumers took 10% of the water but provided 80% of the revenues. Tariffs*

An emergency every day

for commercial and industrial consumers ranged from 7 to 38 times the domestic tariff.

The Water and Sanitation Program's Survey (2001) on Tariffs and Subsidies from 260 Cities and Towns in India revealed the following.

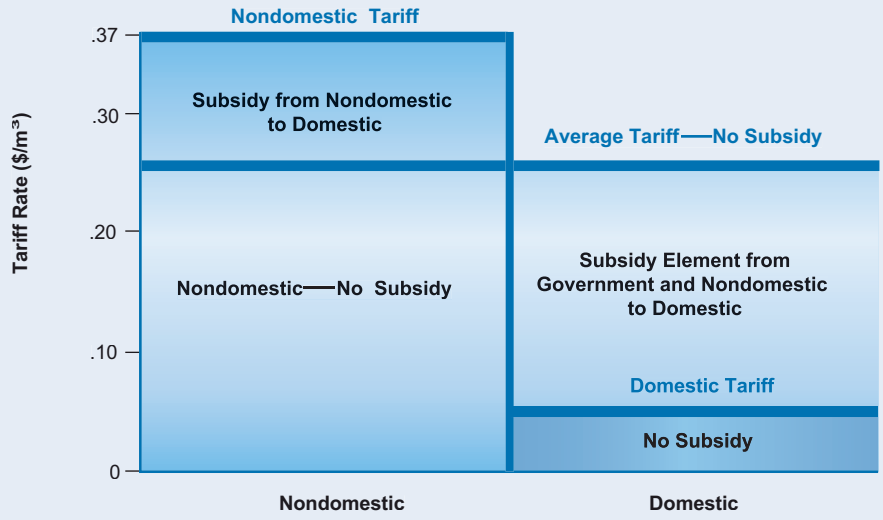
- *45% use water charges, 17% use a water tax, and 38% use a combination of the two to fund water and sanitation services.*
- *17% use only metered connections and 38% use a combination of metered and unmetered connections. The rest are unmetered. Many metered connections are not working.*
- *There are two types of tariffs for metered connections, a flat rate and an increasing block tariff. The former is much more prevalent.*
- *The tariff for unmetered connections is based on either a simple fixed rate per month per household, a rate based on the diameter of the water pipe, or a rate based on the number of taps per house.*

We can justify subsidies if they have a specific purpose, such as targeting the poor. But they must be transparent and there must be a time-bound plan to phase them out. We need to analyze subsidies to see who benefits. It is today quite common to see a large lifeline rate for those served with piped water that benefits most of those connected, but there are still millions of poor consumers who are not yet connected and pay vendors very high prices to get water. More recently, such as in Chile, there have been attempts to directly subsidize the poor. Complete socioeconomic surveys of households determine those eligible for benefits, including water subsidies. Such families pay the utility only a reduced tariff, and the balance of the cost of water is recovered by the utility directly from the municipality through the use of a fully computerized database. This is known as an output-based subsidy (see Box 6.5).

Sewerage is normally charged as a percentage of the water bill sufficient to cover O&M costs of that service, but not capital costs. Thus there are normally grants to utilities for sewerage investments. These need to be phased out over time.

Cross subsidies include those from large users to small users, industrial users to domestic users, and large cities to small towns. These are, however, normally only apparent subsidies, because in reality, the large city, the large domestic consumer, and the industrial consumer nearly always receive some subsidy (although small) from the central government, represented by the grant or soft loan element in capital

Figure 11.5 Subsidies—Greater Colombo



financing, risk taking on foreign exchange, etc. In Colombo, at one time, industrial water tariffs were 13 times domestic water tariffs. Even now, they are as high as 7:1 (see Figure11.5). This distorts development. More generally, in Asia, the figure is around 2:1. In Tokyo and Singapore domestic tariffs are now the same as industrial tariffs. Note, however, that household income is somewhat more uniform in these cities than in cities like Colombo or Manila.

An example of the distortion of subsidies is provided from the current tariff in Cebu. Since everyone must pay the $2 service charge, the effective tariff for the poor, who may use only 6 m^3 per month is $0.60/$m^3$, while the rich, who use 30 m^3 per month, pay an effective tariff of $0.36/$m^3$.

National tariffs help increase coverage with water by spreading investment costs, but they are not good for the sustainability of individual schemes. Every water supply scheme must be able to at least meet its O&M costs from its own tariffs. In the long term, schemes should become self-sustaining.

Removing subsidies on urban water use can have dramatic effects. An increase in the water tariff in Bogor (Indonesia) from $0.15/$m^3$ to $0.42/$m^3$ resulted in a 30% decrease in household water demand. Increased water tariffs induced a 50% reduction in water use over 5 years in a fertilization factory in Goa (India).

When a government gives a grant to a major urban water utility, it is in effect the people who pay taxes in the country who are contributing, but only the few who are in the city are the beneficiaries. It could also be said that this is a form of the poor (in rural areas) cross-subsidizing the rich (in urban areas). This is particularly so for sewerage development.

Governments also need to show, in a transparent manner, what effective financial subsidies are provided to farmers for irrigation when they compete with domestic water supplies in the development and use of water.

C. Funding Development

The Funding Mind-set

A policy briefing paper on financing water and sanitation recently prepared by an international NGO identified the potential solutions to meet the financing gap in water and sanitation as (i) increasing bilateral aid flows, (ii) international PSP, (iii) reallocating public sector resources, (iv) debt relief, (v) recognizing household and community contributions, and (vi) global potential for innovative mechanisms (trading water rights, debt swaps, and water bonds). Recognition of household and community contributions through tariff increases represents perhaps the greatest potential solution of all.

Self-Funding

There is evidence that internal cash generation, used to finance water supply and sanitation in developing countries, has declined. World Bank figures indicate that it went from 34% in 1988 to 10% in 1991, and by 1998 it was only 8%. This is a sad indication of the development of sustainable water supplies, as one would expect that the figures would be increasing each year in line with an exit strategy for funding assistance. Figure 11.6 shows the proportion of total O&M plus capital expenditure covered by tariff revenue in Asian cities.

Funding Operation and Maintenance

Most utilities do not have a very clear definition of what comprises O&M. Therefore, governments often fund maintenance work, such as replacing water meters and vehicles, under capital works programs. Indeed, whenever public enterprise utilities fail to meet their obligations from tariffs, governments are all too ready to bail them out.

Amount of Funding

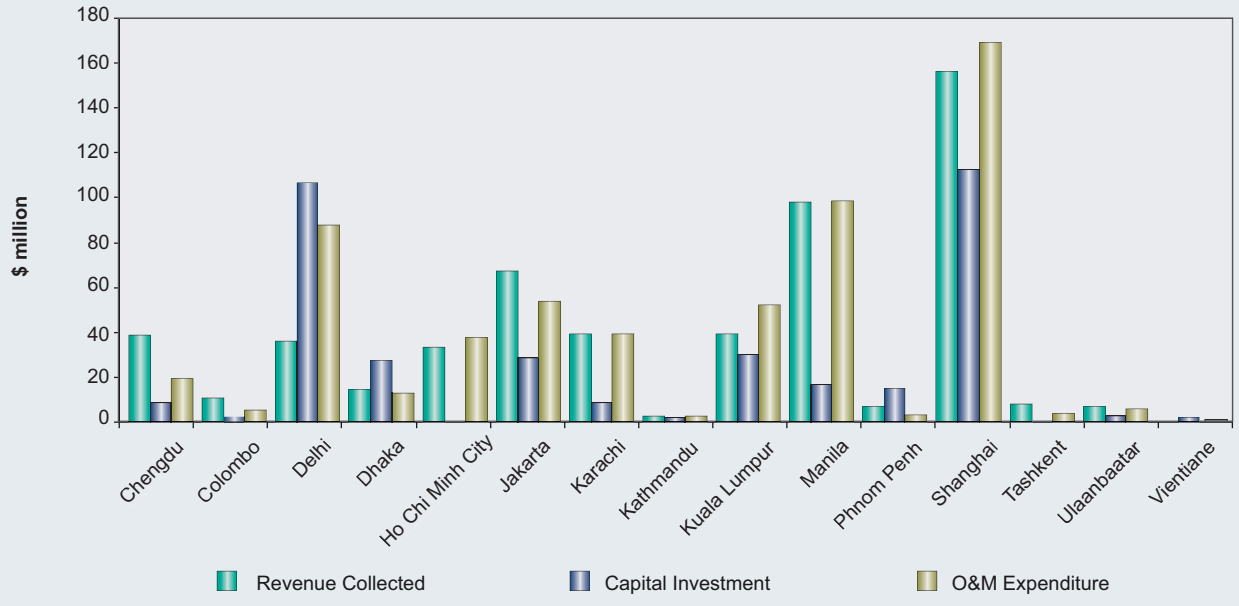
It is generally recognized that there has been inadequate funding of water supply development in urban areas of Asia to keep pace with the rapid trends in urbanization. Large portions of the population are not served with piped water. A very large number of South Asia's people rely on standpipe supplies and receive very poor intermittent water supply service. This is evidence that there is inadequate funding of development.

What is the reason for this inadequate funding? It has been realized for at least 10 years that governments and bilateral and multilateral funding agencies do not have sufficient capital to make much difference if they continue to allocate only 5% of their development budgets to water supply and sanitation. So, one issue is prioritization of the sector. It was once said that the private sector would be able to bridge the development funding gap, but recent evidence suggests that this is not so. The pace of development needs far outstrips private sector involvement, not to mention contributions. Furthermore, tariff increases under private sector contracts are constrained by these contracts, rather than guided by policies.

Sources of Funding

The sources of funding depend on the performance of utilities and the economic conditions of developing countries. They also rely on government policies. Depending on the economic status of a developing country, the sources of funds are likely to vary between government and bilateral or multilateral funding institutions.

Figure 11.6 Annual Investments and Revenue Collection (2001)



Well-established utilities, like the Metropolitan Waterworks Authority in Bangkok, have in the past been able to access domestic money markets through bond issues. Major utilities, like the Metropolitan Waterworks and Sewerage System in Manila, were able to borrow money directly from institutions like ADB. Where concession or BOT contracts are under way, the private sector may provide funding, but depending on the contract it may (like in Manila) not be timely.

The main source of funding for urban water supplies should be tariffs. Secondary sources may include central and local government loans, and private sector capital. Once a utility has established a good reputation, it may also use public bond issues to fund development. Consideration might be given to writing off all debt owed by a utility to the national government, if the utility opts to fund all future development itself directly from tariffs. In the long term, neither development agencies nor governments should be funding major urban water supply development. For this to be the case, an exit strategy is required.

Terms of Funding

Many major utilities continue to receive much of their funding in the form of grants. For example, development agencies extend loans and grants (on a 50–50 basis) to the National Water Supply and Drainage Board in Sri Lanka to finance the Greater Colombo Water Supply Project. But if development funding is from governments directly, all the money is passed on in grant form. Tariff revisions then fail to be made on time and adequately, and debt servicing is often forgiven by governments (the Nepal Water Supply Corporation is an example). Government policies, therefore, are not always followed. When funding is sourced from an international funding institution, loan covenants will apply. ADB has in the past had soft loans with long grace periods, long repayment periods (40 years), and low interest rates (equivalent to about 1% per annum). The eligible countries for these loans affecting the water supply sector were the least-developed countries. ADB also had loans from its ordinary capital resources with shorter repayment periods (20 years) and higher interest rates (around 6–7% per annum). These loans were for more developed countries and large countries like the PRC and India.

Funding Investment from Tariffs

The main solution to the shortage of financing for urban water supply infrastructure lies in a policy reform that dictates that most, if not all, financing for investments must come directly from increased tariffs. In general, this will mean raising the average tariff from the range of $0.05–0.10/m^3 to $0.40–0.50/m^3. The example of Greater Colombo (see the Greater Colombo case study in Appendix 2) shows that this is eminently affordable (less than 5% of household income). Such tariff increases may be made incrementally (a little every month) until the target is met and must be accompanied by improvements in service, such as increasing the number of people with access to a 24-hour supply. The PRC is already implementing this policy through the Harbin Water Supply Project. A $70 million investment is provided directly from tariffs (see Box 11.5). In a practical sense, governments would be advised to set such policy objectives as 5- or 10-year goals.

Funding Priorities

If major urban entities can fund all or nearly all their investments directly from tariffs, government and development agency funds can concentrate more on rural and small town water supplies and on sanitation. What makes this solution reasonable is that there has not been any other viable solution put on the table by development partners or governments that would have the same impact. Nevertheless, we should remember that integrated development reforms are needed. So, organizational development and the extension of real

Box 11.5 People's Republic of China Water Tariff Study

The tariff study approved by ADB in 1997 assisted the Government in preparing the first ever *National Guidelines on Water Tariffs*, which was promulgated in September 1998. Major features included (i) selecting a tariff structure based on local conditions and priorities, (ii) considering a two-part tariff with a volumetric and fixed demand charge, (iii) adopting full cost recovery as the main objective in setting and approving tariffs, and (iv) adopting a simplified process for tariff regulation requiring evaluation and approval at the local level, which was supported by review and monitoring at the provincial and national levels. The *National Guidelines on Water Tariffs* is expected to improve the long-term financial viability of water supply companies, provide for O&M and service expansion, and increase PSP in the water sector.

autonomy to the water utilities, which are products of policy and regulatory reform, must accompany tariff reform, too. Funding should also be provided for watershed rehabilitation. This is long-term thinking, but very necessary for sustainable sources. Rainwater harvesting, wastewater recycling, and trading water rights should also receive funding when tariffs are raised.

Conclusion

The problem in funding the development of water supplies is the dual government policy of not committing more than 5% of annual development budgets to the water supply and sanitation sector and not allowing tariffs to increase to help fund development. It is this dual government policy that has constrained water supply development in many Asian countries. Even policies of funding development through "privatization" have been hamstrung by tariff issues. What is more relevant is that there are no exit strategies for development agencies and governments funding major urban water supplies.

The most important reason for increasing tariffs is to implement government policies, especially those parts that prioritize connecting the urban poor to piped water. The next most important reason is the matter of governance, since improvements in this will put the consumer more in control (the one who pays the piper calls the tune). After tariffs are increased, water will be recognized as primarily an economic good. Higher tariffs will reduce excessive consumption and waste. These reductions will focus attention on reducing NRW (leaks, illegal connections, and metering problems). These savings in water can help eliminate intermittent water supply and will allow other sources of water to be developed, such as rainwater harvesting, trading water rights, wet season storage, recycling wastewater, and watershed rehabilitation. When Asia gets ahead of the game with investments in water, it will spur economic growth in general. Macau,[14] in the1990s, was a good example of this. In Box 11.6, Peter Rogers summarizes why it is necessary to increase the price paid for water.

Box 11.6 Water in the 21st Century, "The Looming Crisis Averted"

- *Increased price reduces demand, substitutes become cheaper, conservation becomes affordable, and it changes consumption preference.*
- *Increased price increases supply, marginal projects become affordable, and economic incentives are provided to reduce water losses.*
- *Increased price facilitates reallocation between sectors, from irrigation to domestic and industrial and from off-stream to in-stream uses.*
- *Increased price improves managerial efficiency, due to increased revenues that improve maintenance, improve staff training and education, and make modern monitoring techniques and modern management techniques affordable.*
- *Increased price reduces the per unit cost of water to poor people, extending piped supply, which reduces the reliance of the poor on water vendors and makes water available to tail enders in irrigation systems.*
- *Increased price leads to sustainability, as it reduces demands on the resource base, reduces pollution loads (due to recycled industrial water), and makes more water available for ecosystems.* (Rogers, 2001)

[14] Macau has one of the best examples of "privatization" of water services in the Asian region.

Tariffs, Subsidies, and Development Funding (Problems) in a Nutshell

- Tariffs are too low in most parts of Asia to influence demand.
- Tariff structures are also to blame for subsidies going to the rich and inadequate demand management.
- Major tariff reform is needed before PSP makes sense.
- The poor are able and willing to pay, but many governments are unwilling to charge.
- High subsidies equate to low governance.
- Tariff covenants do not work.
- Tariff policy is invariably ignored.
- The poor often pay about 25 times the unit rate (for water) paid by the rich, because the poor are not connected to a piped supply.
- Low tariffs perpetuate the status quo, where the hidden economy of water vending is tapped.

Tariffs, Subsidies, and Development Funding (Solutions) in a Nutshell

- Tariffs begin with policy—analyze subsidies.
- Tariff reform is a manifestation of good governance—fewer subsidies.
- Alter the money source from governments to consumers.
- Those connected must pay more so that those not connected can get piped water.
- No question of affordability—the hidden economy proves this.
- Block tariff structures are best when income profile varies greatly.
- Fund investment directly from tariffs—the PRC is doing this now.
- Connection fees can be absorbed by tariffs.
- Tariff reform is needed to encourage PSP.
- Higher tariffs make good things happen in terms of water development options.

Chapter 12

Private Sector Participation

For the last 10 years, PSP in water supplies has been a hot topic. There was a little "pull" from governments and a lot of "push" from development agencies and the private sector toward PSP, which was spearheaded by half a dozen French and British companies. This chapter looks at the progress made in Asia against the main reasons for PSP, and it looks at the future of PSP in Asia through several different eyes to get some perspective on the subject. The Malé and Manila case studies in Appendix 2 give a more in-depth look at two examples of PSP.

ADB's water policy notes that private sector initiatives and market-oriented behavior are expected to improve performance and efficiency, particularly in service delivery. ADB will seek to provide innovative financial packages to enable commercial lenders and promoters to manage the risks involved when investing in water and related projects. ADB will also develop modalities for public-private partnerships in managing physical infrastructure.

A. Promises and Realities

The advantages of PSP heralded in the 1990s included bringing greater efficiency to management, bringing investment monies to the table for development, and bringing autonomy of operations through legal contracts. Looking around the developing country scene in Asia, 10 years later, it can be perceived that the governments of these countries initially welcomed the BOT type of PSP, but soon became disillusioned with "take or pay" contracts, unsolicited bids, and the fact that these focused on production facilities when the real problems lay in distribution. Some governments—such as those in India, Pakistan, and Sri Lanka—were not prepared to accept long-term concession contracts dominated by foreign contractors for major city water supplies. Labor unions and activist NGOs have provided resistance to PSP. Disappointment about PSP may have been caused by expectations that were too high and wrong perceptions about what can be achieved in the short term. Unfortunately, the need for higher tariffs (which has little to do with PSP per se) has been used against the PSP process. Moreover, and just as unfortunately, regulation by contract became a noose around the necks of

Service in low-income areas (after the meter)

contractors and governments, as illustrated by the foreign currency exchange risk issue and demands for higher tariffs to compensate for the effects of the Asian financial crisis. Finally, neither regulation nor domestic PSP were offered as solutions by themselves. These might have been more appropriate steps in the development process. Only now are we beginning to see independent regulatory bodies being established in Asia (Nepal and Sri Lanka) and attempts at domestic PSP (Bangkok).

Examples of PSP in Asian Water Supplies

- **Bangkok:** Consultants proposed splitting the city into two concessions (like Jakarta and Manila). The Metropolitan Waterworks Authority rejected this and proposed instead that, like Thai Airways, the Government would retain a 51% shareholding and the rest of the stock would be offered to the public through the stock exchange. This will be effected in 2003.
- **Chengdu:** This BOT project, prepared under ADB financing, was designed to produce 400,000 m^3 per day on a “take or pay” basis. There were five bidders, and Vivendi with Marubeni was successful. Regulation is by contract. The contractor put in only about 30% of the financing. Meeting the terms of the “take or pay” arrangement is now difficult, because demand was overestimated.

- **Colombo:** The World Bank proposed a concession. The Government turned it down. The real issue was autonomy, as already provided for under legislation but not allowed in practice, because the Government averred that all public enterprises need to be similarly treated. Under ADB loan covenants a regulatory body is being established, and PSP is now being introduced through a BOT contract for water production.
- **Ho Chi Minh City:** Three BOT contracts for bulk supply of treated water were signed in 1995, 1997, and 1999. This is a "take or pay" deal, but there was a mismatch of production and distribution capacity, so the water company had to pay for water that could not be sold. One of the BOT operators is pulling out due to financial difficulties.
- **Jakarta:** Only 30% of the 10 million people in Jakarta are directly served with piped water. Concession contracts that split the city's water supply were negotiated directly with Suez Lyonnaise des Eaux and Thames Water in 1998. Originally the concessionaires were joined by local partners, but after the change in government the Indonesian partners relinquished their shareholdings. NGOs claim concessionaires are not investing their own money in capital works but are using instead the money collected from consumers. The legality and fairness of the contracts were questioned, which led to renegotiations. Both concessionaires have had to grapple with the consequences of the Asian financial crisis and low tariffs.
- **Karachi:** Leveraged by loans to the public sector, the World Bank (water supply) and ADB (sewerage) tried to introduce private sector concession contracts from 1996 to 1998. Due to major objections from NGOs and consumer groups, these failed to eventuate. Recently, NGOs have suggested that the sewerage component could be implemented for just $20 million, versus $100 million under the ADB proposal, by using gravity instead of a pumped design and local consultants, suppliers, and contractors.
- **Kathmandu:** Preparations for a management contract for the Kathmandu Valley Urban Water Supply and Sewerage began in 1996. It was a precondition for ADB support to the $464 million Melamchi Water Supply Project. The World Bank agreed to provide financial support to the PSP process in 1997. In mid-2002, the World Bank pulled out after two unsuccessful attempts to prequalify contractors ended with only one prequalified each time. ADB staff requested that joint ventures of water utilities from developed countries and international consultants with experience in developing countries be allowed to bid. ADB will now revisit the PSP and regulation processes.
- **Kuala Lumpur:** Syabus, a joint venture between the state government and private firms, has been chosen to produce, distribute, and sell water to consumers. The former Selangor Waterworks Department is expected to take over as regulator. The award to Syabus follows the federal Government's directive stating that companies that have been given the right to undertake the treatment of raw water must also be involved in water distribution. From mostly BOT projects in the early 1990s, government policy shifted to PSP in the whole system, from source to consumer.
- **Macau:** The city has about 500,000 people and 170,000 water supply connections. Although it was originally under the private sector around 100 years ago, the Macau Water Supply is regarded as one of the best examples of a water supply run by the private sector. The concessionaire is 85% owned by Sino-French Holdings Ltd., which comprises Lyonnaise des Eaux (50%) and New World Group (50%). Rapid development of the service in the late 1980s was seen as a major catalyst in spurring economic growth. Major achievements include reducing NRW from 48% to 11%, introducing European water quality standards, increasing connections from 55,500 in 1985 to 170,600 in 2000, and increasing production from 85,000 m^3 per day to 265,000 m^3 per day. The average tariff is now around $0.60/$m^3$. Recently, there have been some problems with the raw water source and upstream pollution in the PRC.
- **Manila:** Metro Manila has about 12 million people and service coverage with piped water is nominally about 60%. The PSP process was started in November 1995, and the two concession agreements were signed in February 1997. This was in and of itself a remarkable achievement for the largest ever water supply "privatization" in the world, and it was due to two factors—strong political will (of President Ramos) and managing the process of change (with about $8 million in support from International Finance Corporation). The concessions were bid on a low tariff and awarded to Benpres Holdings Corporation and Lyonnaise des Eaux for the west at 4.97 pesos/m^3 and to Ayala, Bechtel, and North West for the east at 2.32 pesos/m^3. The winning bids can be compared with the then Metropolitan Waterworks and Sewerage System average tariff of 8.78 pesos/m^3. Performance to date is mixed. The

east concession seems to have reduced NRW from about 65% to 57%. The west concession has not reduced NRW (now around 68%). By the end of 2001, only about 75,000 connections had been added. On 10 December 2002, the west concession sought to withdraw—citing failure to agree on new tariff rates and a moratorium (5 years) on the payment of the concession fee as factors in its decision to pull out.

Box 12.1 shows that PSP is of concern to many people all over the world. A major review of PSP in water supplies of developing countries is long overdue. While the results may not augur well for the policy, this study needs to be carried out, and preferably by an independent body of professional repute. Areas of evaluation could include NRW reduction, investment magnitude, staff training, asset mapping, metering, computerization, performance analysis, service to the urban poor, reselling water, and tariff constraints on investment. Box 12.2 summarizes some problems of PSP in the water sector.

Box 12.1 Private Sector Participation in Islamic Countries

Most Muslim scholars agree that a just price for water is that determined by the market, providing the market is free from unfair practices, such as collusion. Even if full privatization of the water sector is allowable in Islam, that does not mean it is desirable. Instead, as is generally the consensus in the rest of the world, where the private sector participates in providing water services, public-private partnerships are recommended where the government retains its "ownership" of water for the community and allows the private sector to deliver (withdraw, treat, and distribute) water and sewerage services but regulates the sector to ensure equitable access and also to ensure that quality standards are maintained. (Faruqui et al, 2001)

Box 12.2 Problems of Private Sector Participation in the Water Sector

- *The headlong rush toward private markets has failed to address some of the most important issues and concerns about water. Water has vital social, cultural, and ecological roles to play that cannot be protected by purely market forces.*
- *There is a need to provide for the basic water requirements of people and ecosystems, permit access to water for poor populations, include affected parties in decision making, and improve water use efficiency and productivity.*
- *Openness, transparency, and strong public regulatory oversight are fundamental requirements in any efforts to shift the public responsibility for providing clean water to private entities.*
- *The World Bank, other international aid agencies, and some water organizations like the World Water Council are increasingly pushing privatization in their efforts, but without a common set of guidelines and principles.*
- *The rapid pace of privatization in recent years and the inappropriate ways several projects have been implemented have compounded the worries of local communities, NGOs, and policy makers. As a result, private water companies are increasingly seeing serious and sustained public opposition to privatization proposals.*
- *Improvements in efficiency reduce water sales and hence may lower revenue. As a result, utilities or companies that provide utility services may have little or no incentive to encourage conservation.*
- *Efforts should be made to strengthen the ability of governments to meet water needs. Unfortunately the worst risks of privatization are also where governments are weakest.* (Gleick et al, 2002)

B. Investments

While investment monies did flow into the "take or pay" BOTs, they have not flowed as expected into the major concessions. In Manila, 5 years after "privatization," there are still 5 million urban poor without access to piped water. In Jakarta, 4 years after "privatization," there are about the same number without access to piped water. Elizabeth Brubaker, in a paper prepared in 1998, noted that *the French system is heavily subsidized. Both public and private operations receive subsidies from many levels of government and from one another. In other words, the privatization of the delivery of services has not led to the privatization of the financing of services.* In Jakarta, the leading NGO for consumers has become a watchdog monitoring the implementation of private contractor investment programs. Even where concessions are in place or planned, funding by development banks continues. When international private contractors do invest, they often seek funding from private sector windows of development banks. So, it must be concluded that PSP has not proved to be a panacea for the shortage of development funding in the water supply sector. Part of the reason for this lies with low tariffs that do not encourage operators to invest. Table 12.1 shows utility performance in Jakarta and Manila in 2001. The high NRW, low service coverage, and low capital expenditure levels should be noted.

In Malaysia, by 1996, 57 water treatment plants with a total capacity of 3.8 million m^3 per day had been placed in the hands of the private sector. Consumers now enjoy better service in terms of both reliability and quality of water without any substantial increase in tariffs. Nevertheless, the major problem in Malaysia's water sector, the high level of NRW, has not been addressed.

C. Efficiencies

NRW has not been greatly reduced under private sector management. In Jakarta, some consumers think that there is just as much corruption in illegal connections and meter reading as there was under the public water utility. According to some residents, these practices are so common among employees that only firing all staff and hiring new staff would likely resolve the issue. The two concessions in Jakarta have NRW of 48% and 53%. The two concessions in Manila have NRW of 66% and 57%, based on 2001 data. None of these figures are in any way respectable.

D. Competition

International competition for private sector contracts in water supplies has been severely restricted. Early attempts to increase private sector competition for the Kathmandu Valley Urban Water Supplies management and lease contract were resisted. BOTs were also in the early days fraught with much unsolicited bidding and direct negotiation.

Inexperienced organizations with no knowledge of the water industry may begin to make an appearance. These organizations may focus on short-term financial gains instead of on finding long-term solutions to the management and technical challenges resulting from the need to provide quality water and wastewater services to consumers. (Lyonnaise des Eaux, 1998)

Table 12.1 Utility Performance—PSP Concessions (2001)

Contract	Piped Water Coverage (%)[a]	Supply Continuity (%)	NRW (%)	Staff per 1,000 Connections	Ratio of Revenue to O&M Cost	Annual Capex[b] ($ millions)
Jakarta West	41	92	48	5.2	1.3	6.7
Jakarta East	51	92	53	5.5	1.2	7.6
Manila West	37	88	66	4.3	0.9	0.1
Manila East	34	88	57	4.5	1.1	16.8

[a] Based on household connections (five persons per connection).
[b] Capital expenditure.

E. Tariffs

It cannot be presumed that there will be any success with PSP in water supplies of developing countries until the problem of low tariffs is addressed. This can only be accomplished through government policies that encourage tariffs covering investments, not just O&M plus depreciation or debt servicing. Then independent regulatory bodies need to be in place and tasked with ensuring that utilities, on the one hand, and governments, on the other, adhere to these policies. Given that the consumer must pay for investments sooner or later, and given that private sector financing is generally the most expensive, it is quite possible that tariffs in the future can fund all water supply investments in cities with more than a million people.

F. Regulation and Contracts

One problem facing water utilities and governments of developing countries, in regard to PSP in water supplies, is the uneven playing field. The knowledge of contractors (one party to the contracts) is far greater than the knowledge of governments (the other party to the contracts). This knowledge disparity is exacerbated by the potential for corruption in making the "deal." Some senior level civil servants and elected officials may have a short shelf life and a tendency to “take and run,” leaving other civil servants and another administration to wrestle with the consequences of skewed negotiations. Transparency has also not been evident in deals. It is not normally possible for the public to review contracts signed between concessionaires and governments. Indeed, many legal contracts are so replete with confusing language that very few people can understand what has been written. The draft lease contract for the Kathmandu Valley Urban Water Supply was such an example.

G. Serving the Poor

The summary of problems and solutions in serving the urban poor by Lyonnaise de Eaux (see Box 6.1) illustrates that there are indeed many problems to be overcome, but that there is some reluctance on the part of the private sector to take much financial responsibility for the solutions. Perhaps this is because contracts were not based on policies to serve the urban poor. In Manila, one concessionaire has responded to serving the urban poor by selling water in bulk to a third party who connects the poor to a 24-hour supply of piped water. Unfortunately, the monthly cost to the consumer is four times the normal rate, and the volume consumed is one quarter of the normal consumption. Likewise, one connection is offered to multiple households, so these users are forced to pay a penalty for high consumption.

H. Risks

A major banker notes that the main risks that banks want to see addressed pertain to construction, revenue, operations, politics, and finance. Significant currency risk arises because customers pay in domestic currency, which does not match the currency of international debt and equity financing. It has also been observed that fewer projects have been successfully financed with private capital than in other infrastructure sectors, and projects financed with private capital have tended to involve direct financial or credit support from governments or third parties, such as bilateral, multilateral, and export credit agencies. When we consider risks, the guaranteed rate of return on concession contracts gives an impression that the main risk assumed by the contractor is one of cash flow. Likewise, on BOTs, contractors take negligible risks under the take or pay scenario. Risks for investors can also be reduced if PSP is considered for a pool of towns at one time, which allows risk sharing.

Difficulties of management in low-income areas

I. Future of Private Sector Participation

There is no doubt that the jury is still out after 10 years of PSP in the water sector. The following excerpts from different sources, however, may provide some guidance on the future directions of PSP.

1. Developing Best Practices for Promoting Private Sector Investment in Infrastructure and Water Supply (ADB, 2002)

The Reform Unit

Establishing a state-owned enterprise reform unit is an important first step toward water supply reform and the introduction of private sector investment in water supply. The unit should consist of a team of trained individuals with expertise in economics, management and finance, water supply, and negotiation.

Sector Reforms

There is a strong case for introducing wider sector reforms, such as commercialization and corporatization of water supply utilities, particularly if the introduction of PSP in water supply is to be a phased or staged process.

Tariff Reform

Tariff reforms are essential if the scarcity value of water and efficient use of water are to be achieved. If water tariffs fail to reflect the costs, householders, when deciding to use water, do not know the value of water in its alternative uses. The same is true for the irrigation farmer and the industrialist. Major river diversions for irrigation needs or hydro schemes will only make sense if nearly all potential water uses are factored into calculations. In some cases, closure of irrigation schemes and generous compensation of farmers may be attractive. This is because the new water released may permit industrial and residential expansion and the export of goods and services far more valuable than some grain foregone. As in other markets, appropriately set tariffs will operate as signals for efficient water consumption, production, and investment in water supply. Tariff reforms should be a precursor to PSP in the water supply sector. Without tariff reform, water supply investments will not be financially viable from the private sector lender's and investor's point of view. If private sector investment goes ahead without tariff reform, DMC governments will need to fund the difference between the lower water tariff paid by consumers and the higher payment made by DMC governments to the private sector. This situation is unlikely to be sustainable in the long term.

Risk Mitigation and Management

In general, risks should be allocated to the party that can minimize and manage risks most effectively. Where no party has a clear comparative advantage in managing risks, they should be shared. Careful identification, analysis, and ranking of risks by an expert team before competitive tendering is a key to best practice in risk mitigation and management. The reform unit, if necessary, in consultation with independent experts, can undertake this process. Ideally, the information gained should be published as part of the tender process.

2. Lessons Learned from the Study of Privatization of Water Supplies in 10 Asian Cities (McIntosh and Yniguez, 2000)

- A regulatory body must be in place prior to signing contracts.
- Governments and water utilities should obtain expert advice.
- The appropriate PSP option should be selected.
- Good relations between governments and private operators are needed.
- Transparency, public awareness, and public relations are beneficial.
- An integrated approach (bundling from source to consumer) is best.
- Employee rights need to be protected, and staff transfer needs to be planned.
- Good and reliable water sources are needed for long-term viability.
- Appropriate tariff structures and tariff-setting mechanisms should be agreed upon.
- Fair and open competition is better than negotiated contracts.
- There is no blueprint for "privatization." Its elements and processes should be adapted to the culture, political structure, and legal and regulatory framework of a given city.

3. The Dutch Model (Blokland et al, 1999)

In many countries water supply is a public service controlled by the Government. There is a lot to be said for this, even if it is only that good water supply and sanitation is in the public interest. The other side of the coin however is that government operated utilities are not always a shining example of efficiency. In recent years, privatization of the water supply sector has therefore been the favoured option. Market forces must ensure that supply and demand are efficiently matched. Private business however has tended to focus on areas where demand is backed up by purchasing power. That means that there are still sections of the population who do not have access to affordable, good quality water.

There is an alternative however. The Netherlands can draw on almost 100 years of experience of working with an alternative mode of organization that is a cross between a public owned utility and a private company: the Public Water PLC (a government owned public limited company). Public Water PLCs are incorporated as private companies and are also subject to the rules and regulations governing commercial business. The majority of their shares however are owned by local or national government. These Public Water PLCs are relatively common in the water supply business. They can be found in Europe as well as in North America, Asia and Africa. In actual fact, the Public Water PLC combines the best of both worlds: public ownership with operation according to commercial business principles. As a public limited company it is required to provide optimum water supply services for everyone in its service area. The fact that it operates on a commercial basis means that the cost of services provided has to be recovered from the users. Another advantage, the importance of which can scarcely be underestimated, is the financial transparency of a Public Water PLC, which is required to open its accounts to public scrutiny. As a public limited company it cannot conceal data in the annual figures of the holding company.

Depending on the local situation, various success factors have a part to play:

- *One important factor is the political will to make the public water supply system a success. This is no easy task, as politicians and administrators—paradoxically enough—have to relinquish a degree of influence to make this happen.*
- *The shares and the seats on the board of directors must be divided carefully among the various local authorities to prevent one local authority gaining the upper hand.*
- *Encouraging local share ownership is important as it ensures that the customers can influence policy. Local involvement is increased by appointing representatives of local authorities or consumers.*
- *It is advisable to consider private minority shareholding in the PLC. The introduction of private shareholdership is likely to increase pressure on the management to improve efficiency. It also means that the water utility can benefit from the private shareholders' knowledge of the market.*
- *It is vital that the board of directors possesses sufficient utility-specific expertise in the fields of engineering, finance, environmental protection and human resources. This prevents a knowledge imbalance between the managing director and the board.*
- *Company law must ensure that Public Water PLCs are accountable for their actions, just like other businesses. This transparency is essential to prevent abuse of power and mismanagement.*
- *It may be advisable to appoint an independent regulator, for instance to reduce political intervention and guard against both technical and financial mismanagement of the water utility.*

4. Excerpt from *The New Economy of Water: The Risks and Benefits of Globalization and Privatization of Fresh Water* (Gleick et al, 2002)

Principles and Guidelines (Suggested for PSP)

- ***Continue to Manage Water as a Social Good.*** *(1) Meet basic human needs for water. All residents in a service area should be guaranteed a basic water quantity under any privatization agreement. (2) Meet basic ecosystem needs for water. Natural ecosystems should be guaranteed a basic water requirement under any privatization agreement. (3) The basic water requirement for users should be provided at subsidized rates where necessary for reasons of poverty.*
- ***Use Sound Economics in Water Management.*** *(1) Water and water services should be provided at fair and reasonable rates. (2) Wherever possible link proposed rate increases with agreed upon improvements in service. (3) Subsidies, if necessary, should be economically and socially sound. (4) Private companies should be required*

to demonstrate that new water supply projects are less expensive than projects to improve water conservation and water use efficiency, before they are permitted to invest and raise water rates to repay investment.

- ***Maintain Strong Government Regulation and Oversight.*** *(1) Governments should retain or establish public ownership or control of water sources. (2) Contracts that lay out the responsibilities of each partner are a prerequisite for the success of any privatization. (3) Clear dispute resolution procedures should be developed prior to privatization. (4) Independent technical assistance and contract review should be standard. (5) Negotiations over privatization contracts should be open, transparent, and include all affected stakeholders.*

5. The Private Sector in Water—Competition and Regulation (World Bank, 1999)

Private Participation in the Water and Sewerage Sector—Recent Trends

- *There is potential for gains from private sector involvement through greater efficiency and improved access to finance for new investments.*
- *There has been considerable political resistance to raising tariffs to cost-recovery levels, increasing the risk of long-term investment in water and sewerage assets.*
- *By the end of 1997, private companies operating in developing countries had reached financial closure on $25 billion of investment in water and sewerage projects. There were 97 projects in 35 countries, including management contracts, leases, concessions, divestitures, and build-operate-own and BOT projects. Just a few international companies were sponsoring and operating most projects. About 33% of the investments were in East Asia and the Pacific and 48% in Latin America and the Caribbean. None were in South Asia; 41 of 97 projects were awarded to just two firms (Lyonnaise des Eaux and Vivendi).*
- *Water and sewerage contracts increasingly are attracting bids from consortia of multisector utility and construction companies.*
- *The water sector has a long history of tariffs below costs and political resistance to raising them. Considerable government commitment is required to raise tariffs to cover costs and to build regulatory arrangements that give private companies confidence they can make a fair rate of return on their investments.*

Improving Water Services through Competition

- *Regulators and consumers may compare utilities to judge their performance.*
- *The price a firm may charge is set by the costs of other firms in the industry.*
- *Regulatory benchmarking of companies against one another should be practiced.*
- *Comparisons of the performance of companies should be publicized by the media.*

Regulating Water Companies

- *To regulate well, the regulator needs to have an idea of how much it would cost an efficient company to supply high quality water. One way of generating that information is to auction the right to supply water every 20 years or so. Firms state the price at which they would be willing to supply water of a specified quality, and the firm offering the lowest price wins the contract.*
- *Prices can be adjusted between auctions based on maintaining a given rate of return on capital or on retail price index minus a factor to account for productivity gains and other changes.*

Getting the Private Sector Involved in Water—What to do in the Poorest of Countries?

- *Take a stepwise approach—begin with a management contract.*
- *Simplify contracts with clear and indisputable performance indicators and a strong monitoring agency.*
- *Contract out parts of the regulatory function—independent auditors.*
- *Renegotiate and adjust contracts over time.*

Competition in Water and Sanitation and the Role of Small-Scale Service Providers

- *There has long been a belief that the water and sanitation sector has a high degree of monopoly. But competition is widespread in the low-income retail market in developing countries. There is no inherent monopoly in such small-scale*

activities as reselling water by the bucket. Small-scale service entrepreneurs supply unserved niches of the water and sanitation market. Small enterprises often account for a larger share of the market than do incumbent utilities, and they are well placed to complement and even compete with trunk concessions and public companies in tailoring services to the poor. Thus governments should take account of existing or potential small providers when designing concessions or any long-term rules for the sector.

J. Conclusion

Some comments above could apply equally well to governments running public utilities and private companies running their own utilities. A transparent government policy that adequately addresses tariff issues is the foundation for all water supply development. An independent regulatory body governing water operators is the next step. Regardless of PSP or a lack thereof, an infusion from the private sector into public utilities is needed in human resources management and financial management. Much more training is needed in-house, and training programs must be structured and include all staff. In this modern age of information technology, everyone can improve with some training each year. This is not an option, it is a mandatory requirement.

If the international contractor is not going to be a part of the permanent solution, a time-bound program of knowledge transfer to national counterparts must be put in place. This has worked well for the Malé Water and Sewerage Company, where after 5 years there were no longer foreign personnel (apart from Sri Lankans and Indians) on the staff. This, of course, works against long-term international inputs, as it should. All private sector contracts should include the transfer of knowledge from foreign to local staff and be accompanied by the requisite training to achieve these objectives.

The main thrust of new approaches to PSP must come from a policy (not just a contract) that promotes tariffs covering investment and a regulatory environment. Domestic "privatization" must be encouraged much more than it was in the past. Water consumer societies and civil society in general must be watchdogs monitoring the performance of water utilities and the implementation of government policies. The public has a right to know the essence of all private sector contracts and should have access to information, including annual reports of utilities. Comparative benchmarking of performance with other utilities is needed. To level the playing field, much more competition should be encouraged. This includes joint ventures involving consultants with experience in developing countries and utilities from developed countries. More public awareness, public relations, and public involvement programs are needed, as these will ensure the public can learn the facts, instead of myths, about PSP. An exit strategy for any international involvement should be considered as a matter of policy.

Future PSP efforts should look to bundling "source to consumer" facilities, because the "series" system of delivering water is only as good as its weakest parts. If there are parts of that system under public corporation or government department control, the benefits of PSP in other parts will to a large extent be nullified.

The Dutch model of crossing a public-owned utility with a private company, in which mostly local authorities own a water utility that is managed by the private sector, could be replicated. The Malé model of 70% public ownership and 30% private ownership for 20 years also appears to be successful, perhaps because the Government has been strong over the need for tariffs to cover investment costs (see the Malé case study in Appendix 2).

Private Sector Participation (Problems) in a Nutshell

- Promises of finance and efficiency are largely unfulfilled.
- There is a lack of competition and transparency.
- Playing field is uneven.
- Service to the urban poor is a major constraint.
- Social, ecological, and cultural matters are sometimes ignored.
- Tariff reform is needed for the private sector to engage.
- Regulation by contract is not the answer.
- Take or pay is not a good option.
- There is much civil society resistance to PSP.

Private Sector Participation (Solutions) in a Nutshell

- Manage the process of change.
- Domestic PSP is preferred.
- Contracts should be based on policies.
- Consider exit strategies for internationals.
- Tariff reform is a prerequisite.
- Competition and transparency are musts.
- Public-private partnership has promise.
- Principles and guidelines are needed.
- Independent evaluation will help.
- SSWPs should be included.
- Regulatory arrangements must come first.

Chapter 13

Governance

The story may begin and end with governance. What do we mean by governance? It has to do with, first of all, enforcement of the law and accountability, transparency, and implementation of government policy. It also means having the knowledge (ability) and autonomy to practice sound management. A first principle of governance is that "the one who pays the piper calls the tune." When water supplies in developing countries are examined, it is found that low tariffs that allow governments and not consumers to be in control are at the core of such problems as the urban poor not being served, high NRW rates, intermittent water supply, lack of demand management, and conflict among water users. Unlinking tariffs and the political process should be at the core of all governance objectives.

ADB's water policy suggests that governments need to modify their role. They need to move away from being service providers and become regulators. Most DMCs require a phased program to increase the autonomy and accountability of service providers either as new enterprises or by reorganizing existing agencies. Legal and regulatory systems need to ensure that water service providers and resource managers are held accountable by law for their performance relative to prescribed standards. The allocation of water to high-value uses is a matter of economic accountability, and ADB will support DMCs in developing appropriate methodologies for improved allocation efficiencies. Externalities, especially social and environmental, will be considered in the allocation. The promotion of participation involving public, private, community, and NGO stakeholders is a key element of this policy. Transparency will be most effective when governments ensure the timely availability of information about water policies and projects to the general public and clarify government rules, regulations, and decisions in the sector.

This chapter explores governance in the context of "operations" and "projects." It invites readers to return to the Problem Chart and the Solution Chart in Chapter 2 to see why governance is both a core problem and part of a core solution. The role of policy and regulation, civil society involvement, and tariff reform in effecting a new form of governance is described. There is some good advice from Kamal Siddiqui.[15] (Siddiqui, 1996). Some good examples of governance are provided in the case studies on Dalian, Malé, and Phnom Penh in Appendix 2.

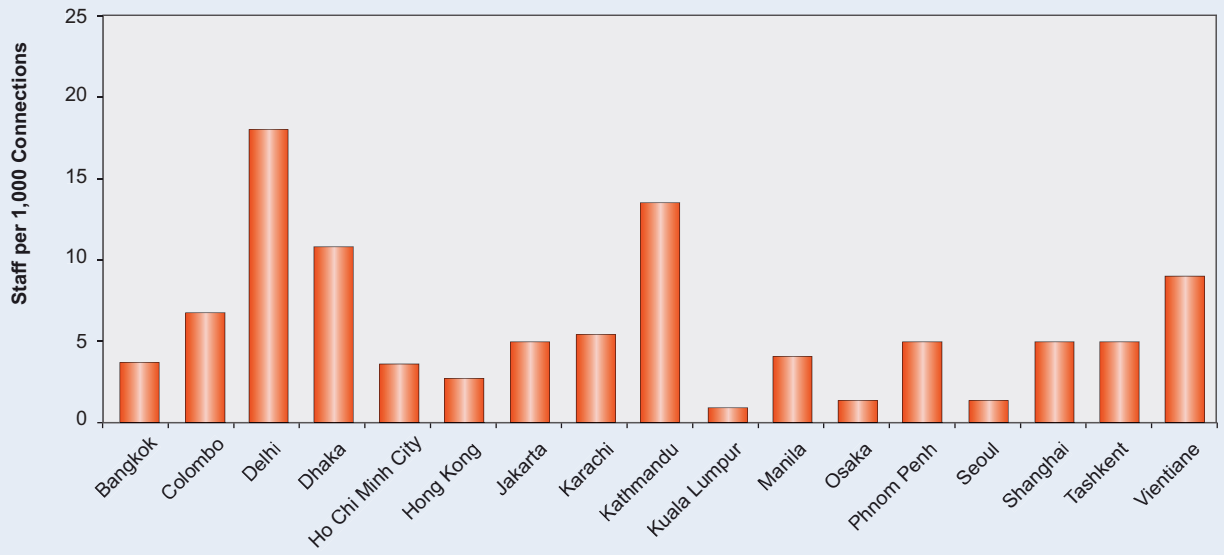
A. Operations

One of the most important considerations in operations is autonomy to run a utility efficiently and competently. The current situation in many utilities is, however, characterized by the interference of elected officials when utilities attempt to exercise the autonomy granted to them to set tariffs to recover costs. This situation is also characterized by the control that elected officials, as opposed to utility management, have over utility staffing. A good utility will have around two staff for every 1,000 connections, but many in Asia have much more than that (see Figure 13.1). In one country, roughly 500 staff were suddenly added to a utility at the behest of an elected official. Moreover, many utilities are not allowed to pay their professional staff market rates of remuneration, which affects the quality of their personnel. In some countries, on the open market, accountants can command salaries of up to three times those earned by engineers, but when civil servant salaries and rules govern, this is not the case. The result is that these utilities attempt to run $100 million per year businesses without competent and qualified accountants. Some elected officials have also been known to interfere in

Water and life

[15] Kamal Siddique is a former ADB Director for Bangladesh.

Figure 13.1 Staff per 1,000 Connections (2001)



granting new connections, and they have been known to prevent disconnection for nonpayment of bills.

In some cases, elected officials appear to support large bulk water users being served by illegal connections. These officials keep new connection fees high, which can encourage illegal connections. Certain elected officials have allowed syndicates to control water supplies to the poor. Officials can profit from vendors purchasing utility water, and some condone groundwater use for free by major industries. They often use their influence to get access to 24-hour supplies for themselves, while most people suffer an intermittent water supply. Elected officials have been known to become overly involved in the daily operations of water utilities, control management, and replace heads of utilities on political grounds. For example, since 1984, the Nepal Water Supply Corporation has had about a dozen general managers. Some office holders insist on distribution network extensions beyond hydraulic design criteria, causing intermittent water supply. The current situation is characterized by a lack of transparent government policy on tariffs, service levels, operator performance, and incentives. Consumers are unaware of policies, and even governments are apt to change policies to suit the current political climate. Without such policies there is no accountability for the performance of governments and utilities. High NRW levels and intermittent water supply are direct results of this lack of accountability.

When many water utilities are examined, human resources management and financial management are found to be weak. Utilities lack skilled staff in these areas because of civil servant rules and salaries. Staff do not have job descriptions, and promotion is based on age, not merit. Most of all, there are no incentives for staff to perform well. Many staff of water utilities have no skills, some are also ghost staff—employees who are listed on the books and receive wages without being physically present. Interestingly, there are many highly educated technical and engineering professionals in these institutions, but while utilities lack autonomy, accountability, transparency, and proper management, these skills to a large extent go untapped. The culture of O&M being a poor relation of development is prevalent because there are no incentives. As a result, some valve operators, meter readers, and new connection teams choose to collude with customers to create their own incentives.

Lack of accountability means meters are not replaced when they are no longer functioning properly. Low tariffs contribute to this situation. Annual reports on operations could easily be produced within 6 months of the end of a given financial year, but often such reports become official only about 2 or 3 years later and are therefore of little use to the public in responding to performance. Consumer satisfaction is a factor in good governance, but consumers have for so long been used to poor service that they regard it as normal

and expect nothing more. This is particularly so with respect to intermittent water supply in South Asia. Low billing and collection efficiency are exacerbated by low tariffs (see Figure 13.2), and they result from a lack of accountability and discipline in complying with the law in general and rules and regulations in particular. An example of this would be the existence of laws stating that local authorities are responsible for water supplies when in practice central governments continue to control these.

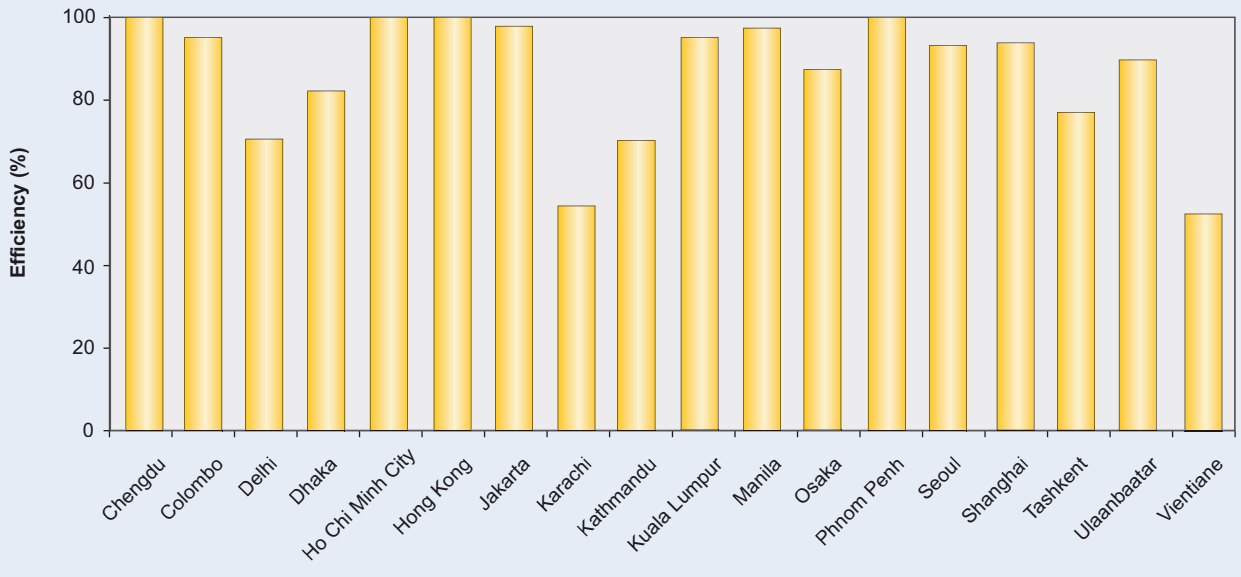
Regulation by contract is a form of governance now prevalent among private operators in developing countries. PSP contracts in Manila show how a lack of transparent policy dooms regulation by contract to failure. When the Asian financial crisis hit, and operators were exposed to high currency exchange risks, the urban poor not being served suffered. If the contracts were based on a transparent policy, they could have been revised easily by the parties concerned, which would have ensured that the underlying policy (providing water to the poor) was accommodated. Regulation by contract prevented this from happening.

The prevalence of high NRW and low service coverage is an indication of poor governance. Some NRW is illegally sold to SSWPs. The profit to those with vested interests (some elected officials, utility staff, utility owners, and local authorities) is considerable, which explains the desire to maintain a status quo that keeps the urban poor paying 25 times the unit rate the rich pay for water. This is also probably why visible leakage is maintained (to mask illegal use). Metro Cebu provides an illustration of this linkage between low service coverage and high NRW. Piped water service coverage based on five persons per connection is 29%. NRW is 34%, and the urban poor buy water from water vendors.

Valve turning is a governance issue

ADB's experience has been that legislation is necessary, but it is certainly not sufficient to ensure the autonomy of water utilities (see Box 13.1). There must be an effort to clean up legislation and make it more relevant to today's world. Civil society needs to take more interest in ensuring that governments do not ignore the law. This might apply especially in extending distribution systems beyond their capacity to provide a 24-hour supply.

Figure 13.2 Revenue Collection Efficiency (2001)



Box 13.1 Institutional Development of Water Utilities

For water utilities to become independent and financially sustainable enterprises, it is necessary that (i) water utilities be manned by qualified staff; (ii) water charges be increased to financially viable levels; (iii) management information, accounting, and accounting systems, including billing and collection, be improved; (iv) a degree of real autonomy and accountability be established; and (v) O&M be improved and NRW reduced to acceptable levels. ADB did address these matters, but such institutional development efforts proved to be inadequate in making a significant impact on water utilities. New measures that may be considered include wider application of commercial management principles, broader use of competition, and increased involvement of users and stakeholders where commercial and competitive action is constrained. Experience has shown that one factor that influenced the success of water utilities was the degree of autonomy that utilities had in planning and operations. More managerial and financial autonomy and more accountability of performance are needed. (ADB, 1994)

If we analyze the current governance situation with respect to operations in a water utility, we can conclude that part of the problem lies in having owner, regulator, and operator as one entity—whereas it is generally acknowledged that in developing countries it would be best if these positions were separated. Self-regulation can only work in a highly disciplined society. If we have a transparent policy, an independent regulator, and an operator with incentives to perform, the situation may change.

If poor governance is at the root of the problem and government is in control, we cannot ask government to reform itself. There is too much vested interest, and too many people are too comfortable with the status quo. We must go outside government to the people who are most affected, such as the urban poor not being served who pay $5/m³ to water vendors. Civil society must put pressure on governments for reforms, and it can do this if it understands the issues and is interested in doing something for the poor and the ill-served. We can begin with transparent policies and a civil society that holds governments accountable for implementing these policies.

There is no question that water utility operators need to have incentives, autonomy, accountability, and the ability to perform. Incentives and the ability to perform can come only when staff are opened up to market forces. As the Executive Director of Dhaka's Water Supply and Sewerage Authority opined, "Why do developing country governments think we can run a multimillion-dollar per year commercial business with civil servant rules and civil servant salaries?" This cannot be done, and the highly successful Singapore Public Utilities Board, which pays its top management staff more than $150,000 per annum—because that is what they would be paid in the private sector—illustrates the point. Bangkok's Metropolitan Waterworks Authority, another better managed utility in Asia, pays its top managers salaries that are comparable with those paid in the private sector. Besides, if you want to limit corruption, you should remove incentives for corruption.

Autonomy and accountability for operators will come with a transparent policy and independent regulation. Operators need to know what is expected of them and that the public will hold them responsible.

B. Projects

When the Nepal Water Supply Corporation was criticized for its poor performance, comments focused on two areas—utility operation and project management. Neither, of course, was in their hands, because of outside interference. The current situation for project management in many water supplies in developing countries is characterized by outside interference, and the effects are far greater than most can see. We can start with outside interference in extending water distribution systems beyond their capacity to provide a 24-hour supply. Take for example the case of the Nepal Water Supply Corporation in Kathmandu. Despite having water for one hour every other day in the dry season, this utility is adding 5,000 connections per year because of the demands of elected officials. These officials should be held accountable for the extra costs associated with health risks arising from intermittent water supply and for household coping costs, including storage, pumping, and treatment.

Then there is the choice of location for investments. It is fairly common to see investments occur in the hometowns of government leaders. When this

happens, feasibility studies can be subverted if leaders push for investments that cannot be sustained. In these instances it would not be prudent for governments to provide O&M subsidies to these water supplies indefinitely. Other leaders, however, prefer to spread investments thinly. When this occurs, efficiency may be sacrificed for popularity. The result is that many things are not addressed thoroughly for the future, which means that the poor are often neglected in favor of new investments, partly because they have no voice and partly because some leaders might have other interests in maintaining the status quo, including condoning syndicates. Pork barrel spending subverts policy and allows some officials to promote their personal agendas. Investment policies are ignored when elected officials support short-term projects that are politically expedient and can be completed during their own terms in office. This is incompatible with developing water supplies for sustainability.

When it comes to project management, development agency-financed projects in particular are hindered by the involvement of elected officials. It is claimed that consultants and contractors are expected to favor elected and appointed government officials with percentages of their contracts. Otherwise their bids will not be considered. Payments are made first for shortlisting or prequalification, then again for the winning bid. Naturally, this means that consultants and contractors must share the blame with officials for perpetuating this system.

The consequences are far-reaching and aggregated. When consultants' fees are squeezed, they can scarcely make a profit, so they skimp on supervising construction. When contractors are squeezed, what was to be their profit disappears. The only way they can compensate is to lower specifications on materials and civil works. This, of course, is aided and abetted by consultants who cannot provide adequate supervision. One result is that pipelines that were made to last for 40 years may end up serving for less than 10 years, because lower pressure rating pipe may be installed and inadequate bedding and backfilling may be used. When this happens, traffic damages the pipes. Another result is that steel can be left out of structures, and lower quality concrete can be supplied. If this happens, safety will be at risk, because water retaining structures may leak, and corrosion may set in on the reinforcing steel very early in its life. In addition, fittings that are not properly protected against corrosion can be supplied.

When development agency financing is involved, governments almost always call for less international

Construction standards?

consultant input, which might be a way of preventing close scrutiny of procurement and construction. At times, governments might try to downgrade international competitive bidding to local competitive bidding. One reason for this could be that local contractors are more easily controlled. It is not uncommon for civil servants working alongside consultants to be paid under the table by these consultants to gain their full cooperation. It has been said that there is a pervasive lack of professionalism among local consultants and government staff. When international consultants and contractors take the view "when in Rome," their professionalism is lowered, too. When a long time is taken in procuring goods or recruiting consultants, it is possible that corruption could be a cause. Leaders might be motivated to approve agreements of this kind, if they are given the chance to visit countries of suppliers or consultants without charge as a favor for appointment. Estimated costs are often inflated to take into account the so-called bribery and corruption factor. Finally, the cost of facilitation in developing countries is considerable. Knowledge is power, and two government agencies, such as one for irrigation and one for water supply, will not necessarily cooperate with each other unless the wheels are oiled. This is all part of the "governance scene." All this is not to say that developing country governments are the only ones at fault. Development agencies and consultants contribute to this unsavory situation, too (see Box 13.2).

In terms of governance and projects, the following can be concluded. A transparent investment policy would certainly help lay the foundation for good governance. This should spell out the criteria to be met and what the overall objectives and goals are. Civil society can then monitor performance while implementating the policy. Providing service to the urban poor should be at the top of the policy list. Consulting and procurement can be taken right out of government's hands and

Box 13.2 Examples of Corruption in South Asia (provided by voluntary informants)

- *Contract kickbacks occur in procuring goods (10–15%), civil works (25%), engineering design (20%), technical assistance (12–15%).*
- *Quality control problems arise in pipe class (PVC), cement, trench depth and width, taps and fittings specifications, aggregate size, corrugated iron thickness and galvanizing standards, dimensions of concrete structures, number and thickness of reinforcing bars, etc.*
- *Political influence is exerted through ministries in prequalifying contractors and consultants; using inappropriate techniques when appointing technical evaluation committees; using incorrect procedures for the constitution of cabinet level tender boards; providing false information to development agencies; collecting money from contractors, suppliers, and consultants for electioneering; harassing contractors to receive money (delaying approvals); extending contracts for unnecessary work; protecting unfit contractors; approving incorrect payments; directly negotiating with contractors over claims; harassing contractors over delays in paying agreed commissions on bribes; and terminating and suspending contracts to exact revenge.*
- *Sector institution corruption includes drawing up specifications to favor certain suppliers, releasing documents and estimates to contractors prior to bidding, having government officials prepare contract bidding documents, paying government officials during tender evaluation, and delaying payment on contractor invoices until bribes are paid. The methods of collecting money are usually through local agents using direct payments with cash notes or deposits in foreign bank accounts; sponsoring foreign tours; covering the costs of educating children in developed countries; and purchasing luxury homes and vehicles. Entertainment costs for government officials during study tours and inspection visits related to the contracts can include payments for shopping and entertainment. Payments are usually made out of the mobilization or advance payment from the development agency.*

subcontracted to a project management team. The performance of this team in complying with the guidelines or rules and regulations can be audited from time to time. Of course, this outsourcing can be done voluntarily (as of now) or it can be mandatory (when the tariff increases to a level that puts consumers in control). Development agencies can get tough on the implementation of loan covenants and provide far closer audits of quality control. Development agencies can also look at reducing bureaucracy, so that projects are implemented in 2 years instead of 8 years. And last, development agencies can more actively promote professional societies and professionalism in developing countries. But before any of this can happen, governments must provide clear policy directions on water resources management, including allocating and trading water rights, pollution control, watershed protection and rehabilitation, and groundwater use for industry.

C. Tariffs and Governance

Since the money trail and power run through governments when there are high subsidies and low tariffs, the answer is to raise tariffs. The more consumers pay, the more power they will have to demand better service.

Policies need to include much higher tariffs that are compatible with full cost recovery. There must be a move toward tariffs covering investments directly and governance shifts from governments being in control to consumers being in control. Some government officials, however, may be reluctant to let this happen, as they currently benefit from improprieties when they control funds that are maintained through high subsidies to water supplies.

D. Public Awareness and Transparency

Corruption can be addressed by increasing transparency in operations, empowering civil organizations through information and involvement, and rationalizing and enforcing laws that already exist. What exist now that did not in the past are the Internet and civil society (represented by NGOs, journalists, and academics who are becoming much better informed about the world around them). Moreover, there are few excuses for not having excellent information upon which management decisions can be made. Computerization has made all that possible.

E. Private Sector Participation as a Solution to Corruption

While it has been suggested by some that PSP is a solution to the problem of corruption in water supply, others note that some big private operators have already been convicted of corruption.

Governance (Problems) in a Nutshell

- Bureaucracy feeds corruption.
- Political interference (corruption) exists in projects and in operations.
- Snowball effect of corruption in consultant recruitment and procurement is devastating.
- Low tariffs feed corruption.
- Autonomy of utilities is denied.
- Money trail runs through governments.
- Poor governance and low tariffs are at the core of all problems.

Governance (Solutions) in a Nutshell

- Transparent policies and independent regulators are needed.
- Tariff reform to put consumers in control is necessary.
- Civil society involvement is a must.
- Good things happen when tariffs are raised.
- Governance is at the core of all solutions.

Chapter 14

Government Policy

If governance is both a core problem and part of a core solution, the transparency and implementation of government policies are the criteria against which governance can be measured. This chapter looks at what has happened to government policies in the past and then explores what should be addressed in government policies on water supply and sanitation in the urban context, who should be consulted during the policy formulation process, in what form policies can be communicated, and how policies should be monitored.

A. A Framework for the Policy

ADB's water policy notes that national water policies should address both resource management and service delivery aspects. Effective water policies will involve several reforms, including the development of a neutral sector apex body that can oversee the policy formulation and sector reform processes. ADB will provide support for the review and revision of legislation, particularly in water rights and allocation among competing uses, water quality standards, groundwater use, demand management, resource conservation, private participation, and institutional responsibilities for water sector functions at national, regional, or basin levels. ADB will continue to press for and support policies that provide the explicit participation of the poor in water and related projects. ADB recognizes that women are important water users, clients, and beneficiaries, as well as managers of water for family nutrition, hygiene, and health and community activities. Equally, women are development agents, professionals, and decision makers in water sector activities. ADB will therefore promote the integration of gender concerns in policies, plans, programs, and projects.

The following findings from ADB's Sector Synthesis of Post-Evaluation Findings in the Water Supply and Sanitation Sector (1994) indicate the areas of concern in the sector and some elements water supply and sanitation policies should be addressing.

- Political hesitancy related to regularly raising tariffs could possibly be overcome through a combination of (i) continued policy dialogue supported by progressive privatization congruent with market values of water and (ii) direct ADB assistance aimed at supporting consumers' education and making them more aware of the value of water, the costs of treatment and supply, and the need for both conservation and further capacity expansion of the supply system.
- The extent to which benefits from water supply are likely to be sustained will depend upon greater recognition of the role that prices can play in managing water demand to expand supply and protect the environment.
- Focus should be on reducing water losses and wastage rather than investing in supply capacity expansion and new distribution systems.
- Rigorous socioeconomic research is required to provide a better understanding of the market for piped water and the response of consumers to different service standards, tariff levels, and pricing structures.
- Several new systems were reported to be underutilized. This was largely due to slower-than-expected growth in water demand, which resulted from unrealistic targets for users of public taps, declining household income, and increased water prices. Slow growth in demand was also in part due to the existence of alternative water supplies and the perceived difference between piped and natural supplies.

Extracts from a draft vision for Gujarat (India) appear in Box 14.1. These extracts could form the basis for preparing a more specific national or state policy.

B. Transparency and Policy

Why is government policy important? Governments have had policies in the past, and policy statements were agreed with development agencies as conditions for loans. Sadly, these policies too often did not translate into actions and were thwarted by the ad hoc involvement of elected officials in management and decision-making processes. The most telling part about these policies was their lack of transparency. In other words, the public did not know about them. Civil society,

Box 14.1 Draft Gujarat Vision for Water Supply and Sanitation, 2010

- ***Human Rights***—*Access to safe water and sanitation is recognized as a human right and citizens are active partners and managers in water and sanitation services.*
- ***Water Supply***—*Everyone has access through a connection to a regular, reliable, and affordable supply of adequately safe water through systems that are socially acceptable, environmentally sustainable, technologically and economically viable, and managed in a way that is centered on people. Every public tap gives potable water.*
- ***Water Resources***—*Integrated water resources management is practiced at all levels.*
- ***Sanitation***—*Everyone has access to latrines connected to waste disposal systems. All schools have latrines for boys and girls. Slum dwellers also have sanitation.*
- ***Health and Hygiene***—*These are strongly promoted.*
- ***Information, Education, and Communication*** —*These are promoted.*
- ***Equity***—*Gender, religion, class, caste, and community equity are attained. Slum settlements are integrated into urban water supply and sanitation systems. Women are involved in decision making for natural resources management. Instances of girls dropping out of school on account of water and sanitation are eliminated.*
- ***Financial and Economic***—*Users are paying for services. They pay according to the level of service they want and are willing to pay for. O&M costs involve communities. Household contributions toward both capital and service costs, routed through communities, make the water supply system more sustainable. Community groups monitor service charges as well as maintenance. Water charges are raised at a progressive rate in urban areas. In urban areas pay-and-use sanitation systems are available.*
- ***Water Technology***—*All urban structures have rainwater harvesting facilities. Local sources predominate in drinking water supply. Tanker supplies are reduced to a minimum. Research and development are promoted. Desalinization is introduced.*
- ***Water Recycling***—*All high-rises and large structures have recycling facilities. At least 50% of water used is recycled. Storm water is used to recharge underground aquifers.*
- ***Sanitation Technology***—*Water use is minimized. Manual handling of excreta is banished.*
- ***State Institutions***—*Government monopoly is transformed into facilitation. The Gujarat Water Authority oversees the water sector and undertakes water accounting and auditing. Good governance, transparency, and accountability are practiced. Each district has its own water authority.*
- ***Civil Society and Market Institutions***—*The Gujarat Water Authority, set up as an autonomous body with full stakeholder participation, is the apex organization in charge of regulating all water resources in Gujarat. Civil society is an active participant in it. Water committees are functional in every community. User groups have been trained. Local people's institutions are legally empowered. Thirty percent of larger schemes are maintained through private sector initiatives. Civil society in general and women in particular are involved in planning. A positive and synergistic partnership between communities, government, the private sector, and NGOs is established.*
- ***Policy, Legislation, and Regulation***—*Policy framework toward decentralized control as well as responsibilities is centered on people and gives opportunity for employment creation, leading to greater self-sufficiency and sustainability of services. Gujarat has a water policy and legislation to back up its actions. Drinking water gets first claim on water supplies. A regulatory framework has been developed to encourage and control private operators of water and sanitation services. Recognition and incentives for drinking water and sanitation performance are given. Regional water supply schemes are adopted as a last resort or backup system. Industrial pollution is controlled. Conflict resolution mechanisms are put in place.* (National Institute of Design, Gujarat, Jal-Disha, 2000)

therefore, could not share in the policy making or monitor implementation. What is needed first is stakeholder consultation, followed by policy statements for the public that are put up on walls, printed in newspapers, posted on the Internet, broadcast over the radio, etc., in the national language, for everyone to see or hear. In some countries this might be enough. In other countries it may be necessary to introduce independent regulatory bodies to oversee implementation. If elected officials continue to influence management and decision making, the final line of defense would be private sector contracts for the development and management of water supplies. If there are transparent policies, independent regulators, and operators with incentives to perform, the situation may change. Because governments set the policies, there can be no advancing until policy statements have been agreed.

C. Scope of Water Supply and Sanitation Policy

Scope of Policy

It is best to start with those who have no piped water. Policies on new connections and on new investments and their locations and priorities are needed. Once these are established, those served with standpipes should be considered, as well as when and how these people are going to get direct connections. Next, intermittent water supply needs to be reviewed, to provide a policy on 24-hour supply. A policy on water quality is needed. Most of all, a clear policy on tariffs and subsidies and how subsidies may be phased out is needed. The financing policy must be spelled out. Where the funds will come from for investments must be decided. There need to be policies on demand management and water conservation. Certainly, policies on PSP need to be explained. Policies on competition for operating water supplies need to be defined. Decisions must be made in terms of who will be responsible for given water supplies—national water authorities, local authorities, or private operators. Policies covering the operations and investments of SSWPs should be created. Policies on incentives for water operators, designed to improve performance and benchmarking of that performance, are needed. Crosscutting policies on service to the urban poor are needed. Policies on watershed rehabilitation are needed. Policies on wastewater pollution and control, wastewater recycling, rainwater harvesting, and trading water rights should be considered. While these needs are mostly related to water supply, policies on sanitation are needed as well. These should cover service levels (sewerage, septic tanks, and latrines), tariffs, and financing in particular. The question of who will have institutional responsibility must be answered, and the financing terms need to be defined.

Policies are dynamic and can change with time. But what is needed for formulating sound policies is good field data and appropriate analysis of data, which must be followed by discussions with stakeholders on the objectives, scope, and implementation of policies.

Community bathhouse—a matter of policy

New Investments

Considering those people living in urban areas not being served with piped water should be the starting point for investment policies. These are often the urban poor. Governments should first of all recognize the human right to water. Next, governments should address the issue of land tenure in relation to their policies of providing water to unauthorized settlements. In line with this, some questions need to be asked: What are the policies on the provision of water to new housing estates and industrial estates? What towns have the highest priority for new investments and why? What is the basis for declaring new investments financially viable? How do policies address natural and urban migration population growth? What is the end game for development agency borrowing or government borrowing? How can civil society monitor the implementation of investment policies? How are new investment policies linked with tariffs and subsidies policies? How do policies address the phasing out of standpipe supplies and the achievement of a 24-hour supply? What are the policies concerning the portion of the development budget going to water supply and sanitation? What portion will go to water supply versus sanitation?

New Connections

The policies on new connections, especially that part of them that relates to connection fees, should facilitate the urban poor obtaining direct connections. In new developments, connection fees can be included in development cost financing. In existing developments, the fees can be paid over 2–5 years with the monthly tariff.

Water Quality

Do governments have policies providing potable water at the tap in their piped water supplies? What are the standards of water quality that governments will be required to meet? What are the water quality monitoring policies that will safeguard the people from arsenic poisoning, bacterial contamination, or heavy metal toxicity? How does all this relate to intermittent supply? Finding the answers to these questions is the first step in determining the level of commitment of Asian governments to ensuring that the water being supplied is of acceptable quality.

Water Accountability

What are the policies on metering water production and consumption? If the job is worth doing, then surely it must be done well. With that in mind, what are the policies on meter replacement? What are the policies on reducing NRW, especially regarding illegal connections and leaks? In this age of information technology, administrative losses should be negligible.

Tariffs and Subsidies

Before these policies can be formulated, the existing subsidies should be clearly determined. The answers to the following questions will help in doing this. What are the policies on phasing out subsidies? What are the policies on national or scheme-specific tariffs? What are the cost recovery objectives? What about tariff structures? Should block tariffs be retained to give lifeline rates to the poor and penalty rates to high-volume consumers? (In a city where household income varies from $500 per year to $50,000 per year, block tariffs are essential.) Should those people receiving a 24-hour supply pay a higher tariff than those receiving intermittent supply? Should tariffs be raised in the dry season to introduce water conservation? What should be the ratio of industrial to domestic tariffs? What about the policy to reduce this ratio? To what extent should tariffs contribute directly to investments? (One hundred percent of water supply investments in large cities can be funded out of tariffs.) Should tariff policies tie tariffs to a maximum of 5% of household income? Should tariffs include or exclude sewerage charges? What are the tariff policies on sewerage? Are they designed just to collect O&M costs? What then are the policies on phasing in future capital costs? Should tariff increases be matched by service improvements as a matter of policy? Is it good policy to increase tariffs a little every month to achieve objectives, or is it better to have heavy increases from time to time? Should any scheme be subsidized to cover O&M costs? Why?

Financing

When considering issues related to financing, it might be helpful to ask the following questions. What are the policies on financing urban water supplies? What are the policies on financing urban sanitation? What are the mixtures of loans and grants to cities or utilities? What are the policies for phasing out grants? What are the onlending terms? Where will governments get the funds? What proportion of funds should be from World Bank, ADB, Japan Bank for International Cooperation, bilaterals, etc.? What proportion of investments will be funded directly out of tariffs? What are the policies for increasing this to 100% over time? What about municipal or utility bond issues? What about private sector financing of investments? What about BOTs? Most importantly, what is the end game for independence? What about options concerning alternative technologies that alter the need for vast public financing of water infrastructure, such as rainwater harvesting and eco-sanitation? Will governments provide financing for household rainwater harvesting and eco-sanitation? Will policies support local financing, suppliers, contractors, and consultants in lieu of those from abroad, as is now being proposed by NGOs for the Karachi Sewerage Project?

Private Sector Participation

What are government policies on PSP? Do these just amount to outsourcing? Do they include management contracts, leases, concessions, and BOTs? Do they include public-private partnerships? To what extent are the limits of international involvement constrained? Three steps in the development process appear to have been missed in much of Asia: (i) the creation of a public utility with a regulatory body, (ii) the addition of domestic PSP with a regulatory body, and (iii) the addition of international PSP with a regulatory body. Instead, a number of Asian governments jumped straight to international PSP and regulation by contract, and this is not working. It would, for this reason, be good to

see many more instances where domestic PSP with a regulatory body is introduced. The domestic private sector can provide good human resources management and financial management expertise. Occasionally, the international private sector could contribute through consultancies in the water supply technical field. What do governments expect from the private sector? Are investment monies expected? Is expertise in providing efficiencies expected? Are contracts to ensure autonomy expected? What are government policies on competition for private sector contracts? Will they relax prequalification based on government policies and enact these policies with regulatory bodies in place? Or will governments sign private sector contracts that lead to regulation by contract without basing these on government policies? In government policies, what incentives are to be offered to private sector operators? Will public sector operators be allowed to compete with private sector operators on a level playing field? How will governments ensure level playing fields when negotiating with private sector operators? Will consultants be employed to manage the process of change? What are government policies on redundant staff in water utilities? What are government policies on service to the urban poor under private sector operators? Will governments consider output-based subsidies? All these must be considered when the subject of PSP is raised.

Small-Scale Water Providers

Again, before governments can formulate policies on this subject, they need good data from the field related to these people and who they are, how much money they make, how many jobs are involved, what the price of the water is at the source and to customers, what the source of water is, what water quality is like, how much water is being provided, and how the customers regard this service. Governments must consider registration. Governments must consider financial assistance to SSWPs. They must consider employment issues both now and in the future. The policies on SSWPs must be closely linked with policies and priorities concerning investments. We should remember that the total revenue turnover from SSWPs in large cities is sometimes more than that of the formal water utilities.

Performance Incentives

Government policies must recognize that it is not possible to run major water utilities with civil servant rules and civil servant salaries. Staff need incentives to perform. Performance criteria must be set and staff held accountable for meeting these. Staff must be given training appropriate to their jobs. Policies on participation in national, regional, and international conferences help provide incentives to perform. Government policies that do not address this key issue of performance incentives will surely fail. Utilities must be required to report their performance on agreed performance indicators and show improvement over time. They should be required to compare themselves with others nationally, regionally, and internationally.

Water Conservation and Demand Management

Policies must be specific about how to effect water conservation. Will conservation efforts include watershed rehabilitation, reducing NRW, rainwater harvesting, wastewater recycling, and demand management through both public awareness and pricing? How will each one of these be implemented? Will implementation include working inside homes to eliminate leaks? Will it include extensive and continuous programs in schools? To what extent will the media be employed? How can implementation be monitored so that everyone can see the results? Rainwater harvesting in cities through the regulation of building permits and provision of incentives to households; demand management by pricing; and reducing NRW will be the most significant developments in cities of developing countries in the next 10 years. In addition, Asia cannot ignore the rehabilitation of its watersheds. Rehabilitation will not just happen. Government policies and a commitment to implementing them will be necessary.

Trading Water Rights

It should be remembered that around 90% of water is used for irrigation. With its rapid urbanization, Asia cannot ignore a comparison of the uses of water for irrigation and urban water supplies. Only when the price of urban water is 10 times the price of irrigation water will there be the proper incentive to trade water rights on a win-win basis. This is coming. The case of the Angat Dam in Manila is a good example. But first the legal ties dictating who owns the water must be loosened, and people must be prepared to trade or at least lease customary rights. Government policies on water supply and sanitation in cities must address this issue.

Can policy protect the poor?

After the meter—a matter of policy?

Wastewater and Sanitation

Government policies on water supply in cities cannot ignore the fact that first and foremost Asian countries need an integrated water resources management approach. This means especially that it is time for separate government agencies dealing with water resources, hydropower, irrigation, wastewater, and water supply to share information with one another and develop coordinated and integrated approaches to the development and management of water. Policies should refer to quality control on effluent discharged from industries. Policies should address the need for industries to treat effluents before discharge, the relocation of industries to industrial estates, and incentives offered to industries to either obtain good treatment or relocate. Policies should address the issue of combined or separate wastewater and domestic sewage treatment. And, policies should consider the issue of large or small sewerage schemes.

In terms of appropriate sanitation, policies should guide developers in the appropriate levels of service, such as conventional sewerage, small bore and/or condominial sewerage with local underground or landscaped sewage treatment, septic tanks, or latrines. Policies on septic tank desludging should be defined. Encouraging the use of eco-sanitation or other appropriate technology solutions should also be included in policies. We should not collect our wastes to put them in someone else's backyard. We should deal with them in our own backyard.

Institutions

Policies should define institutional responsibilities, since these overlap for many institutions in the water sector. Where reforms are taking place, policies should elaborate on the reforms and on who will be responsible for what. Do policies support decentralization or devolution of power to local authorities? If so, how will this be achieved? Have national water authorities become too big and inefficient, and will they need to be broken up and their work outsourced? Can regional centers that can run autonomously be created? These are all issues for government policies on water supply and sanitation. A checklist is provided in Box 14.2.

Box 14.2 Government Policy Checklist (Not Exclusive)

Policy statements for release to the public should at least address the following matters.

- Water supply service coverage
- Tariff policies and objectives
- Sewerage service coverage
- NRW
- Water availability (hours per day)
- Demand management
- Water quality
- Criteria for selecting investments
- Levels of service
- Accountability of utilities
- Service to the urban poor
- Accountability of water
- Water vending
- Accountability of finances
- Bottled water
- Public awareness
- Funding of source development
- Water pollution control
- Funding of capital investments
- Tariff structure
- Trading water rights
- Water extraction (groundwater)
- Subsidies and cross subsidies
- Watershed conservation
- Recovery of O&M costs of sewerage
- Private water supplies
- New connections
- Reselling water
- Operator performance
- PSP
- Operator incentives
- Regulation
- Staff numbers
- Illegal connections
- Wastewater and sanitation
- Institutional responsibilities

D. Policy, Regulation, and Civil Society

Governments have a right to formulate their own policies (preferably in consultation with stakeholders and civil society). But for governments to be held accountable for implementing those policies, these must be made available to the people—and this means those connected to piped water (the customer or consumer) and those not connected to piped water. NGOs and the media can play an important role in bringing this policy to the people and in monitoring its implementation.

Independent regulatory bodies will go a long way toward ensuring that there is a continuous focus on the implementation of government policies, whether the focus is on actions of government agencies or those of water utilities. This focus will also give civil society a focal point for gathering information and expressing people's views. Without civil society and regulatory bodies keeping an eye on the implementation of government policies, nothing from the past will change—and the chances of good governance and sustainable tariffs being achieved are low.

From the utility point of view, government policies on autonomy and tariffs are paramount. Utilities should be heartened when regulatory bodies and civil society monitor the implementation of those policies.

Government Policy in a Nutshell

- Obtain good field data and analyze them.
- Consult with stakeholders and civil society.
- Address governance and tariff issues.
- Address NRW, service levels, SSWPs, and the urban poor.
- Address PSP and public utility performance incentives.
- Address the roles of institutions in the sector.
- Civil society will monitor policy implementation.
- Regulatory bodies will monitor policy implementation.
- NGOs and the media will bring policies to the people.

Chapter 15

Regulation and Benchmarking

By definition, regulation is about making and enforcing rules for, in this case, the development and management of urban water supplies and sanitation in developing countries. This book focuses mostly on economic regulation, which includes investment, tariffs, and service levels. Other regulation connected with urban water supplies includes water resources and environmental and health regulation, but these are all major fields by themselves.

ADB's water policy notes that, to serve the best interests of consumers and managers of water resources, the pricing and incentive and penalty systems, regardless of their simplicity or sophistication, require regulation. Regulatory systems need to be established to ensure that laws, standards, rules, and regulations are equitably and consistently applied.

This chapter touches on why regulation of water supplies has now become important, its objectives, what should be regulated, how the regulation should be undertaken, and who should be doing it. Some principles of regulation are put forward, and the summary findings from an ADB regional seminar on the regulation of water supplies, held in 2001, are listed. The importance of benchmarking the performance of water utilities is emphasized, and the contribution in this field of ADB's two water utilities data books is noted.

A. Purpose of Regulation

In most Asian countries, the entities in charge of water supply and sanitation are nominally given the responsibility of seeing that government policies and legislation are implemented. What is the reality? In a city-state, like Singapore, there is discipline and commitment by the Government, and the Singapore Public Utilities Board ends up self-regulating and doing a fine job. Many developed countries, although not perfect, operate in much the same fashion. But in many Asian countries, both legislation and policy are overlooked. Elected officials become involved in the development and management of water supplies on a daily basis. The crux of the problem is that water utilities do not have the autonomy needed (even though this is legislated) to manage their own affairs. The result has been low tariffs, intermittent water supply, a large number of urban poor not being served, and high NRW. This problem has also resulted in corrupt procurement, consultant recruitment, and contracting that have severely threatened economic lives of projects. Even though self-regulation was not working in several South Asian and Southeast Asian countries, until very recently there was no move to introduce independent regulation.

Then along came "privatization," and suddenly it was realized that, in the best interest of civil society, Asia should have regulatory bodies to see that the private sector does not abuse its monopoly privilege. But regulatory bodies take time to develop. So, in the meantime, Asia has effectively had regulation by contract. Private sector contracts have not been based on declared government policies, but on an ad hoc set of rules determined at the time by the contracting parties.

When regulatory bodies were set up, such as in Manila, they were not true regulatory bodies. Instead, they were more like contract administrators. While development agencies generally agree that to enter into a private sector contract without first establishing regulatory arrangements is a recipe for disaster, the reality is that over the last 10 years in most developing countries there was only regulation by contract. The example of Manila is a classic case, but it is typical of what has been happening elsewhere in the world. Of course, in most cases, the private sector wants regulation by contract, because private operators will not then be affected by changes in government policies. But as the private sector found in Jakarta, a contract is little protection from the will of the people. Nevertheless, independent regulation can encourage the private sector to invest in Asian water supplies by providing a more stable, transparent, and accountable environment.

Now let us consider public water supplies in urban areas of Asian developing countries. Can regulation help them? Well, one main purpose of regulation is to gain autonomy for utilities. That starts with transparent government policies. In many countries, transparent government policies and regulatory bodies are both needed for utilities to maintain an arm's length separation from elected officials.

B. Objectives

We can see from the statements above that one main objective of regulation is to ensure that water utilities have the autonomy needed to comply with government policies and legislation. But how does this work? First, regulation must have its basis in government policies and legislation. Second, while the regulator does not implement policies, it must monitor the implementation of policies. And, third, a regulator should ask many questions, which might include the following. Is the Government facilitating the implementation of its policies? Is the water utility complying with these? Are private sector contracts also in compliance?

Regulation must apply to all water operators, not just those in the private sector. Regulation brings with it sector transparency, accountability, equitability, and efficiency. Regulatory bodies are the entities that civil society can turn to if it is not getting the services it expects. Regulatory bodies must protect consumer interests. And, they must equally protect operator interests. Regulators should not be tasked with administering contracts. That is between owners and contractors. Regulatory bodies should only be tasked with seeing that contracts conform to policies and that policies are implemented. Regulation is not control.

Another objective of regulation is good governance. This applies to corruption in decision making related to the implementation of water supply and sanitation projects as well as new connections, utility staffing, disconnections and illegal connections, and syndicates like those that control informal service providers of water.

C. Scope of Regulation

The first question to decide is the geographic extent of regulation. Should regulation be carried out on the national, state, provincial, or municipal level? Is a multiple sector regulator best? The second question to decide is what policies will fall under this regulator. Is it possible that a regulator could start with a few things to regulate and in time phase in more and more? Regulation is a process or journey. For example, even now water quality is being more closely regulated every year in developed countries. For economic regulation, the first priorities might be water supply investments, tariffs, service levels, and incentives for and performance of operators. If water supplies are bundled from source to consumer, they will be easier to regulate. In fact, if any operator does not have control over the source of water, it will be very difficult to tie that operator to contractual obligations.

Tariffs, the lifeblood of any water utility, are the first and most important matter to be regulated. It should be noted that regulators do not set tariffs but approve them after confirming that they conform to government policies. Political obligations should not influence tariff decisions. Tariff structures may also be regulated in terms of objectives, such as serving the urban poor and demand management.

Investment proposals need to conform to government policies, including economic, financial, environmental, and social feasibility on the one hand and priority locations for poverty reduction on the other. Procurement, consulting, and construction must be audited from time to time to see that they conform to policies.

Service levels need to be defined and operators held responsible for providing those service levels. This includes piped water coverage, water quality, 24-hour supply, and phasing out standpipes. It may also include public toilets, on-site sanitation, and septic tank sludge disposal.

Water utility operator performance needs to be regulated. Performance indicators can include the number of connections, production volume, NRW, 24-hour supply, water quality, staff per 1,000 connections, metering, billing and collection, and operating ratio. An independent public audit of the water balance and of service levels should be conducted from time to time. Profit or other incentives need to be linked to performance, both in terms of bonuses and penalties. A regulator must determine which targets are satisfactory by benchmarking over time a utility's present performance against its past performance and the performance of others in the sector operating nationally and regionally.

Competition for water supply contracts must be regulated. While competent operators are necessary, broad competition is desirable also. This has been one major failure of the "privatization" process over the last 10 years. Competition has been limited to a select few contractors.

Groundwater regulation is also needed in most Asian cities. Who should be responsible for this is often debated. One opinion is that groundwater regulation is so intimately linked to the water supply itself that it should come under the economic regulator.

We need specific regulation of service to the urban poor. This will address the payment of connection fees, access to piped water, block tariffs, and freedom of information. It will also address SSWPs.

Water conservation must also be regulated. This can include public awareness, education, watershed protection, rainwater harvesting, reducing NRW, and demand management through pricing. Economic regulators will need to coordinate with water resources, environment, and health regulators on these matters.

D. How to Regulate

There is little experience in regulating water supplies in developing countries. Chile provides perhaps one of the better examples, and the main feature is that this country has considerable financial and human resources to carry out various tasks. It uses a hypothetical model to determine the operator's target efficiencies. It also has introduced direct subsidies to low-income consumers on a means basis. There is, however, no blueprint. Each country, and even each location within a country, will have its own characteristics that need to be considered when deciding how to regulate. It is good to remember that regulation is a dynamic process that takes time. The journey should be designed. Consumers are the ultimate regulators. Regulation should involve monitoring, not control. It should be remembered that regulation already exists, but it is mostly not structured, strong, or independent. Regulators do not provide water. Regulators must have access to information. Most information can be provided by water utilities as part of their management regime. Regulators can independently check this information on a sample or audit basis. It is also very important to agree on the validity of information. For example, how will NRW be estimated when the whole system is not metered and half the meters are not working anyway? There is an old adage: if you cannot measure, you cannot manage. That is very relevant to water supplies of developing countries. Regulators should be involved in the process leading up to the signing of a contract with a private sector operator. This is primarily to ensure that it is compatible with government policies. It has been said that regulatory principles should include social equity combined with financial sustainability in a transparent manner. There is a need to ensure that policy, regulation, and operation are separated. Almost everyone agrees that having relatively high tariffs will mean fewer problems. A rigorous analysis of subsidies will help. In fact, it could be said that unless governments are committed to higher tariffs, compatible with full cost recovery, as a matter of policy, most regulation will be of little use. An active consumer body will be healthy for regulators. Civil society in the form of journalists, academics, and NGOs should keep regulators on their toes.

E. Choosing Regulators

There are perhaps three schools of thought here. One is that one person should be appointed as the regulator. This person does not necessarily need to be an expert in anything, but he or she should be regarded highly by most people from most political parties. The regulator would have a team of experts in law, water, finance, economics, and social capital to collect and analyze information and advise him or her. The second school of thought is that a regulatory body should be formed by the experts themselves, totaling not less than three or more than five persons. The third school of thought is that the regulatory body should comprise people representing the stakeholders, including industrial and domestic consumers, operators, and local governments. Common to all these is the thought that there should be appropriate gender representation in the regulatory body, since women are often the main providers of water at the household level. The regulatory body needs adequate finances to function properly, and it is commonly believed that these should be sourced from tariffs to retain independence from government and should be in the order of 1–2% of the revenue gained from tariffs. Most agree that the success of a regulatory body could depend on its having (i) a clear mandate, (ii) autonomy, (iii) accountability through arbitration, (iv) transparency, (v) stability, (vi) professionalism, and (vii) objectivity. Whoever the regulators are, they need continued education and the ability to network with other regulators in the Asian region. ADB has been supporting this approach.[16] Other advice indicates that regulators should be of the highest caliber and possess great personal integrity to resist political overtones.

F. Principles of Regulation

Regulation must be based on a transparent government policy. Private sector contracts must also be based on that policy. Regulation by contract is not a solution. Regulation should apply to all water supply operators, be they private sector, national authority, or local authority. Regulation is needed to provide autonomy to the water utility and to improve governance. In doing this, it will encourage private sector investment. The principles of accountability, efficiency, equitability, and transparency should be objectives of a regulatory body. Without a government policy that embraces the provision of incentives to operators for performance and a commitment to much higher domestic tariffs, the

[16] Regulatory Systems and Networking of Water Utilities and Regulatory Bodies (ADB, 2001b).

benefits of a regulatory body will be negligible. A summary of findings from a regional seminar on regulatory systems, held at ADB in 2001, is given in Box 15.1.

G. Benchmarking

It is necessary to differentiate between metric benchmarking and process benchmarking. The former is a quantitative aspect and includes collecting and analyzing data leading to the identification of areas of relatively good and poor performance. The latter concentrates on improving the current work process to meet or exceed the targets set by metric benchmarking. Process benchmarking does this by breaking down current work practices into a series of small steps that are then compared with best practices in other organizations outside the industry.

The ADB *Water Utilities Data Book—Asian and Pacific Region* (1993) and *Second Water Utilities Data Book—Asian and Pacific Region* (1997) provide information that allows water utilities to assess their rank among themselves in terms of various performance parameters. They also allow one utility to assess its own performance over time. A good way to get started is for every utility to set itself no more than 10 performance targets that are manageable (see Box 15.2). If tariff

Box 15.1 Summary of Findings—Regional Seminar on Regulation of Water Supplies

- Sound regulation will attract investment.
- In Chile, the head of the regulatory body is appointed directly by the President.
- Regulation of water vendors is needed, too.[a]
- Five caveats: equitability, efficiency, accountability, transparency, and sustainability.
- Three more: performance standards, incentives, and competition.
- Regulation is based on policy and any PSP or other contract must comply with policy.
- The PRC has National Tariff Guidelines and a Municipal Price Bureau.
- Having a transparent policy that the public is aware of is itself a regulatory function.
- Legislation is necessary but not sufficient. A regulatory body can oversee.
- Civil society is the ultimate regulator.
- What we have today is the information age, including the Internet, E-mail, and mobile phones. The media can tap into this to bring information to the grassroots level. Therefore, we have an opportunity for transparency. But are all governments ready for transparency?
- Active consumer NGOs can serve as watchdogs.
- Operators must have contracts for performance. Regulators may suggest actions to be taken to improve performance.
- Benchmarking water utilities at country, regional, and international levels is important. This information must also be made available to the public, so it can see how one utility is doing compared with others (ADB water utilities data books).
- If you cannot measure it, you cannot manage it.
- Protection of customer interests is important.
- Regulators must have access to information.
- Regulation in Colombia is based on principles of social equity, financial sustainability, and transparency.
- Regulation in Zambia includes a board of stakeholders and team of experts. Policy came first.
- It is important to get strong skills in a regulator.
- There should be a code of practice for operators with obligations to consumers.
- Regulation is a dynamic process. The journey needs to be designed. Start simple.
- Regulation needs flexibility .
- Anything can work if there is a strong political will. (ADB, 2001b)

[a] The latest thinking is that this should be limited in the short term to registration.

policies and loan covenants are to include references to O&M, it is essential that every utility clearly defines O&M. Likewise, it is important to differentiate between NRW and UFW (see Chapter 9). Preparation and timely publication of an annual report on operations are essential for the accountability of the utility to the government and the public. This report can include the information listed in Box 15.2.

Box 15.2 Suggested Indicators for City Water Supply

- Population in city (persons)
- Piped water production (m^3 per day)
- Number of household connections (persons per household)
- Number of standpipes (persons per standpipe)
- 24-hour supply in service area (%)
- Per capita consumption from house connections (l/c/d)
- NRW (percentage of production)
- Average actual domestic tariff ($/$m^3$)
- Operating ratio (expenses against revenue)
- Utility staff per 1,000 connections

H. Evaluation of Water Utilities

This is becoming more and more important as a means of determining whether a utility represents a good investment for development agencies or the private sector. The evaluation needs to be made in two parts. The first part relates to the degree of autonomy of a water utility in terms of governance. These are factors normally outside the control of a utility. The second part relates to aspects under the control of a utility, such as consumer satisfaction, water management, and accountability.

Tables 15.1 and 15.2 can be used as a basis for deriving detailed evaluation criteria for each subheading, so that it is then possible to compare "apples with apples" each year. Development agencies can prepare their own detailed evaluation criteria, so that they can compare utilities on the same basis.

Table 15.1 Evaluation of Water Utilities (Part A)—Governance

• Transparent Policies	20%
• Independent Regulatory Bodies	10%
• Private Sector Participation	10%
• Civil Society Involvement	10%
• Subsidies (low)	10%
• Tariffs per Policy	20%
• Utility with Autonomy	20%
	100%

Table 15.2 Evaluation of Water Utilities (Part B)—Utility Performance

Consumer Satisfaction		40%
Coverage	10%	
Water Availability (24 hours)	10%	
Service Level	10%	
New Connection Fee	10%	
Water Management		20%
Metering	5%	
NRW	10%	
Consumption	5%	
Financial Management		20%
Self-Financed Investments	5%	
Operating Ratio	10%	
Accounts Receivable	5%	
Human Resource Management		10%
Staff per 1,000 Connections	5%	
Management Salaries	5%	
Accountability		10%
Annual Report	10%	
		100%

I. Public Audit

From time to time, but not less than every 5 years, it will be necessary for regulatory bodies to conduct independent public audits on the water balance and on water service levels. This will establish clearly the elements of NRW, so they may be appropriately addressed, and ascertain where the focus should be placed with regard to capital works designed to connect those people not connected to piped water. It is important to conduct these audits at the same time, so that a check on compatibility of findings can be made.

Utility water audits should of course follow the elements shown in Box 9.2. But under "Authorized Consumption" there should be a further breakdown into (i) Illegal Connection for Own Use and (ii) Illegal Sale. Likewise, "Metering Inaccuracies" can be broken down into (i) No Meters, (ii) Meters Not Working, (iii) Meters Not Recording Accurately, and (iv) Meters Misread.

Audits of water service levels must start with total populations of cities and account for all people by noting their sources of water (often more than one), the quantities of water consumed monthly from each source, and the amounts paid for that water.

The different categories audited may include (on the source side) water utilities (legal), water utilities (illegal), groundwater (own), and groundwater (others). For service levels, there will be a range of possibilities, including house connection; shared house connection; purchase from neighbor, public tank, public tap (standpipe), tanker, or water vendor; public dug well; public tubewell; own dug well; and own tubewell. To have good public audits of service levels, it will be necessary to register all SSWPs.

Regulation and Benchmarking in a Nutshell

- Regulation and benchmarking should be based on transparent government policy.
- The objective is autonomy and good governance through accountability, transparency, equitability, and efficiency.
- Why, what, who, and how must be addressed.
- There are three options: (i) one regulator, (ii) body of experts, or (iii) body of stakeholders.
- Civil society is the ultimate regulator.
- PSP contracts should be based on policy, not on regulation by contract.
- PSP and public water supplies should be regulated.
- Information technology improves transparency.
- Operators need incentives based on performance.
- Stakeholders should design the journey, which is a dynamic process.
- Benchmarking is fundamental to regulation.
- Evaluating utilities on governance and performance is desirable.

Chapter 16

Civil Society Involvement

Civil society includes all stakeholders with interests in the water sector (consumers, NGOs, academics, journalists, etc.). These stakeholders are important because, ultimately, the pressure (on governments) for necessary reforms is going to have to come from civil society, not development agencies. The first step in this process is for civil society to become much better informed, which was the main finding of *Water in Asian Cities—The Role of Civil Society*, the regional consultation held at ADB in October 2002. This chapter starts with what consumers are saying, looks at special findings from the regional consultation, then deals with issues of governance. It goes on to explore what can happen when the consumer is in control, expands on public awareness and transparency, then identifies some specific roles for NGOs, academics, and journalists. Appendix 1 contains views from civil society.

Water projects supported by ADB will incorporate carefully designed components that promote the participation of civil society in identifying needs and issues, designing solutions, and establishing mechanisms for monitoring and dispute resolution.

A. What the Consumers Are Saying

The following is a summary of the main points learned from numerous interviews with consumers in Asian cities conducted in 2001.

- Poor water quality is the main complaint.
- Intermittent supply (including power cuts) is the next complaint.
- Low pressure means household pumping—waiting in queues.
- They have difficulty in paying the water bill.
- Connection fee is high (corruption).
- There is a lack of consumer awareness about the issues and solutions.
- Groundwater levels are falling.
- Piped water service coverage is low, but there are tens of thousands of applications.
- People are willing to pay for good service—up to $10 per month.
- There are too many standpipes and not enough connections.
- Illegal connections abound.
- Meter reading is sometimes inaccurate.
- Utility staff fear they will lose their jobs if privatization comes.
- Unions and NGOs are against privatization—they say it will bring higher tariffs.
- High benefits to utility staff result in fewer illegal connections.
- Those not connected have no idea when they will get piped water.
- Paying the connection fee over 6–12 months is OK.

The conclusion is that governance and tariffs are the core problems, and promoting public awareness of the problems and solutions is the first requirement.

B. Regional Consultation Findings

Special findings from the ADB regional consultation in October 2002, *Water in Asian Cities—The Role of Civil Society*, are given below to further enhance stakeholder understanding and awareness.

- Large water supply projects can be completed by the private sector within 18 months.
- Use city forums (coalition of civil society groups).
- Consider rainwater harvesting in cities (India's Chennai is an example).
- Civil society can give a voice to the poor.
- Filmmaking can help, but target the audience and message.
- It is not just government boards that interfere in water utilities.
- Remove the biggest polluters from the cities.

- There is a need to protect watersheds—users must pay for this.
- Correct public utilities and be careful not to jump to PSP.
- Operators must have a social dimension and involve their customers.
- The rich and middle class get subsidies, not the poor.
- We must recognize SSWPs.
- Utilities should get involved in bottled water.
- Water and human values and water and culture are important.
- Property titles should never be an impediment to piped water.
- Development agencies should work with local governments and help attract local financing.

C. Issue of Governance[17]

If poor governance is at the root of the problem and government is in control, government cannot be asked to reform itself. There is too much vested interest, and people are too comfortable with the status quo. Efforts must be made to go outside government to the people who are most affected, such as the urban poor not being served who pay $5/m³ to water vendors. Civil society must put pressure on government, if reforms are to happen. This can be done when issues are understood and civil society is interested in doing something for the poor and the ill-served. We can begin with a transparent policy and a civil society that holds government accountable for implementing that policy.

D. When the Consumer is in Control

Information technology has allowed consumers to make informed choices and hold governments more accountable. In this context, the word "consumers" refers not only to those already receiving a service but also to those with the potential to receive that service.

Customer relationships count. Their experience matters. And they are in control when they have access to information. (Seybold, 2001)

When consumers are in control through paying the full cost of water service delivery, (i) corruption is minimized, (ii) there is more accountability for finances and water, (iii) there is more efficiency in water service delivery, (iv) there is more transparency regarding information, (v) there is more staff responsibility, (vi) service is more equitable, (vii) a consumer society will likely be formed, (viii) service levels will be reviewed, (ix) performance benchmarking is encouraged, and (x) there is pressure to improve service.

E. Public Awareness and Transparency

ADB will promote wide-ranging public awareness and community education programs—especially among women, youth, and farmer groups—to broadcast the message of water being a resource that needs prudent management. In particular, education that helps communities understand the links between water, sanitation, health, and productivity will be encouraged. ADB will incorporate components that educate industrial consumers on the efficient use of water and the need for higher prices for water use and efficient treatment and discharge.

The Internet helps civil society become better informed about the world. Once it is informed, civil society can help create the necessary public awareness to pressure governments into the right policies (those that will ensure that water is provided equitably) and encourage leaders to use the right strategy to implement these (for example, tariff reforms). Civil society can include all stakeholders—development agencies, served consumers, the urban poor not being served, utilities, the private sector, unions, civil servants, politicians, NGOs, journalists, and academics.

Objectives of Public Awareness

These may include the following:

- helping the public understand water service levels;
- educating the public about water use, including how to reduce waste in the home, and promoting good hygiene;
- educating the public about water conservation;
- helping the public understand where the cost of water comes from and why tariff increases are necessary;
- keeping the operator on its toes in terms of performance responsibilities;

[17] There is some repetition here from other parts of the book, but this ensures that due emphasis is placed on important matters and that this chapter can be more readily understood by itself.

- letting the public know about government policies and plans;
- informing the public about development agency funding and its requirements; and
- encouraging people to compare their water utility with others in the region.

Scope of Public Awareness Activities

These may include the following:

- appointing a public relations firm to prepare materials and programs;
- undertaking consumer and school surveys to test public knowledge and awareness;
- using media (radio, television, newspapers, and the Internet) at least monthly;
- explaining tariffs to the people;
- publishing the main findings of water utility annual reports;
- preparing textbooks for schools and educating teachers;
- forming consumer associations;
- explaining the role of the regulatory body to the public;
- explaining PSP to the public;
- surveying homes for water use and waste;
- establishing a consumer complaint response center;
- maintaining a utilities Web site and updating it daily on news and status of services;
- establishing a service for low-income consumers, which gives special attention to the poor;
- inviting the public to follow up on leak repairs;
- conducting public meetings with special interest groups;
- making short videos on different water supply situations to encourage public discussion;
- hiring an independent consultant to check operator performance;
- publicizing widely and continuously government policy and the status of its implementation, especially with regard to serving the urban poor;
- proactively preparing feature articles on water supply issues for the media;
- publishing comparative data from other utilities;
- publicizing activities and views of the principal regulator; and
- encouraging consumers to write to newspapers and regulators.

F. Role of NGOs

NGOs have a vital role to play in ensuring that the interests of the poor, those not connected, and the ill-served are safeguarded and that their voices are heard in public and private sector debates. NGOs can be initiators of consumer societies. In cooperation with academics, journalists, and regulators, they can monitor the implementation of government policy. The example of the NGO Forum for Water Supply and Sanitation in Kathmandu (Nepal), which was initially established with support from WaterAid, is one that could be replicated elsewhere. This organization has clearly demonstrated that, when they are well informed on the subject, the views of NGOs will be respected.

G. Role of Academics

Academics can keep an eye on the big picture. They can analyze subsidies in particular and report the amounts going to the poor or the rich. They can analyze tariffs and tariff structures. They can discuss questions of governance and PSP. They can analyze the water balance to see where water is being used and lost. And they can analyze the service levels and payments for water by urban residents. Recent studies on SSWPs have clearly identified the need to investigate these areas.

H. Role of the Media

Journalists can focus on the poor, the people not being served, tariffs, water utilities and their efficiency, the performance of governments in implementing their declared policies, and private sector involvement. But first they should spend time and effort in becoming educated on the subject. In every major city, at least one journalist could become an “expert” on water. While much material is available on the Internet, including the Web sites of water utilities, it is up to the media to bring this to the attention of those who do not have access to computers, which can be done by passing on this information via newspapers or radio.

Civil Society Involvement in a Nutshell

- Consumers indicate governance and tariffs are core problems.
- Focal points are NGOs, academics, and journalists. City forums help.
- Civil society needs to be better informed.
- Starting point is involvement through key stakeholder consultation in formulating government policy.
- Public awareness and transparency are keys to civil society involvement.
- When consumers pay the full price of water, they will be in the driving seat, which is the objective.
- Civil society should interact with the regulator.
- NGOs can champion the poor and can form consumer societies.
- Academics can investigate facts, especially concerning subsidies.
- The media can be powerful, but first it must be well informed.
- Civil society involvement promotes good governance by monitoring the implementation of government policy.

Chapter 17

Research

For an organization, institution, or government agency to be effective, it must constantly engage in research as a part of striving to do better. Research is needed in the urban water supply sector to provide awareness and understanding that in turn will give a basis for sound decision making. This chapter identifies topics that can be further investigated and researched, and it suggests some focal points for that research. In general, there is a need for balanced research that takes into account social, economic, and environmental considerations. It is important that the results of research be shared, which can be done by posting these results on the Internet.

A. Topics for Research

Intermittent Supply

The subject of intermittent water supply in developing countries requires research. We need to know the real cost of intermittent versus 24-hour water supply. What are the pumping costs? What are the storage costs? What are the treatment costs? What is the volume and value of water wasted every day? How accurately can water consumption be measured? What is the quality of the water delivered? What is the value of time wasted waiting for water? What is the anxiety factor? How many days in the year does water not come? What is the prevalence of bottled water for drinking? What solutions to this situation do the stakeholders envisage? What is the extent of good hygiene practiced in homes? This research should be done in at least 10 cities in five countries to get a good understanding of the situation.

Income Profiles

Every water utility involved with a city in Asia with a population of over 100,000 should evaluate the household income profile for people living in the potential service area. This should be done on a sample basis and reported with reference to location. It should then be aggregated for overall results. This provides an upper revenue limit based on affordability. Of course, this information must be analyzed in the context of alternative water supplies and the tariff structure to determine willingness to pay.

Alternative Water Supplies

Willingness to pay for piped water depends more than anything else on what alternative water supplies are available to consumers. Research should carefully evaluate this factor to ensure that demand is not overestimated in new water supply schemes. A factor in the use of alternative water supplies is hygiene education, so this too should be evaluated (see Health Factors on page 126). What is the quality of alternative supplies and for what purpose are they used? Is there a need for education and awareness programs?

Effective Subsidies

What are the subsidies being provided by governments to different water users, including farmers, urban domestic consumers, industrial consumers, and rural domestic consumers? Are there apparent or real cross subsidies from (i) high-volume domestic consumers to low-volume domestic consumers, (ii) industrial consumers to domestic consumers, or (iii) urban consumers to rural consumers? Consider the block tariff structure—who benefits most from subsidies, the rich or the poor? How many people are not connected (in their homes) to piped water?

Price Elasticity of Demand

There is a need to look at per capita water consumption and the cost of water. Does a tariff increase result in a temporary or permanent reduction in the volume of water used? This is now easy to evaluate, if a computer sampling of accounts is used. To what extent is demand influenced by income, by tariff level, and by alternative source availability?

Service Levels and the Water Balance

In any major city there are gray areas relating to statistics on service levels and the water balance. If the NRW rate is 60%, what is the basis for assuming

that 10% is due to metering inaccuracies, 30% to illegal use, and 20% to leakage? If there is 30% illegal use, how much of that comes from illegal sales? How much results from illegal connections? If there are 10 million people in a city and only a million connections, how do those not connected get water? Do they use shared connections? Do they purchase from neighbors or vendors? Do they use groundwater? What is the volume of water used by each category, and what do they pay for it?

Small-Scale Water Providers

There needs to be more research on these entrepreneurs. All should be registered and officially recognized to understand how they fit into the overall water supply system. The sources of their water, the amount of water distributed, the method of distribution, the source cost, the consumer cost, and the quality of the water delivered need to be recorded. The results need to be compared for compatibility with the research (above) on service levels and the water balance. The profit element for SSWPs needs to be examined. Then the long-term role of SSWPs vis-à-vis government policies and formal piped water development plans needs to be assessed. This is big business, and it is important to know as much as possible about it.

Health Factors

There is a need for research into the extent of the knowledge and practice of hygiene, especially among the more informal settlements in Asian cities. What are the sources and quality of drinking water? Is it boiled or filtered? What is the practice concerning hand washing? What is the practice concerning sanitation? Since major improvements in hygiene practice can be made at little cost, this is an area where research can quickly lead to action. Research should be conducted on the stunting of child growth and its links to the quality and quantity of drinking water.

Pollution

Research is needed on big industries that pollute waterways. What is the nature and quantity of effluent produced? What pretreatment or treatment is done on-site? What type of treatment is required by law? Are industries properly zoned? What are the official government policies on zoning? What are the regulatory arrangements? What are the consequences of uncontrolled pollution? Who benefits? Who pays?

Groundwater Monitoring

As mentioned elsewhere in this book, groundwater has been overexploited in the past and continues to be overexploited now. There is a need to control extraction, to ensure that the resource remains sustainable and usable. Research is needed to establish the amount of the current extraction and compare it with the sustainable yield. Research must cover the incidence of falling groundwater levels, the incidence of saline intrusion in coastal environments, and ground subsidence.

The Urban Poor

There needs to be, for public review, an independent annual report on the water supply and sanitation situation of the urban poor. This should include poverty mapping of the city, water supply and sanitation service levels, and costs (both direct and indirect) to the urban poor. The annual progress in improving the plight of the poor should be highlighted. To what extent are government policies on water supply and sanitation services to the urban poor being implemented? Are modifications or improvements to those policies needed?

Private Sector Participation

After 10 years, the jury is still out on PSP in urban water supplies in Asia. There is a need to supply those governments considering PSP with independent and objective assessments of ongoing PSP activities in the sector. The research should identify (i) attempts that failed to get off the ground and why, (ii) problems with ongoing PSP contracts, (iii) success stories, and (iv) the prognosis. The research should take a look at how well the objectives of increased efficiency, more investment funds, and greater autonomy are being realized.

B. Focal Points for Research

It is fine to suggest lots of research, but who is going to do this, and how is it going to be funded? First, there is the need to determine focal points for research. In this regard, it must be determined if research will be done on a regional or national basis. At a regional level, institutions like ADB, Japan International Cooperation Agency, World Bank, UN-Habitat, World Health Organization, Economic and Social Commission for Asia and the Pacific, and the Asian Institute of Technology (Bangkok) can be focal points. At a national level, the

Marga Institute (Sri Lanka), the Ateneo Center for Social Policy and Public Affairs at the Ateneo de Manila University (Philippines), the National Institute of Public Finance and Policy (New Delhi, India), and PERPAMSI (the association of water utilities in Indonesia) are examples of potential focal points. Institutes aside, any university in Asia that wishes to undertake research on Asian urban water supply issues in connection with a thesis for a master's or doctorate level degree could be a potential focal point. The University of Tokyo has been working with ADB for several years on such topics. Where regional institutions like ADB are involved, it is more natural for the research assignment to be undertaken by selected consultants.

C. Funding Research

Whether it is conducted by World Bank, ADB, or any other institution involved in urban water supply development in Asia, there is a need for research and for funding that research. In this way all stakeholders will be more aware of facts, and important policy reform decisions based on these facts can be made. The two institutions mentioned have access to special water cooperation funds, which are heavily supported by the Dutch Government. The World Bank's Water and Sanitation Program is supported by bilateral development agencies. ADB has its own budget for advisory technical assistance. Most important of all, however, is that the participating government or governments request support for research on the topics mentioned above. There has to be an expressed need. There will also be strong competition for funds, so the justification must be strong and well presented.

Research in a Nutshell

- Research is a part of the very necessary effort to increase awareness and understanding among all stakeholders.
- Researchers should balance social, economic, and environmental considerations.
- Research should target income profiles, subsidies, service levels, SSWPs, intermittent supply, alternative supplies, health factors, price elasticity of demand, the urban poor, illegal use, illegal sales, corruption, pollution, groundwater, and PSP.
- Focal points are universities, institutes, and water associations.
- Funding could be sourced from ADB, World Bank, and bilateral development agencies.
- Results should be posted on the Internet.

Chapter 18

Guiding Principles

The purpose of this chapter is to take a step back and see the big picture, so that the messages in this book may be viewed against broader perspectives.

- *We neglect history at our peril. Lord Raleigh once observed that a lack of understanding of history meant that the heights of technical achievement were reconquered again and again at great intellectual expense.*
- *Sensitivity and compassion must be at the root of any development project.*
- *Success in the past came because the people who ran (an undertaking) had a stake in it.*
- *Security of supply is important.*

Bob Norman, past President, Institution of Professional Engineers, New Zealand. *Engineering Heritage: Artifact or Instrument?* Keynote address, ALGENZ Conference, Dunedin, New Zealand. (Norman,1998)

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- *In just the first 10 weeks of the cholera epidemic in Peru, losses from reduced agricultural exports and tourism were estimated at $1 billion, or more than three times the amount invested in water and sanitation services in the whole country during the 1980s.*

John Briscoe, World Bank. *When the Cup is Half Full*. Article for *Environment—Water and Sanitation Success Stories*. (Briscoe, 1993)

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- *Our voice must be for those whose access is always threatened—the poor, the slum dweller, the dispossessed.*
- *We know that women are the key, even if we don't use the key yet. Women must be written into the water equation. It takes courage to break the mold.*
- *Data is not information. Information is not knowledge, and knowledge is not wisdom.*
- *There is enough water. It is only that we do not use it wisely enough.*

Margaret Catley-Carlson, former Chairperson, Water Supply and Sanitation Collaborative Council. (Catley-Carlson, 1997)

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- *What we did in Curitiba was essentially a partnership with the people.*
- *We planted one million trees.*
- *Separate used water. This represents a colossal economy and the possibility of treating effectively all the city sewage, avoiding river pollution.*
- *What will make cities different is their ability to reconcile with nature and their inhabitants.*

Mayor Jaime Lerner of Curitiba, Brazil. *Intervention in Curitiba, Brazil*. Paper presented at the Water Supply and Sanitation Collaborative Council Meeting, Rabat. (Lerner, 1993)

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- *The Asian vision requires urgent action to reach the underserved and unserved population.*
- *It requires good governance and compassion for transparency and accountability and corruption-free practices.*
- *We agree on a gender-sensitive, people-centered, and self-reliant development model that promotes consultation and dialogue between and among all stakeholders, empowering those who are socially and economically disadvantaged.*

***Vision 21 of the Water Supply and Sanitation Collaborative Council*.** (Water Supply and Sanitation Collaborative Council, 2000)

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We need a water ethic, a guide to the right conduct in the face of complex decisions about natural systems we do not and cannot fully understand. The essence of such an ethic is to make the protection of water ecosystems a central goal in all that we do. It is no more radical a notion than suggesting that a building be given a solid foundation before raising it 10 storeys high. Water is the basis of life and our stewardship of it will determine not only the quality but the staying power of human societies. Living by such an ethic would mean using less whenever we can and sharing what we have. The challenge is to put as much human ingenuity into learning to live in balance with water as we have into controlling and manipulating it. The last oasis is conservation, efficiency, recycling, and reuse.

Sandra Postel. *Last Oasis—Facing Water Scarcity*. (Postel,1997)

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Guiding Principles in a Nutshell

- Learn from history. Success in the past came because the people who ran an undertaking had a stake in it.
- Partner with the people and civil society.
- Plant a million trees.
- There should be a sustainable water ethic for all.
- Good governance is at the core.
- Target the underserved and those not served.
- Remember the epidemics.
- Write women into the equation.

Chapter 19

Strategy for Action

There is no blueprint for improving urban water supplies in Asia. Every country and every city have their own unique social, political, physical, and economic environment that will determine what is appropriate in regard to development. Nevertheless, it will be useful for governments and utilities to have a general strategy for action. The purpose of this chapter is to condense the findings of this book into one "nutshell," representing a framework for action. Remember that all solutions are dependent on the resolution of the core problems of governance and tariffs, which can be accomplished by introducing transparent policies, independent regulatory bodies, and involvement of civil society.

One way of involving civil society is to hold stakeholder consultations as a basis for formulating government policy. First comes the identification of key stakeholder groups. These may include (i) urban poor using vended water, (ii) small-scale water providers, (iii) domestic consumers, (iv) industrial consumers, (v) utility staff, (vi) utility management, (vii) unions, (viii) government officials, (ix) politicians, (x) the private sector, (xi) development agencies, (xii) NGOs, (xiii) academics, (xiv) the media, (xv) consultants, (xvi) contractors and suppliers, and (xvii) professional associations. Second come separate stakeholder consultation meetings, convened by the government, with each group. Ideally these would be 2-day meetings and *Asian Water Supplies* would be used as a sourcebook throughout. The first day would be for listening to ideas of stakeholders regarding problems and solutions. The second day would be for responding to findings and offering further solutions. A representative of the stakeholder group should be elected. After the proceedings of the first stakeholder consultation meeting for all stakeholder groups have been documented, they should be analyzed as a whole and one report prepared for dissemination to all stakeholder groups. A second phase stakeholder consultation should then be held with representatives of stakeholder groups to discuss the findings. At this meeting, experts from successful water utilities in the region (for example, those from Bangkok, Dalian, Malé, and Phnom Penh) could be invited to tell their stories. Finally, a draft government policy statement would be prepared, based on the views of stakeholder representatives.

In this book there are chapters on specific topics, and at the end of these chapters the solutions in a nutshell are presented. This chapter brings all these together in one place. It is best to view this as a menu from which selections can be made as appropriate for a given enabling environment and location. All the solutions from the chapters are unlikely to be applicable in any given situation, but many can be. It is also important to remember that none of these solutions will work unless the core solution of good governance (policy, regulation, and civil society involvement) and a paradigm shift in tariffs (funding investments out of tariffs) are first addressed.

Realities

- Coverage with piped water does not always require major urban water utilities to seek funds from external sources.
- Shortage of water is not the reason for intermittent water supply.
- The poor are willing and can afford to pay the full cost of piped water.
- It is not possible to run a $20–100 million per year commercial operation (selling water) with civil servant rules and salaries.
- Reducing NRW below 20% of production is economically justified.
- The private sector will not always bring much needed funds for development to the table and improve water utility efficiency.
- In answer to rapid urbanization, it is not necessary to go farther and farther afield to find more water sources.

- Intermittent water supply is not OK.
- Appropriate legislation does not always allow a water utility to operate with autonomy.
- Water utilities suffer when the money trail runs through governments.
- Households in Asia do not need 200 l/c/d.
- Private operators are not always the cause of higher tariffs.
- Regulatory bodies are not only needed because of private sector contracts.
- Private operators are not always eager to serve the urban poor.
- Private sector participation does not always bring competition.

Problems and Solutions

- An individual problem, such as NRW, cannot be solved in isolation. It can only be addressed after the core problems have been resolved.
- The core problems are poor governance (including corruption) and low tariffs.
- The core solutions include a transparent policy, an independent regulatory body, a paradigm shift in tariffs, and the involvement of civil society.

Water Resources Management

- Water policies and social auditing are needed.
- Have long-term planning horizons.
- Introduce demand management through awareness and pricing.
- Plant more trees to rehabilitate watersheds.
- Plant crops that use much less water than do rice, cotton, and sugarcane.
- Do not subsidize water management.
- Remember the triple bottom line: environmental, social, and economic development.
- Develop rainwater harvesting in cities.
- Remember the beavers—build check dams.
- Trade customary water rights.

Water and Sanitation Service Coverage

- Compare the number of connections with the number of people.
- Examine the extent of intermittent water supply.
- Examine the extent of standpipe supply.
- Examine on-site sanitation versus sewerage versus treatment.
- Undertake independent professional audits of service levels.
- Analyze root causes of inadequate coverage.
- Promote awareness of the situation among civil society.
- Address as a priority the needs of those with no access to piped water.

Intermittent Water Supply

- Promote awareness among stakeholders.
- Address governance issues related to the autonomy of utilities.
- Introduce higher tariffs for 24-hour zones.
- Place moratoriums on new connections.
- Invest in hydraulic modification of distribution systems.
- Start with 24-hour zones, and then expand these.
- Enforce strict metering and collection.
- Reduce NRW.

Water and Poverty

- Public audits are needed to obtain facts about service levels.
- Policies are needed that focus on providing the poor with piped water.
- Raise tariffs to connect the urban poor.
- Employ a block tariff structure, but watch the sizes and prices of blocks.
- Soften terms of payment for connection fees.
- Eliminate standpipes wherever feasible.

- Encourage civil society (NGOs) to champion the poor.
- Detach land tenure issues from access to piped water.
- Governance is at the core of the solutions.
- Develop knowledge bases related to the water needs of the urban poor.
- Enable the poor to influence decision making.

Small-Scale Water Providers

- Services provided include distribution pipework for utility water and/or groundwater, kiosk sales, pushcart and tanker vendor deliveries, and neighborhood resale of utility water.
- Water sources (whether legal or illegal) are mostly water utilities, but also groundwater.
- SSWPs sometimes generate more revenue than formal utilities.
- In default of the water utility, SSWPs provide the urban poor with essential services. Many SSWPs are also poor.
- The great inequity: the connected can pay $4 for 30 m^3 and those not connected (supplied by SSWPs) can pay $20 for 6 m^3. The status quo is maintained by those with vested interests.
- In many cases, SSWPs are not formally recognized by utilities or local governments.
- Tariffs are higher than those charged by utilities but connection fees are lower.
- SSWPs provide more flexible arrangements for connections and payments than water utilities, leading to better relations with customers.
- Officials need to learn more by auditing existing utilities and SSWPs, so that SSWPs can be registered and recognized but not regulated (yet).
- Residents need to have clear policy statements from governments on piped water coverage and SSWPs. Governments should include SSWPs in water supply strategies.
- SSWPs need access to financing.

Management

- Policies must provide autonomy and revenue (tariffs).
- There should be accountability through regulatory bodies and annual reports.
- Organization development is necessary.
- If you cannot measure, you cannot manage.
- Incentives must be linked to performance.
- Use open market salaries for professionals.
- Give O&M prestige.
- Interface between staff and consumers should be given importance in the field.

Non-Revenue Water

- Governance and tariffs must be tackled first.
- Leak-detection equipment comes last, not first.
- Repair visible leaks.
- Make utility staff responsible for small zones (caretakers).
- Meter all production and consumption properly.
- Add district metering.
- Provide incentives for utility staff performance.
- Explore links to water vendors.

Sanitation

- There is a need for explicit government policies.
- In densely developed areas, conventional centralized sewerage systems are a must.
- In less densely developed areas, it may be possible to construct decentralized small sewerage systems with local, appropriately landscaped, sewage treatment facilities.
- On-site sanitation is OK, if the plot size and ground permeability are adequate and the groundwater table is low.
- Eco-sanitation (not mixing feces with water) has promise.
- Reed bed technology for treatment of wastewater is OK.

- Target the urban poor as a matter of priority.
- Divert development agency and government funding from major urban water supply projects to urban sanitation projects.
- Solutions must be part of integrated water resources management.
- Opt for community sanitation facilities, like those in Pune.
- Get the facilities and education in the schools first.

Tariffs, Subsidies, and Development Funding

- Tariffs begin with policy—analyze subsidies.
- Tariff reform is a manifestation of good governance—fewer subsidies.
- Alter the money source from governments to consumers.
- Those connected must pay more so that those not connected can get piped water.
- No question of affordability—the hidden economy proves this.
- Block tariff structures are best when income profile varies greatly.
- Fund investments directly from tariffs—the PRC is doing this now.
- Connection fees can be absorbed by tariffs.
- Tariff reform is needed to encourage PSP.
- Higher tariffs make good things happen in terms of water development options.

Private Sector Participation

- Manage the process of change.
- Domestic PSP is preferred.
- Contracts should be based on policies.
- Consider exit strategies for internationals.
- Tariff reform is a prerequisite.
- Competition and transparency are musts.
- Public-private partnership has promise.
- Principles and guidelines are needed.
- Independent evaluation will help.
- SSWPs should be included.
- Regulatory arrangements must come first.

Governance

- Transparent policies and independent regulators are needed.
- Tariff reform to put consumers in control is necessary.
- Civil society involvement is a must.
- Good things happen when tariffs are raised.
- Governance is at the core of all solutions.

Government Policy

- Obtain good field data and analyze them.
- Consult with stakeholders and civil society.
- Address governance and tariff issues.
- Address NRW, service levels, SSWPs, and the urban poor.
- Address PSP and public utility performance incentives.
- Address the roles of institutions in the sector.
- Civil society will monitor policy implementation.
- Regulatory bodies will monitor policy implementation.
- NGOs and the media will bring policies to the people.

Regulation and Benchmarking

- Regulation and benchmarking should be based on transparent government policy.
- The objective is autonomy and good governance through accountability, transparency, equitability, and efficiency.
- Why, what, who, and how must be addressed.
- There are three options: (i) one regulator, (ii) body of experts, or (iii) body of stakeholders.
- Civil society is the ultimate regulator.

- PSP contracts should be based on policy, not on regulation by contract.
- PSP and public water supplies should be regulated.
- Information technology improves transparency.
- Operators need incentives based on performance.
- Stakeholders should design the journey, which is a dynamic process.
- Benchmarking is fundamental to regulation.
- Evaluating utilities on governance and performance is desirable.

Civil Society Involvement

- Consumers indicate governance and tariffs are core problems.
- Focal points are NGOs, academics, and journalists. City forums help.
- Civil society needs to be better informed.
- Starting point is involvement through key stakeholder consultation in formulating government policy.
- Public awareness and transparency are keys to civil society involvement.
- When consumers pay the full price of water, they will be in the driving seat, which is the objective.
- Civil society should interact with the regulator.
- NGOs can champion the poor and can form consumer societies.
- Academics can investigate facts, especially concerning subsidies.
- The media can be powerful, but first it must be well informed.
- Civil society involvement promotes good governance by monitoring the implementation of government policy.

Research

- Research is a part of the very necessary effort to increase awareness and understanding among all stakeholders.
- Researchers should balance social, economic, and environmental considerations.
- Research should target income profiles, subsidies, service levels, SSWPs, intermittent supply, alternative supplies, health factors, price elasticity of demand, the urban poor, illegal use, illegal sales, corruption, pollution, groundwater, and PSP.
- Focal points are universities, institutes, and water associations.
- Funding could be sourced from ADB, World Bank, and bilateral donors.
- Results should be posted on the Internet.

Guiding Principles

- Learn from history. Success in the past came because the people who ran an undertaking had a stake in it.
- Partner with the people and civil society.
- Plant a million trees.
- There should be a sustainable water ethic for all.
- Good governance is at the core.
- Target the underserved and those not served.
- Remember the epidemics.
- Write women into the equation.

Chapter 20

Messages to Stakeholders

It is useful to summarize the main messages of this book as given in A and B below. And let us not forget the Problem Chart and Solution Chart in Chapter 2, which give a more visual explanation of these messages. Messages C and D place the urban water supplies of Asia into a broader context.

A. Creating the Enabling Environment (Governance)

We need transparent policies and an independent regulatory environment that will give autonomy to water utilities, equitability of service, and a paradigm shift in tariffs. None of this will be possible without the active involvement of civil society.

B. Hike Tariffs to Help the Poor

It may sound strange, but the best way to help the poor is to hike tariffs. In this way, the poor not being served can receive service, and those with an intermittent water supply can get 24-hour piped water in their homes. Questions of affordability and willingness to pay are best answered by the poor themselves, who invariably declare that they are willing to pay for water, if they get good service.

C. Water as the Entry Point for Development

Water is a basic human need. Improving the lives of the urban poor must start with water and sanitation. Success here will give these people hope and show the way to other development needs, including health and education. Water supply must be integrated into other urban development needs.

D. Water and Culture

The future rests with the young. It is time for them to learn about the ancient links between water, culture, and religion. In this way, they might find again the spiritual qualities of water, and give water—this precious resource—the respect and reverence it had in the past.

Developing Wastewater Services in Emerging Market Economies: The Cases of China and Ukraine

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Delivering affordable, dependable and sustainable wastewater services is a challenge for local governments worldwide. But it is an especially tall order in emerging market economies, in which the old service norms, institutional forms and pricing policies often constrain the development of autonomous and competent wastewater service providers that can develop their systems to meet users' needs and collect sufficient revenues to cover their costs.

China and Ukraine are two countries that are wrestling with the problems of developing sustainable wastewater collection and disposal services while their economies transition toward the market. This paper examines the performance of local governments and their Wastewater Service Providers (WASPs) in selected towns in both countries and seeks to identify the factors that contribute toward improving service quality and achieving financial sustainability.[1] The goal of the analysis is to draw conclusions that may be applicable to WASPs in other emerging market economies.

The paper will examine in turn three aspects of wastewater service delivery — institutional arrangements, service pricing and stakeholder participation — in each of the two countries. For each aspect, the paper will briefly define the Chinese and Ukrainian contexts and identify the main problems faced by WASPs and local governments (LGs). A final section will attempt to draw conclusions about the types of interventions that could be successful in promoting improved service delivery in the future.

Institutional Arrangements for Wastewater Service Delivery

In both China and Ukraine, wastewater service delivery is a devolved function for which local governments are responsible. Ukraine's law "On Local Government" of 1996 makes LGs responsible for the provision of a number of "communal services," including piped wastewater collection and disposal. Most LGs execute this official mandate through "vodokanals," which are legally independent organizations that are nominally owned by the local community (residents of the town or city) but in practice operate under the direction of the local government. (A minority of vodokanals or their fixed assets are leased to private companies.) Vodokanals are generally responsible for water supply and piped wastewater collection and disposal.

Chinese towns are also responsible for the delivery of local wastewater services. In small cities and towns, services are usually provided by a municipal department, often operating independently from the water company, a municipally owned utility. In large cities, wastewater collection and disposal services are generally carried out by municipal departments or LG-owned water/wastewater companies.

The broad outlines of the institutional arrangements in both countries are favorable to responsive, sustainable wastewater service delivery to the extent that local governments can design and implement their own programs. However, the specific roles and responsibilities of

[1] The material in this paper is drawn from two technical assistance projects implemented by Planning and Development Collaborative International, Inc. (PADCO): the ADB-financed "Town-Based Urbanization Strategy Study" (TA 4335-PRC) implemented China in 2004-2005, and the USAID-financed "Ukraine Tariff Reform and Communal Services Enterprise Restructuring Project" implemented in 2000-2005.

the WASPs are insufficiently defined, and there are few incentives for WASP managers and staff to improve institutional performance and/or service quality.

In the Chinese case, the operational environment for wastewater delivery is first and foremost undermined by the political imperatives of local government leaders. In recent years, the Government of the People's Republic of China (PRC) has put heavy emphasis on economic growth. Local government leaders — both in the Party and the town or city government — are evaluated based on the amount of new investment they leverage and the increase in local economic output. Prospects for promotion within the party and to larger urban settlements will depend first and foremost on economic growth. The degree of environmental sustainability of local growth is not an evaluation criterion. These political priorities do not incentivize improvements in urban environmental infrastructure generally or in wastewater service delivery in particular. On the contrary, many officials are driven to undertake any investment project that will boost growth, regardless of its impact on the environment.

Another constraint in Chinese towns is the dependence on decision-makers at higher levels of government in order to improve wastewater services. Large capital investment projects and tariff increases require approval of higher-level governments, such as a county, county-level city or prefecture-level city.

Finally, the performance of many Chinese WASPs is undermined by their separation from water service providers. It is much more effective to bill customers for wastewater and water supply services at the same time (through the same bill), given that willingness-to-pay for water supply is always higher than willingness-to-pay for wastewater collection. The fact that water suppliers are able to disconnect their customers in case of non-payment also contributes to higher payment collection rates, which benefit wastewater service providers also when billing is combined.

Unlike their Chinese counterparts, Ukrainian local have the authority to set tariffs for wastewater services delivered by vodokanals (communal service enterprises) without higher-level approvals. The vodokanals calculate the tariffs and make a proposal to the LG, which approves the tariff by action of its executive committee. While the autonomy afforded by this arrangement is an asset, it also subjects the pricing of wastewater services to the vagaries of local government politics in an emerging democracy. Many Ukrainian mayors feel that raising the prices of communal services will lower their chances of being reelected. The old notions of water as a public good that the State should provide for free run deep in Ukrainian society, especially among older people and pensioners, which make up a large portion of the total population. It takes a progressive local government leader to decide that raising tariffs is either (i) the right thing to do for sustainable service delivery, despite its unpopularity, or (ii) can be fashioned into a political asset by emphasizing improvements to service coverage or quality.

Economic growth continues to trump environmental protection in Chinese towns.

In both Ukraine and China there is a general lack of clarity about the roles and responsibilities of WASPs vis-à-vis municipal owners and end users (customers). There are few written agreements between local governments and wastewater service providers specifying the responsibilities of the wastewater service provider with respect to service levels, capital investment financing, and service pricing (tariffs). The obligations of the local government — in effect, the LG's contribution to improving wastewater services — are also underarticulated: there is no specific commitment by the municipality to provide financing for improvements, build public support for increasing payment collection, or approve necessary tariff increases. At the same time, there are no contractual agreements between WASPs and end users. In this operational environment, the wastewater service provider lacks clear targets to work toward and clear commitments from the city and customers to assist in achieving institutional and sector objectives.

Pricing of Wastewater Collection and Disposal Services

At its best, the pricing of urban services such as wastewater collection and disposal is a complex, interdisciplinary and flexible exercise through which interested parties set prices to achieve a set of often conflicting objectives. On the one hand, user charges should be affordable to customers. On the other hand, tariffs should be set to ensure the level of revenue needed to keep providing decent services in the future. Where fixed assets require rehabilitation or coverage must be expanded, tariff revenues may have to cover capital investment costs too. In a successful service development planning and tariff setting process, the different parties work together to find common goals and then formulate interventions to achieve them.

Such a "holistic" view of the tariff setting process is not yet widespread in Ukraine. In the 1990s, most municipalities, despite being responsible for service pricing, distanced themselves from this process in order to limit perceived political damage. Cities would posit themselves as the arbiter of the tariff setting process, a role that assumes conflicting views among vodokanals and customers. Generally siding with the customers in order to strengthen their position for future elections, municipal governments would generally reject tariff increases proposed by vodokanals, thereby locking the WASPs into a downward spiral of aging assets, rising energy costs and financial shortfalls.

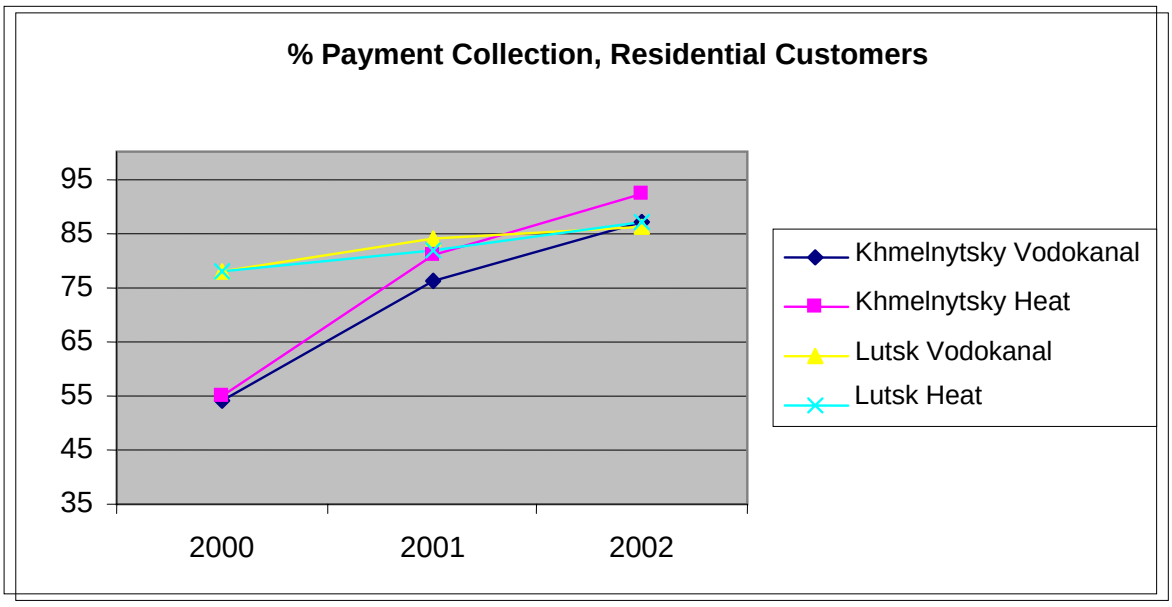
Wastewater service pricing in China is also influenced by the notion of water supply (and by association, wastewater) as a public good to which all citizens are entitled. Local government leaders are wary of raising water and wastewater tariffs, which are consequently below the level required for recovery of operation and maintenance (O&M) costs in most towns.

In cities in China and Ukraine, extensive capital investment is needed to ensure adequate future service delivery. In China, it is necessary to expand coverage of piped wastewater collection services in response to rapid urban development and to build appropriate wastewater treatment facilities. Ukrainian municipalities need to rebuild pumping stations and treatment plants to reduce energy consumption and lower energy costs; moreover, much of the aging piped network needs replacement.

Under the principle that the customer should bear as much of the cost of service provision as possible, WASPs in both countries should calculate new tariffs that cover O&M costs and whatever share of investment costs the end user can bear. This calculation requires knowledge of household income and expenditures. Ability-to-pay analysis was carried out under the USAID-financed Tariff Reform and Communal Services Enterprise Restructuring Project in two Ukrainian cities (Lutsk and Khmelnytsky) to evaluate the impact of alternative hypothetical tariff scenarios on household finances. The analysis concluded that there was additional disposable income, and that it would be possible to raise water and wastewater tariffs without surpassing the normative "15% limit" set by the local governments: combined housing and communal services costs should not exceed 15% of the income of a household at the 25th income percentile.

On the basis of this analysis and extensive stakeholder consultation, the City of Lutsk decided to increase its water and wastewater tariffs by 32 percent in June 2002. In combination with increased payment collection, the higher tariffs provided enough revenue to cover O&M costs and finance a modest $500,000 short-term capital investment plan.

Following on the Lutsk experience, three-quarters of the 29 communal service enterprises that graduated from the Tariff Reform Project over the period 2002–2005 achieved cost recovery through a combination of tariff increases, higher payment collection rates and operational cost reduction (27 enterprises were loss-making at entry into project).



Municipal public works departments and wastewater companies in China also desperately need to raise tariffs in order to generate financing for the construction of wastewater treatment plants. But there is no standard methodology for calculating tariffs that include a component for O&M and another component for capital investment. And ability-to-pay

analysis is not used to systematically evaluate the capacity of customers to pay more. Perhaps most critically, there is no established public forum in which packages of service improvements and pricing options could be discussed and agreed with customers and other stakeholders in Chinese cities in towns.

Stakeholder Participation in Wastewater Service Delivery

The Government of the PRC is currently pursuing a goal of creating a “harmonious society” in which the benefits of growth are equitably distributed among different population groups. Equitable distribution of the benefits of urban development requires dialogue among the various concerned parties: local governments, real estate developers, holders of use rights to land, buyers of newly created real estate products, and users of wastewater and other municipally provided services. In China today, however, customers do not have a voice in the provision of urban services. Decisions about service levels and coverage in many cities are taken primarily based on engineering requirements and the availability of capital investment subsidies from higher-level governments. There is no systematic consultation of different population groups, and end user preferences and priorities are not incorporated into the service planning and pricing process.

The investment requirements of Chinese towns and cities in the area of wastewater treatment are staggering. If the current trend in environmental degradation of surface and ground water supplies is to be halted, thousands of urban settlements across the country will need to build wastewater treatment facilities. Under current conditions — an unfunded mandate to provide services coupled with insufficient authority to increase tariffs — it would seem difficult for Chinese WASPs to respond to the challenge. Any successful approach to improving service levels will have to be multi-pronged, but one important aspect is likely to be improving relations with stakeholders: the users of wastewater collection and disposal services. In the respect, the recent experience of Ukrainian cities may prove instructive.

In the 1990s Ukraine adopted a representative democratic form of government in which executive and legislative officials are elected at the local government level. This system requires some degree of responsiveness to the priorities of the public on behalf of local mayors and council deputies. But as described in the service pricing section above, elected officials have in many cases acted as arbiters rather than leaders in the area of urban services provision. This is now changing. Town halls in such cities as Komsomolsk, Chernigiv, Kalush and Lutsk have forged partnerships with their communal service enterprises (including vodokanals) and the local stakeholders.

Where such partnerships have been forged, the parties have been able to agree on and implement substantial improvements in service delivery and sustainability. The process in most towns has followed this general outline:

1. Build customer awareness. Conduct public outreach and carry out media campaigns to educate the public about the need to rehabilitate or expand wastewater systems, to increase revenues in order to pay for improvements, and to pay for services in order to ensure the financial viability of vodokanals.
2. Gather information on customer preferences and priorities. Conduct focus groups and/or customer surveys to find out what customers see as the major problems, what types of service improvements are most important to them, and whether they are willing to pay more in user charges in order to receive better services.
3. Formulate proposals that respond to customers’ stated priorities. In the process of service planning and capital investment programming, include the projects and operational changes that will improve coverage, improve wastewater treatment, protect local rivers and streams, etc. Formalize these proposals into strategic action plans.

4. Garner public support for the strategic plans. Publicize the plans by distributing summary versions of them, posting them in public places for review, and holding public hearings on the plans.

Public hearings in Ukraine are used to build stakeholder support for wastewater services reform.

Participants in focus groups and public hearings can be presented with different technical/pricing options that have different sets of capital improvements associated with them. Each option or scenario is presented as a package; for example, achieving 24 hour a day water supply (from scheduled delivery) will necessitate a 20% tariff increase, while 24/7 water *and* higher water pressure above the second story will entail a 30% increase. Participants should be able to evaluate the costs and benefits of each package themselves, and contribute their opinion to the decision-making process.

Conclusions

This brief review of the wastewater sector in Chinese and Ukrainian towns indicates that there is great scope for refining and improving institutional arrangements, pricing policies and stakeholder participation. The following concrete recommendations are set out for consideration by policy-makers and practitioners in emerging market economies.

- Reinforce the legal and regulatory basis of WASPs so that they can establish technical service targets, plan capital investments and set prices in collaboration with local governments and stakeholders;
- Develop and implement service agreements in which the rights and responsibilities of local governments and WASPs are clarified. Local government commitments to achieving service delivery targets must be spelled out clearly;
- Get the incentives right for improved performance of WASPs and LGs. Link improvements in wastewater services and environmental protection to the career advancement among civil servants and elected officials.
- Unite the entities responsible for water supply and wastewater collection into a single organization responsible for both services. This will improve service planning and facilitate tariff payment collection;
- Use ability-to-pay analysis to determine how much local households can afford to pay for improved wastewater services;
- Use customer outreach techniques such as focus groups and customer surveys to determine end user preferences and priorities with respect to wastewater service levels and coverage.
- Develop a tariff calculation methodology that includes a capital investment component.

- Develop and evaluate alternative capital investment and tariff scenarios with input from stakeholders;
- Build consensus for a preferred option or scenario through information dissemination and public hearings.
- Implement the strategic plan.

Successful Approaches to Improving Wastewater Management and Sanitation in Pakistan

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The paper outlines the planning, methods and results of working with members of small and medium sized rural communities to meet identified needs for wastewater management and sanitation. The projects were designed and implemented by the National Rural Support Programme, Pakistan's largest NGO.

Although many rural people recognize the need for wastewater management and sanitation, these remain neglected issues in the majority of villages, in part because people assume that the Government is responsible for funding and implementing the necessary infrastructure. Since economically-marginal villagers cannot afford the costs themselves, innovative methods of raising funds and providing expertise are required.

The paper argues that NRSP's methods of 'mobilizing' villagers provide a basis from which to overcome the inertia and to address these critical problems. NRSP has successfully implemented hundreds of wastewater management and sanitation schemes, using social mobilisation and drawing on social capital. It has implemented these projects through small Community Organizations and larger Village Organizations. NRSP has also worked with members of District Governments to fund and implement small and large-scale projects.

The paper describes the methods used to accomplish these activities. It also describes the benefits to everyone involved in participatory methods. It argues that the practices followed by NRSP provide a model for other NGOs and Government departments interested in similar activities.

CONTENTS

SUCCESSFUL APPROACHES TO IMPROVING WASTEWATER MANAGEMENT AND SANITATION IN PAKISTAN

Dr. RASHID BAJWA
NATIONAL RURAL SUPPORT PROGRAMME
PAKISTAN

Introduction

This paper outlines the planning, methods and results of working with members of a number of small and medium sized rural communities to meet identified needs for wastewater management and sanitation. The projects were implemented by the National Rural Support Programme (NRSP), Pakistan's largest NGO.[1]

Since NRSP's mandate is to alleviate rural poverty, it is central to NRSP's philosophy that the economically-marginal have the right to decent sanitation systems in their communities. It is an operating principle at NRSP that any physical infrastructure project, including wastewater management and sanitation schemes, must benefit the majority of households in a village and must include the poorest community members.

In describing an integrated, community-based approach to wastewater management and disposal, the paper identifies a proven method of overcoming the prevailing combination of dependency and mistrust that exists with respect to village development projects in most rural communities in Pakistan.

Wastewater Management Issues in Pakistan

Only 13.5% of rural households in Pakistan have any sewage collection and disposal system[2], and many of these provide only minimal 'disposal' *i.e.* untreated waste is deposited in open gutters in laneways or, at best, in fields at the edge of the village. In the projects carried out by NRSP, 90 to 100% of the households did not have a latrine prior to the project.

In most villages, the narrow lanes between the houses are not properly surfaced, which means that rainwater, kitchen runoff, animal waste and human waste accumulate in the streets. In the majority of rural areas, household, farmyard and small-scale industrial effluents flow into surface ponds, rivers or the canal irrigation system. Whether the wastewater seeps into the soil or flows into the drinking water supply, water borne diseases are only one aspect of a 'negative nexus' that follows from poor sanitation and wastewater management.

NRSP's Portfolio of Projects

NRSP's Wastewater Management and Sanitation projects are part of a long-term effort to implement physical improvements in communities. NRSP's portfolio of Community Physical Infrastructure (CPI) schemes includes drinking water supply schemes, communication (i.e. link roads and small bridges) schemes and agriculture-related

[1] NRSP is one of ten Rural Support Programmes operating in Pakistan.
[2] Bhutta, Dr. M. Nawaz

projects (many based in improving the supply of irrigation water) in addition to sewerage and drainage schemes.

NRSP's Physical Infrastructure and Technology Department had implemented 617 of these Community Physical Infrastructure schemes prior to 2000.

NRSP became a partner of the Pakistan Poverty Alleviation Fund (PPAF) in the year 2000. That partnership enabled NRSP to rapidly scale up its CPI programme. Since then, NRSP has implemented 143 stand-alone drainage and sanitation projects with funding from the PPAF. (See Appendix A) These projects have benefited 11,241 households, and cost a total of Rs 58,466,366 (USD 974,472).

NRSP has implemented five large scale Integrated Community Physical Infrastructure Projects with PPAF funding. These have a combined value of USD 165,870. (See Appendix B)

There have also been 268 Sanitation projects implemented by NRSP with funds from other donors, including the Barani Village Development Project,[3] Islamic Relief, ActionAid and the D. G. Khan Rural Development project. These are detailed in Table 2, Appendix A. These have benefited almost 75,000 households.

In a few cases, NRSP has implemented large-scale sanitation projects with funds from foreign donors: Canada's CIDA, for example, has provided funds for NRSP-implemented large-scale sanitation projects in Lodhran (southern Punjab).

Technological and Social requirements for successful wastewater management Projects

In its 13 years of operation NRSP has found that the only way to achieve a comprehensive solution to wastewater management and sanitation problems is to devise projects based on community requirements and to involve community members at every stage, from identifying needs to the long-term maintenance of the projects. These needs must be understood in both technological and social terms and the two must be integrated with each other, if a project is to be both successfully implemented and sustained in the long term.[4]

Social Mobilisation

Because the history of rural development in Pakistan is largely a history of under-performance, mistrust and apathy, it is necessary to build trust between a development NGO and rural communities. Since it was founded in 1992, NRSP has used "social mobilisation" as the framework for all of its poverty alleviation and development activities. Social mobilisation begins when NRSP 'Social Organizers' engage in dialogues with members of rural communities. These dialogues are founded on two things: the first is that if they form one or more Community Organizations (COs), each

[3] Funded by the International Fund for Agricultural Development and the Rawalpindi District Government

[4] NRSP's approach to the social aspects of organizing communities to meet their sanitation and wastewater needs reflects that of its exemplar, the Orangi Pilot Project in Karachi, Pakistan's largest city.

with members of 15 to 20 households, and if they pool their human and financial resources, members of rural communities can meet their development needs. Once a CO is formed, the community members prioritize their needs: many identify sanitation schemes as their first priority because they understand the connection between unsanitary conditions very well.

The other requirement is that CO members must work together to make maintain the physical infrastructure of the project for the long term. All COs are encouraged to save small amounts of money regularly: when a CO takes on a sanitation project its members have funds in reserve to make the necessary contribution, which averages about 20%. Households that are poorer than others can contribute to the project by providing labour.

For large wastewater and sanitation projects, several COs form a Village Organisation (VO) to represent the majority of the households. The VO elects a President, a Secretary and a Manager. The CO or VO members are responsible for providing the land for wells, water tanks and filtration ponds. In NRSP's experience there is always someone willing to donate land for these projects.

The next step is for NRSP and the COs (or the VO) to sign a formal 'Terms of Partnership' (ToP) agreement. At least 75% of the community representatives must be present in a meeting to sign this agreement. In the meeting, the NRSP staff explains every detail of the project. Before they sign, everyone involved knows the specifications, the contributions required from all parties, the disbursement schedule for funds, the implementation process and procedures, the time required to complete the project and the estimated annual operation and maintenance costs. They are also aware of the roles and responsibilities of NRSP and other partners.

The CO or VO then constitutes a Project Committee which assumes responsibility for the overall implementation of the project, and the management and operation of the project after its completion. The Committee, working closely with NRSP, supervises the project execution, makes sure that instructions from the NRSP engineer are followed, assigns responsibilities to VO members and keeps accurate records of all activities and expenditures. The committee also records the progress of the work and reports it to NRSP. The same committee maintains the Project records and accounts. If there are any discrepancies, the committee informs the VO members and NRSP as soon as possible.

After signing the ToP, the CO or VO opens a Project bank account. NRSP disburses the grant to the VO in instalments, as each stage of the work is completed. The Project Committee forwards a request to NRSP for the release of the funds in the form of a 'Resolution' signed by at least 75% of the VO members. NRSP's accounting staff check the expenditure vouchers, and the Engineers check the progress and quality of the work. Before releasing the final payment the NRSP Engineer makes sure that the work has been completed satisfactorily and that the best materials have been used.

Working with Local Governments to Implement Sanitation Schemes

In the year 2000 the entire system of Government in Pakistan was re-structured, resulting in decentralized administrative and financial authority. The purpose was to achieve more effective service delivery and transparency in decision-making. Twenty-five percent of each District's development budget is now required to be channelled

through bodies called Citizen Community Boards (CCBs). This has provided an excellent opportunity for NRSP and its member COs and VOs to be registered as CCBs and to utilise some of these development funds for wastewater management and sanitation projects.

Some elected officials, one of them a Member of the National Assembly, have enthusiastically taken up the challenge of joining with NRSP and with COs and VOs to meet these needs. Members of several District Governments have also co-operated, realising that the development funds available to them can be leveraged with community funds and with donor funds (in this case PPAF and NRSP), thereby reducing their costs while accomplishing necessary development projects. Here, too, community involvement following from social mobilisation was the key to completing the project successfully.

Some elected members of District Governments have been slower to respond, perhaps fearing that their role as 'donors' in control of development funds would be diminished. Some also worry that working with an NGO might reduce their authority, or that it might result in more complicated procedures. NRSP always works to dispel these concerns and to encourage potential partners to visit completed schemes and talk to everyone involved.

Training and Capacity Building

NRSP arranges training programmes for the members of the committees established by the COs and VOs. The members learn how to manage the construction process, how to keep records, how to procure high quality materials, and, after project completion, how to properly operate and maintain their projects. They are also encouraged to adopt participatory ways of working: holding regular meetings, ensuring attendance of at least 75% of members in meetings and ensuring that CO members are saving regularly. Members learn how to maintain accurate records and to link the VO with relevant organizations.

When the local Government is a partner in a sanitation scheme, NRSP also trains the relevant Government officials in planning, designing and implementing projects and in mobilising and motivating community members to participate in them.

Technological Requirements of Projects

Members of NRSP's Physical Infrastructure and Technology Development Department, all of them qualified Engineers, assess the needs identified by community members and then create a Project Digest which identifies the technical, economic and environmental requirements for the specific project. In an Integrated Project (Appendix B), this usually includes water harvesting and storage systems, distribution systems, street paving, installing connections to the drainage system in each household, installing sewers, building filtration and water treatment tanks and installing pipes to safely carry treated waste away from the village – either into the fields where it can be used as fertilizer or into a water channel.

The Project Digest also details the costs of the project, including all materials and labour, and the contributions of the community members and NRSP. When a District Government is involved as a partner, its share is also recorded in the project Digest. The

Digest also estimates the operation and maintenance costs, to give the Committees a clear idea of their financial responsibilities.

Potential environmental impacts are also accounted for, although all of the stand-alone or integrated projects are both 'low-tech' and relatively small scale. Care is taken to ensure that only high quality materials are used: this ensures that the systems will last as long as possible and that they will not negatively affect the eco-system.

Monitoring

NRSP has found that regular monitoring is vital to projects. The relevant committees and the NRSP Field Staff monitor the day-to-day activities. If other partners are involved (for example, another funding agency, or members of a District Council), they also check the progress. If a District Government is involved the projects are reviewed regularly in the Union Council[5] meetings. The NRSP Engineering staff produces monthly and quarterly Progress Reports which they forward to NRSP's regional and head offices. They also maintain a daily diary in which they record progress and/or problems.

Lessons Learned

The effects of cleaner streets and a proper wastewater disposal system are clear and immediate: pollution is reduced or eliminated; people can move about more freely to conduct daily affairs; they can also engage in social and ritual events with more comfort, when they no longer have to worry about staying clean. In some communities, people used to say that the dirty streets worried them when they had to attend funerals but that problem has now been solved.

The Projects result in clean streets, which means fewer mosquitoes and other pests. Fewer people fall ill and the children miss fewer days at school. People develop a keener sense of civic responsibility, and keep the streets clean. Although everyone benefits in terms of lower expenditures on health, there are particular benefits for women and children. The economic situation can also improve because of increased crop production from the wastewater.

Mutual accountability is the key to completing the project on time. A truly participatory approach like the one described here requires that all information be shared, and that decision-making be based on trust and full disclosure. Partnerships with elected representatives present a particular challenge, because Government officials have tended in the past to resist sharing responsibility and resource- allocation with village residents. However, the experience so far indicates that everyone involved realizes that they benefit from being part of this participatory method.

Once people have seen how well these projects can work, they are ready to tackle other development projects that are vital to their communities. Members of local Governments are also more willing to become involved in participatory sanitation projects when they have been involved with NRSP and with CO members. A degree of mutual trust and willingness to plan future projects almost invariably results.

[5] A Union Council is the smallest unit in the decentralised system.

Although many rural residents are quite poor, they are willing and able to contribute funds for community development. In the Integrated projects discussed in this paper, CO members contributed a total of Rs 2,070,451 (USD 34,423). If we count the value of the unskilled labour contributed, (usually about Rs 100 or USD 1.67) per day for unskilled labour) this value is a great deal higher. The total community contribution to all of the projects described in this report is Rs 54,289,161 (USD 904,819).

Once it has been demonstrated that effective interaction between partners is successful, endeavours of this kind can be implemented in other villages. NRSP's small-scale efforts in implementing wastewater management and sanitation projects have been scaled up: the integrated village development and sanitation projects described here are also being replicated on a large scale in several Provinces.

Projects using the principles and methods described in this paper represent significant improvements in the physical condition of the villages – indeed, in most cases they represent the first efforts ever, to work with communities to address sanitation issues. They also exemplify the ways that people can be mobilized to work together to respond to sanitation needs.

Perhaps most importantly, both provide tremendous learning opportunities for other organizations interested in demand-driven projects of this kind, and serve as potential models for local governments, other communities and donors interested in implementing wastewater management and sanitation projects.

Reference

Bhutta, Dr. Muhammad Nawaz. Wastewater Reuse and Pollution Control. International Symposium on Community Based Approaches: Towards Integrated Water Resources Management. Islamabad: UNDP, 2004. Pp. 71-81.

APPENDIX A

Table 1: Details of PPAF-funded Physical Infrastructure Schemes (Sanitation, Street Pavement and Drains) from December 2002 to June 30, 2005

Province	Total Schemes Initiated	No. of participating Households		Disbursement	Approved Cost	CO Contribution	Total Cost
Punjab	80	7,521	Rupees	19,047,688	23,050,976	10,049,472	33,100,448
			USDollars	*317,461*	*384,183*	*167,491*	*551,674*
Sindh	19	1,031	Rupees	3,194,400	6,163,892	1,988,325	8,152,217
			USDollars	*53,240*	*102,732*	*33,139*	*135,870*
Baluchistan	2	80	Rupees	456,800	456,800	106,414	563,214
			USDollars	*7,613*	*7,613*	*1,774*	*9,387*
NWFP	41	2,403	Rupees	10,160,060	11,201,313	3,113,572	14,314,885
			USDollars	*169,334*	*186,689*	*51,893*	*238,581*
AJK	1	206	Rupees	1,450,000	1,870,058	467,514	2,337,572
			USDollars	*24,167*	*31,168*	*7,792*	*38,960*
Total	**143**	**11,241**	**Rupees**	**34,308,948**	**42,743,039**	**15,725,297**	**58,468,336**
			USDollars	*571,816*	*712,384*	*262,088*	*974,472*

Note: One USD = Rs 60

Source: Physical Infrastructure and Technology Development Dep't. NRSP.

Table 2: Details of Community Physical Infrastructure Schemes (Sanitation, Street Pavement and Drains) July 2002 to June 30, 2005, funded by non-PPAF donors*

Province	Schemes Initiated	Participating Households	Amount Disbursed (Rs)	Approved Cost	CO contribution	Total Cost
Punjab	261	73,047	100,257,722 (USD 1, 670, 962)	RS 109,443,906 (USD 1, 824, 065)	RS 35,901,458 (USD 598,357)	RS 145,345,364 (USD 2, 422,422)
Sindh	6	1, 868	1, 144, 424 (USD 19, 073)	RS 1, 242, 774 (USD 20, 713)	RS 597, 025 (USD 9, 950)	RS 1, 839, 799 (USD 30, 663)
Total	**268**	**74, 915**	**101, 402, 146 (USD 1, 690, 035)**	**Rs 110, 686, 680 (USD 1, 844, 778)**	**RS 36, 498, 483 (USD 608, 308)**	**RS 147, 185, 163 (USD 2, 453, 086)**

* Barani Village Development Programme (BVDP), Canadian International Development Agency (CIDA) District Governments (DG), Integrated Rural and Urban Development Programme/Khushal Pakistan (IRUDP/KP)

APPENDIX B

DETAILS OF INTEGRATED VILLAGE DEVELOPMENT PROJECTS IMPLEMENTED BY NRSP WITH PPAF FUNDING

Table 1: Dhok Tabarak Shaheed, Islamabad Capital Territory
Participants: 100 households
Total Project Cost: Rs 2,830,275 (USD 47,141)

Component parts of the project	NRSP/PPAF Contribution (Rs)	CO Contribution (Rs)	Total Cost (Rs)	CO contribution
Drinking water supply	499,000	275,114	774,114	36%
Sewer system	300,020	57,200	357,220	16%
Street pavement	754,672	132,827	887,499	15%
Disposal station	100,233	11,000	111,233	10%
Household latrines	1,105,743	368,580	1,474,323	25%
Total	**2,260,668 (USD 37,678)**	**569,607 (USD 9,493)**	**2,830,275 (USD 47,141)**	

Table 2: Integrated Village Sanitation Project
Location: District Mardan (North West Frontier Province)
No. of participating households: 80
No. of participating COs: 4
CO contribution to all costs: 20%
Total cost: Rs 1,967,961 (USD 32,799)

Component	Total Cost (Rs)	NRSP/PPAF Share (Rs)	CO Share (Rs)
Street pavement	1,401,874	1,121,499	280,375
Side drains	346,581	277,265	69,316
Pipe culvert	81,711	65,369	16,342
Disposal Stations	135,795	108,636	27,159
Sign Board	2,000	1,600	400
Total	**1,967, 961 (USD 32,799)**	**157,4369 (USD 26,239)**	**393,592 (USD 6,560)**

Source: Physical Infrastructure and Technology Development Dep't. NRSP.

Table 3: Integrated Sanitation and Development Project
Location: District Badin, Sindh Province

Component	Total Cost	NRSP/PPAF Contribution	CO Contribution	CO contribution %
Drinking water supply	147,564	126,439	21,125	14.32
Street pavement	444,030	344,030	100,000	22.52
Street drains	577,637	396,262	181,375	31.40
Disposal station	154,139	120,389	33,750	21.90
School bathrooms	17,789	13,789	4,000	22.48
Sign Board	5,000	5,000	00	00
Total	**1,346,159 (USD 22,436)**	**1,005,909 (USD 16,756)**	**340,250 (USD 5,671)**	**25.28**

Source: Physical Infrastructure and Technology Development Dep't. NRSP.

Table 4: Integrated Sanitation Scheme
Location: Sudhnoti District, Azad Kashmir
Beneficiary households: 206
No. of participating COs: Nine
CO Contribution to costs: 20%

Component	Total Cost	CO Contribution	NRSP/PPAF Contribution
Drinking water supply storage	2,092,891	418,578	1,674,313
3 latrines each in 2 schools	244,618	48,936	195,745
Total	**2,337,572 (USD 38,959)**	**467,514 (USD 7,792)**	**1,870,058 (USD 31,167)**

Source: Physical Infrastructure and Technology Development Dep't. NRSP.

Street Paving Project
Location: Union Council Bokan, District Jhelum (Punjab)
Beneficiary households: 25 (50 households benefited)
Project Components: Drainage system, street pavement and a sewerage pond
Total Project cost: Rs 421,146 (USD 7,019)
Annual maintenance cost: Rs 12,634 (USD 210.6)
Drainage System cost: Rs 166,692 (USD 2,778)
NRSP/PPAF Contribution: Rs 126,344 (USD 2,105)
District Government contribution: Rs 210,573 (USD 3,509)
Community contribution: Rs 84,229 (USD 1,404)

Street Paving and Drainage System in Mianwali, Khushab (Punjab)
Participating Households: 55
Total cost: Rs 1,050,947 (USD 17,516)
NRSP Contribution: Rs 840,758 (USD 14,013)
CO Contribution: Rs 210,189 (USD 3,503)
Annual Maintenance Cost: Rs 31,530 (USD 525)

APPENDIX C

Before

After

NATIONAL SANITATION STRATEGY

2005

LOCAL GOVERNMENT DIVISION
MINISTRY OF LOCAL GOVERNMENT, RURAL DEVELOPMENT AND COOPERATIVES
PEOPLE'S REPUBLIC OF BANGLADESH

NATIONAL SANITATION STRATEGY

LOCAL GOVERNMENT DIVISION

MINISTRY OF LOCAL GOVERNMENT, RURAL DEVELOPMENT AND COOPERATIVES

PEOPLE'S REPUBLIC OF BANGLADESH

First Published March 2005

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1

CONTEXT

1.1 MDG Target

Sanitation has received international attention in recent times. In September 2000 the United Nations General Assembly endorsed eight Millennium Development Goals (MDG). Two of these goals are directly linked with sanitation-reduction in child mortality and ensuring environmental sustainability. Targets for achieving these goals are to reduce by two-thirds the under-five mortality rate within 2015 and to improve the lives of at least 100 million slum dwellers by 2020 through access to better sanitation. Two years later, in September 2002, the World Summit on Sustainable Development (WSSD) voiced a stronger concern for promoting sanitation. In the Implementation Plan of WSSD, nations agreed to pursue a specific sanitation target: halving the figure of 2.4 billion people who do not have access to basic sanitation facilities by 2015.

The Government of Bangladesh (GoB) is committed to achieve the MDG targets. This commitment is reflected in the draft Poverty

Reduction Strategy Paper (PRSP) that envisages reducing infant mortality rate from the 2000 benchmark value of 66 to 37 by 2010 and 22 by 2015. Similarly, child mortality is to be reduced from 94 to 52 by 2010 and 31 by 2015. To achieve the targets, the government has emphasized improving sanitation as a national priority.

1.2 Impact of Low Sanitation Coverage

As in many other developing countries, sanitation remains a major challenge in Bangladesh. The low sanitation coverage (33%) in Bangladesh poses a serious public health concern. It is estimated that 71% rural households and 40% urban households practice open defecation or use unhygienic latrines. Diarrhea remains a major killer disease. About 110,000 children under five die of diarrheal disease every year. It is thought that one out of four deaths of under-five children is caused by diarrhea. Over 65 million episodes of diarrheal diseases occur annually among under-five children. An average child in Bangladesh suffers 3-4 episodes of diarrheal disease every year. There has been no significant reduction in morbidity rate of diarrheal diseases despite having a high safe water access. Other water-borne diseases are also prevalent.

The high disease burden translates into high healthcare cost. It is estimated that the people of Bangladesh spend no less than Taka 500 crore annually to cover physician's fee, medicine and travel cost to clinics in treating the major water-borne diseases. The cost would be much higher if the loss of income, time spent for patient care, and effect on child development are factored in. Diarrheal diseases in Bangladesh cause the loss of 5.7 million Disabilities Adjusted Life Years, 61% of total DALYS. The poor are the hardest hit by the sanitation related diseases. Loss of income and productivity due to the diseases may push a poor family further into poverty and debt, thereby perpetuating the cycle of poverty.

1.3 Sanitation and Poverty Linkage

The linkage between sanitation and poverty is often overlooked. It is the poor people who suffer most from lack of access to basic facilities and services. Loss of earnings and production are additional handicaps for poor people, for whom physical fitness is the main productive asset. Use of safe drinking water and sanitation facilities, together with improved

hygiene practices, has a direct impact on poverty by reducing the vulnerability of poor people, specially women and children, to disease, ill health and death. Use of improved facilities releases women and girls time for paid work, school and rest, savings are made from household expenditure on medical expenses.

There is hard evidence that sanitation interventions lead to significant improvement in disease control and overall well-being. A study documented that total sanitation coverage and improved water facilities reduced diarrhea by 99%, dysentery by 90% and other stomach-related problems such as intestinal worms by 51%. As a result, monthly medical costs for common illnesses decreased by 55% in rural areas and 26% in urban areas. Working days lost due to illness fell from 77 to 35 days per year, and schooldays lost due to illness fell from 16 to 7 days per year in rural areas. The savings were passed to buying food and clothing. Expenditure on food and clothing increased by 6% and 2% respectively. These figures testify to the poverty alleviation dimension of sanitation intervention. Such evidence has led to the global call for sanitation improvement. In response to the international goal, the Government of Bangladesh (GoB) has expressed a firm commitment to improve the sanitation situation.

1.4 National Sanitation Goal

The national sanitation goal is to achieve 100% sanitation coverage by 2010. This challenging target is much ahead of the MDGs. The government has already taken the initiatives to achieve this national sanitation target in collaboration with development partners and NGOs.

1.5 Objectives of the National Sanitation Strategy

The primary objective of this national sanitation strategy is to delineate the ways and means of achieving the national target through providing a uniform guideline for all concerned.

More specifically, the objectives of this strategy are to:

- address the key sector issues,
- define the roles of various actors and
- guide the creation of enabling conditions for success.

1.6 Scope of the National Sanitation Strategy

The scope of this present strategy is to address primarily the issues related to unhygienic defecation and personal hygiene practice. However, strategies for addressing the issues of solid waste management, and disposal of household waste water and storm water will be considered separately also as a matter of priority.

1.7 Process of Developing the Strategy

The GoB assigned a team of experts to draft a national sanitation strategy for this purpose. A participatory approach was adopted in developing this strategy. Consultative meetings were organized with stakeholders from the central to the grass roots level. However, this is designed as a living document and may be revised from time to time in the light of progress made and changed needs.

2

BASELINE SURVEY ON SANITATION

A nationwide baseline survey was conducted in 2003 to assess the sanitation coverage in the country. The survey covered all rural and urban households. The survey revealed an appallingly poor sanitation scenario in the country. Only 33% of the households were found to have hygienic latrines, while 25% have unhygienic ones. About 55 million people (42% households) do not use any form of latrine. A brief summary of the survey results is given below.

Households with hygienic, unhygienic or no latrine

Area/ Region	Number of households	Households with hygienic latrines (%)	Households with unhygienic latrines (%)	Households with no latrines (%)
National	2,13,94,093	33	25	42
Rural	1,83,26,332	29	24	47
Urban	30,67,761	60	28	13

Reasons reported for not having a latrine

Area/ Region	Number of households with no latrines	Lack of money (%)	Lack of awareness (%)	Lack of space (%)	Preference for open defecation (%)
National	89,82,551	73	25	11	4
Rural	85,95,626	73	25	10	4
Urban	3,86,925	80	21	18	3

Note: Data collected based on multiple response survey

The survey also showed varying level of coverage under different socio-economic and hydro-geological conditions of the country. It also documented reasons reported by households for not having a sanitary latrine. The results of the baseline survey are extremely important and form the basis for designing future interventions to achieve the national sanitation target.

Considering the per annum growth rate of about 4% sanitation coverage in the past and also considering that the required rate of sanitation coverage would be of the order of 12% per annum to achieve 100% coverage, the task ahead is extremely challenging. Accordingly the sector capacity needs to be sufficiently strengthened to ensure the required growth rate.

3

IMPORTANT TERMS AND DEFINITIONS

Several key terms are defined here for clarity and consistency. They are not the last words on the subject, but are presented to foster a common understanding of all concerned.

3.1 100% Sanitation

At the very least, the term "100% sanitation" will mean to include all of the followings:

- No open defecation
- Hygienic latrines available to all
- Use of hygienic latrines by all
- Proper maintenance of latrines for continual use, and
- Improved hygienic practice

However, it is to be emphasized that health impacts of sanitation are the primary reason for sanitation improvement programmes. Health consequences should be considered as central. Therefore, Total

Sanitation should also mean total sanitary condition for healthy living. Thus the term must include,

- hygienic latrine facilities away from the environment,
- proper management of solid waste, and
- proper disposal of household wastewater and storm water.

3.2 Hygienic Latrine

The linkage between sanitation and health leads to an understanding that the primary focus of sanitation should be on the environmental transmission routes of excreta related diseases. Based on this understanding, a "hygienic latrine" is defined as a sanitation facility the use of which effectively breaks the cycle of disease transmission. Improved hygiene practice is to be emphasized and proper use of hygienic latrines ensured because both play the vital role in breaking the cycle of disease transmission.

The most fundamental health objective of sanitation must be achieved through proper design, installation, and use of a sanitary or hygienic latrine. There is no universal design of a hygienic latrine that could be effectively used under all socio-economic and hydrogeological conditions. It is therefore important that a wide range of sanitary or hygienic latrine technologies is available to suit different conditions.

A hygienic latrine would mean to include all of the following:

(1) Confinement of feces away from the environment,

(2) Sealing of the passage between the squat hole and the pit to effectively block the pathways for flies and other insect vectors thereby breaking the cycle of disease transmission, and

(3) Venting out of foul gases generated in the pit through a properly positioned vent pipe to keep the latrine odor free and encourage continual use of the hygienic latrine.

3.3 Operational Definition of Hardcore Poor

The following set of eligibility criteria shall be used to define hardcore poor households. These criteria have been taken from Pro-poor strategy for water and Sanitation sector in Bangladesh (2005). The focus is

mainly on the hardcore poor households since they are the prime target group of the subsidized program of the government. The criteria will ensure that the targeted groups actually enjoy the greater benefits of the government subsidized sanitation services.

The criteria are very simple and can easily be measured through simple observation. Note that the household is the unit of measurement for these criteria.

The strategy suggests relaxing these criteria for identification of hardcore poor households in Chittagong Hill Tracts (CHT) and saline-prone coastal areas.

Eligibility criteria

1. Landless households
2. Pavement dwellers/homeless
3. The main earning person or the head of family is a day laborer, owning less than 50 decimal of agriculture land or residing in a rented premise lesser than 200 square feet, and having no fixed source of income.
4. Households headed by Disabled or Females or Old (65+ years) persons.

If the answer to any of the above criteria is 'yes', the household will be treated as hardcore poor to give priority in subsidized sanitation services.

3.4 Basic Minimum Level of Service

Referring to the definition of hygienic latrine, the basic minimum level of sanitation service would be that every member of a household should have access to a safe hygienic latrine - either a separate household latrine, shared latrine subject to use by maximum of two households or a community latrine.

A basic unit could be a simple pit latrine that is designed for effectively confining the faeces, sealing of the squatting hole, and a provision for a vent pipe for the release of gases. 3 to 5 litres of water per person should be available for anal cleansing, hand washing, and cleanliness of the latrine. However, design and construction of a basic unit may vary from place to place depending on the hydro-geological conditions.

4

15 GUIDING PRINCIPLES

The following principles lie at the heart of the National Sanitation Strategy. The principles are primarily based on the guiding principles included in the 'Dhaka Declaration' of the South Asian Conference on Sanitation (SACOSAN), held in 2003. These principles have subsequently been elaborated and refined during the process of preparing this strategy and should apply in all conditions, in rural and urban areas, in rich and poor communities, and whether sanitation is an individual household system or a community system.

Sanitation is a human right

The international acceptance that health and access to water are human rights clearly implies that access to sanitation should also be considered as a human right. The national government is therefore obliged to progressively ensure access to basic sanitation equitably and without discrimination.

Sanitation is primarily about health

The primary objective of the national sanitation campaign is to contribute to improving the health and quality of life of the entire population. It is focused on the elimination of open defecation and other unhygienic practices, as well as the promotion of good hygiene practices.

Sanitation is also about privacy, convenience, dignity, safety and security

While the primary objective of sanitation is about health, other social factors such as privacy, convenience, dignity, safety and security are also important.

Creating and sustaining demand

Hygiene promotion and behaviour change leads to creating and sustaining demand for sanitation facilities.

Hygiene promotion and behaviour change

Sanitation improvement is focused on achieving sustainable changes in hygiene behaviour and not limited to latrine installation only.

Software financing are needed for scaling up and sustainability

Government and community financing are crucial for promotion, awareness, capacity-building and the creation of funding mechanisms for scaling up sanitation and hygiene programmes.

Hardware subsidies only for the poorest

Hardware subsidies should only be provided to the poorest of the poor, to be given under appropriate and effective monitoring and evaluation arrangements.

Communities are central to the sanitation planning process

Communities must be at the centre of planning and implementing sanitation programmes. Special emphasis needs to be placed on effectively involving the poorest in the communities.

Gender sensitive approach

The planning of, investment in, and promotion of sanitation facilities must address the special needs and priorities of women and children. Gender aspects need full consideration in sanitation programmes.

Social, cultural and technical appropriateness

Local values and cultural practices should be given due consideration in sanitation improvement programmes. Sanitation technology should be viable, affordable and locally appropriate. Indigenous knowledge and local skills must be promoted.

Decentralization of decision-making

Decision-making and implementation of sanitation programmes must be conducted at the local level by the local government institutions (e.g. union parishad, gram sarkar, ward commissioners) for sustained sanitation services. The central government will be responsible for funding, guiding, monitoring, and coordinating sanitation programmes throughout the country following a coherent consultative process.

Equitable allocation of resources

Funds to support sanitation programmes should be equitably distributed throughout the country, considering population and level of development of different areas. Funding should not be disproportionately allocated to certain sections of the population.

Partnership approach

Effective, strategic partnerships, at national and local levels, involving government bodies, non-government organisations, development partners, community-based organisations and the private sector are essential for achieving progress on sanitation.

Environmental integrity

Sanitation services that have unacceptable impacts on the environment, particularly pollution of water resources, will not be considered adequate. Particular attention is required to the adequate separation of latrines and water points.

Emergency preparedness

Sanitation services need to be planned with consideration of the impact of emergency situations, such as floods and cyclones.

5

RELEVANT POLICY GUIDELINES

5.1 The National Policy for Safe Water Supply and Sanitation 1998

The National Policy for Safe Water Supply and Sanitation 1998 is the basic policy document governing the water supply and sanitation sector.

The policy mentions that the Government's goal is to ensure that all people have access to safe water and sanitation services at an affordable cost. The policy emphasizes elements of behavioral changes and sustainability through user participation in planning, implementation, management, and cost sharing. Ensuring the installation of one sanitary latrine in each household in the rural areas and improving public health standard through inculcating the habit of proper use of sanitary latrines is mentioned as one of the objectives.

About urban sanitation, the policy objective is to ensure sanitary latrine within easy access of every urban household through technology options ranging from pit latrines to water borne sewerage. Installing public latrines in schools, bus stations and important public places and

community latrines in densely populated poor communities without sufficient space for individual household latrines is also emphasized.

Local government and communities shall be the focus of all activities relating to sanitation. All other stakeholders including the private sector and NGOs shall provide inputs into the development of the sector within the purview of overall government policy with Department of Public Health Engineering (DPHE) ensuring coordination.

Appropriate water supply and sanitation technology options shall be adopted to specific regions, geological situations and social groups. Continuous research and development activities shall be conducted to improve the existing technologies and to develop new technologies.

The role of women in the process of planning, decision-making and management shall be promoted through their increased representation in management committees and boards (Pourashavas/ Water and Sewerage Authorities, WASAs).

The users shall be responsible for operation and maintenance of sanitation facilities and will bear its total cost. However, in case of hard-core poor communities, educational institutions, mosques and other places of worship, the costs may be subsidized partially or fully. In public toilets separate provision shall be made for women users. Credit facilities should be made available to bear costs of water and sanitation service. Private sector and NGO participation in sanitation shall be encouraged.

Within a specified period legislation shall be enacted making use of sanitary latrine compulsory. Regular qualitative and quantitative monitoring and evaluation shall be conducted to review progress of activities and revision of the strategy based on experiences. The Local Government Division will prepare Half Yearly Report on the activities of the sector and submit to the concerned authorities.

5.2 Draft Poverty Reduction Strategy Paper (PRSP)

The government of Bangladesh issued the first version of the interim Poverty Reduction Strategy Paper (IPRSP) in April 2002 and the second version in December 2002. Water and sanitation issues received little attention in the IPRSPs. These were included only as minor issues under

Infrastructure Development. In October 2003 the Government started the process of developing a full PRSP that is scheduled to be finalized in 2005.

In the process of developing the full PRSP the Government has acknowledged the potential of Water Supply and Sanitation (WSS) issues as a sub-thematic issue under health following a civil society sector submission to the Poverty Reduction Strategy process in Bangladesh and increasing demand from sector agencies. Since the national budget allocation and donor support will be provided as per the PRSP in the near future, the inclusion of WSS as a separate chapter in the full PRSP will help ensure adequate funds for accessible water supply and sanitation services for all in Bangladesh.

5.3 National Water Management Plan 2004

The national water management plan has envisaged access to appropriate sanitation to all by 2010 and has also made a provision for waterborne sanitation and storm water drainage in major cities. Also it has proposed resource allocation to achieve time bound targets. Accordingly, the sanitation strategy would consider this plan to enhance total sanitation through agreed resource planning of the government.

5.4 Sector Development Framework (SDF) 2004

Government of Bangladesh (GoB) has approved a Sector Development Framework (SDF) which guides planning, coordination and monitoring of all future sector development activities with a focus on devolution of authority to LGIs, user participation, economic pricing, public-NGO-private partnership, gender-sensitivity. Accordingly, the national sanitation strategy would conform to this framework.

5.5 Pro-Poor Strategy for Water and Sanitation Sector 2005

The Pro-poor strategy for water and sanitation provides the operational definition of hardcore poor households, definition of basic minimum service level, targeting and organising the hardcore poor households, and mechanism for administering subsidies.

5.6 Sanitation Related Policy Decisions 2004

Beginning in 2004, the Government has allocated 20% of the Annual Development Programme (ADP) fund to Upazillas for improving sanitation coverage. According to government decision, 90% of this

allocation would be used to procure sanitary latrines for distribution free of charge to the hardcore poor people. The sweated labour for carrying sanitation materials and for construction of latrines will be considered as sweat equity from the beneficiaries. The remaining 10% funds are to be used for promotional activities. In addition, Tk. 5000.00 has been allocated and disbursed to each Gram Sarkar for their local development, sanitation being one of the major activities. Subsequently in January 2005, the decision has been revised to raise the funds for promotional activities from 10% to 25%. For urban sanitation also, Government has allocated 20% of the Annual Development Programme (ADP) fund to Paurashavas and City Corporations.

One important aspect of the decision is that the focal point of the national sanitation campaign is the Union Parishad at rural level and in urban areas it is Ward of Municipalities and City-corporations. The Union Parishads have been entrusted with the task of latrine distribution and promotion.

6

BUILDING ON SUCCESSES AND LESSONS LEARNED

While the set national goal of 100% sanitation by the year 2010 may seem ambitious and the challenges ahead herculean, there have been a number of positive experiences in the recent past which provide useful lessons to build upon. The strongest ones of these are:

6.1 Public Sector Led Sanitation and Hygiene Programme

The nationwide social mobilisation for sanitation was implemented by the public sector (DPHE) during the 1980s and 1990s. The approach was to create demand through social mobilization and the project emphasized fixed-place defecation and homemade latrines to popularize the use of sanitary latrines among the people. The ring-slab latrines were still available at subsidized cost to the people. The sanitary latrine coverage perked up during the social mobilization campaign but the pace fell back with the end of the project. Local government involvement was attempted under this programme by introducing union WATSAN committees. Success was limited due to a slow decentralization process and lack of a proper supportive environment.

6.2 NGO Implemented Programme

NGOs have implemented many sanitation programme with direct support from donor agencies. Many NGOs implemented successful sanitation initiatives by building community demand for improved sanitation. Starting in early 2000, a number of NGOs stated a completely new approach. Instead of appealing to individual households, they addressed a whole village as one unit. The focus shifted from individual action to collective action. There was no subsidy on hardware, not even for the poor people. Instead, many types of latrine models were developed to suit all sections of the population. Confinement of feces in a hygienic manner was the minimum requirement. A vigorous motivational campaign was mounted to raise awareness and demand for sanitation. Villagers and local government were full partners in these campaigns. The result was spectacular. Many villages attained 100% sanitation with every household having access to a sanitary latrine.

6.3 Union Parishad Led Initiative

There have been several Union Parishads which have provided effective leadership to the community in achieving 100% sanitation coverage. They have accomplished this with the support from Government, NGOs/CBOs for creating hygiene awareness and community mobilization. Till date 94 Union Parishads have achieved 100% sanitation coverage.

6.4 Upazila Led Initiative

100% sanitation coverage could also be achieved in some Upazilas , where Upazila Nirbahi Officers (UNOs) could rally support from the Union Parishads and the community. Some successful examples are Rajarhat of Kurigram, Puthia of Rajshahi, Saturia of Manikganj and Rajapur of Jhalakathi. These demonstrate what can be achieved if local government institutions take the initiative.

6.5 Local Small Scale Private Initiatives

There are hundreds of Village Sanitation Centers run by private sector providing sanitation services at the door steps of rural community at competitive prices. They also have a role in creating demand for sanitation. Investment from small scale private sector is also considerable.

6.6 Facing the Urban Challenges Through Public-private-community Partnership

One of the most serious challenges faced by urban slum dwellers revolves around the lack of tenure rights. Virtually no slums in Bangladesh are 'recognized' and therefore the provision of basic services, including water and sanitation, is theoretically illegal. Only 16% of the population in urban slums uses safe water, whilst sanitation coverage is just 13.5%.

An NGO initially approached the Dhaka city water authorities on behalf of slum communities and was granted temporary permission to use the land for water point construction. Although the connections legally have to be in the NGO's name, community involvement has been maximised, particularly in the area of operation and maintenance of the water points. Given scarcity of land, sanitation blocks housing latrines and washing facilities are constructed for the shared use of 60 to 100 families. These are managed by the community. The community has also been at the forefront of health and hygiene awareness raising campaigns. This successful integrated model has attracted the interest of other national and international development actors working in slums and is being replicated at other urban centres, including slums of Chittagong, the second largest city in Bangladesh, working together with Chittagong Water Supply and Sewerage Authority (CWASA).

6.7 Lessons Learned

There are some important lessons, which can be learned from the efforts made so far, and these need to be disseminated and discussed so as to reach a national consensus for strategy development. The lessons could be summarised as:

- National campaigns are effective at raising awareness for accelerated efforts.
- Commitment of local government is a key to achieving the goal.
- GO-NGO-Community partnership is essential.
- Duplication of efforts shall be avoided.
- Adequate community mobilistation for motivation and sustainability increases sanitation coverage.

- All members of the community including women, students, children, community leaders can play an important role for community mobilization.
- No hardware support or subsidy should be provided except for the hardcore poor.
- A range of sanitation options and costs should be provided.
- The poor will need special support and assistance and this should be agreed and adopted by the community.

6.8 Scaling Up

However exciting, the successful projects have so far been small scale and may not have contributed significantly in reducing the under served on a national scale. However, there are important lessons from the small-scale experiments, which demonstrate that improvement is possible. With proper adaptation of the lessons from the small pilots, it will be possible to reach the objective of 100% sanitation by 2010.

The government and other stakeholders have now started to think about scaling up the sanitation effort and its sustainability. It is, however, recognized that for both issues the role of local government is crucial. Local Government Institutions (LGI) is the glue that ties villages together. Government funds and other assistance are to be channeled through the LGIs. It is the LGIs who can motivate the entire population of unions and upazillas.

7

MAJOR SANITATION ISSUES

In order to achieve the goal of 100% sanitation by the year 2010, the focus of strategies shall be on the following 6 major areas of concern:

- Open defecation
- Hardcore poor remaining unserved
- Use of unhygienic (hanging/open) latrines
- Lack of hygiene practice
- Urban sanitation
- Solid waste and household wastewater disposal not duly addressed

Institutional, financial, technological and social aspects shall be considered in formulating strategies to address each of these issues.

According to the nationwide baseline survey on sanitation (2003), 42%

of the population i.e. about 55 million people do not have any form of latrine and therefore, resort to open defecation. The survey further reveals that of this 42%, about 73% households do not have latrines due to lack of financial resources, people of 25% households are not aware of the importance of having a latrine, 11% households do not have space for latrine installation while about 4% households preferred defecation in the open. This strategy paper is intended to address the following 21 specific issues in the sanitation sector.

21 Specific Issues:

- Lack of financial resources for having latrines in the households
- Lack of awareness of the benefits of sanitation on health and economic productivity
- Lack of space particularly among landless people
- Habit for open defecation
- Lack of technological know-how among people for building low cost hygienic latrine
- Lack of institutional capacity / mechanism to support people build their own hygienic latrine at affordable cost
- Inadequate hardware outlets
- Absence of mechanism for identifying hardcore poor and ensuring effective utilization of government subsidy
- Public toilet facilities are grossly inadequate particularly in urban areas, and also in public transport systems e.g., Trains, Boats, Motor-launches and Steamers
- Land tenureship/ownership remains a crucial issue for providing services to urban slum dwellers
- Limited technology options to address sanitation requirements particularly in densely populated slum areas
- Discrete and inequitable investment

- Absence of mechanisms for effective monitoring and evaluation at all levels and lack of coordination
- Concerned organizations lack mission, vision and strategy for continual improvement of services
- Public agencies need more orientation on process based approach
- Socio-economic dimension of WSS are not fully understood/ considered
- Provision for staff development and continuing education in public agencies particularly in LGIs not in place
- Weak partnership among public agencies, local government institutions, non-government organizations, private sector and development partners
- Lack of incentives for successes
- Absence of emergency response plan on sanitation
- Absence of a legal framework for improved sanitation

8 STRATEGIES FOR SANITATION IMPROVEMENT

8.1 Creating Effective Demand through Health Education and Hygiene Promotion

Investments in sanitation can deliver major benefits in terms of improved health, economic growth, enhancement of quality of life, poverty reduction, and environmental sustainability, provided that the investments are in response to effective demand and that service delivery is effective and efficient. This demand for sanitation can effectively be generated once people are convinced of the need for sanitation improvements and they will then invest their own resources into improvement programmes.

However, sanitation improvements can never be confined to the provision of latrines by government agencies as it has been clearly demonstrated in the past that how essential it is to link health and hygiene education with water supply and sanitation for achieving lasting health benefits.

Improved sanitation facilities will only achieve a parallel reduction in

diarrheal diseases if they are developed alongside appropriate hygiene programmes. It must be fully recognized that hygiene contributes to the prevention of transmission of excreta related diseases and seeks to create effective barriers between pathogens that cause diseases, the intermediate carrier and the people.

Despite strong links between sanitation and health, there is, however, little public awareness of this and consequently sanitation is low on people's priorities. The national sanitation campaign must, therefore, redress this situation through information and education to promote awareness of the role of sanitation in lasting health benefits and thus stimulate effective demand for hygienic latrines.

The most important strategy for sanitation improvement is to raise public awareness that we must change unhealthy behaviour and practices in order to achieve sustained health benefits. The national sanitation program must support and provide health and hygiene education that will enable people to improve their health through correct hygienic practices, which eventually will lead to increased demand for appropriate sanitation facilities.

Health and hygiene education and promotion

- must be an integral part of all sanitation and water supply projects
- must be undertaken by all concerned dealing with health, environment, infrastructure and education; Ministries of Local Government, Health, Environment, Information and Education must take a coordinated effort for health and hygiene promotion
- DPHE and Local Government Engineering Department (LGED) through their countrywide organizational network, must play an appropriate role in facilitating LGIs in technology choice and also for creating demand for sanitation.
- should be targeted at all levels of the community with particular focus at high risk groups such as mothers of infants, small children and the economically disadvantaged groups
- must be enhanced through field-level health workers after proper orientation, education and training in effective health and hygiene

promotion methods

- must be sensitive to specific local issues, such as rural and urban differences and cultural factors

8.2 Ensuring Individual and Community Actions

The success of the national sanitation initiatives will depend on firm commitment not only of government but of every individual household. Unless all members of every household are aware of the damaging effects of poor sanitation, they will not commit their time, energy and money to sanitation improvements.

It is, therefore, important that the whole community be at the center of all the pre-planning, planning, design, decision-making and implementation stages of all sanitation programmes as their effective participation will ensure increased commitment, ownership and sustainability of sanitation improvements. Not only the family decision makers but all members particularly women and children must participate in the decision making process.

Enabling community members to play an active role in planning and decision making will ensure that local values are incorporated and thus will ensure that the resulting sanitation program is relevant, appropriate, acceptable, accessible, affordable, equitable, empowering, and makes use of indigenous knowledge and local skills.

NGOs have considerable experience in various aspects of community-based sanitation and health and hygiene promotion programmes. It is envisaged that NGOs will continue to play this important role of involving the entire community in sanitation programs.

Private sector involvement particularly in building sanitation facilities will result in local business development and provisions for employment opportunities.

Schools, both primary and secondary, will be a major community focal point for sanitation development and health and hygiene promotion. All schools must have hygienic latrines and hand washing facilities and the use of these facilities must be linked to lessons on health and personal hygiene.

8.3 Activating LGIs to Play the Key Role for Improving Sanitation Coverage

Capacity of LGIs should be enhanced in terms of awareness, responsibilities, accountabilities and more decision making power regarding planning, implementation and monitoring.

Public fund should flow directly and timely to Union Parishads / Wards to empower them to implement their sanitation programmes.

Capacity of Union Parishads/Wards should be enhanced through additional staffing so that LGIs can effectively supervise or oversee sanitation programmes in their localities.

Effective partnership between LGIs and community should be established for providing appropriate sanitation services to the local communities.

DPHE should facilitate the LGIs in implementation of sanitation programmes

Effective collaboration amongst LGIs, NGOs/CBOs and private sector should be developed for implementation of sanitation programmes as per requirement of local need.

8.4 Facilitating Adequate Supply Chain of "Hygienic Latrines"

- Capacity enhancement of existing production centers and establishing new production centers at each Union Parishad/Ward level to meet the requirements of about 12% growth of "hygienic latrine" per annum.

- Motivation of private sector producers for more investments

- DPHE should be capable enough to monitor the quantity and quality of hygienic latrines.

8.5 Reaching the Hardcore Poor

Although there are some separate success cases in Bangladesh, initiatives in general to provide rural and urban population with safe sanitation have not been particularly successful in reaching the poorest of the poor due to lack of specific guidelines. The poorest of the poor have, by definition the least asset, the least social, political status and the greatest difficulties to acquire their right of subsidized sanitation services. Studies and

experience suggest that despite the provisions and budget allocation for subsidized sanitation services by the government, donor and NGOs policies for the poorest, such services rarely reach to the poorest. The Pro-Poor Strategy for Water and Sanitation sector in Bangladesh (2005) provides specific guidelines for assisting the hardcore poor. However, the following steps should also be considered carefully in conjunction with the pro-poor strategy.

- Poverty is a multidimensional and a relative phenomenon. Therefore, the poorest of the poor need to be defined separately at each of the lowest tier of local government institutions both in urban and rural, based on some specific criteria following consultation process amongst different stakeholders i.e. community representatives, NGOs/CBOs, local government agencies etc. Identification of hardcore poor should be based on the specific criteria set by the pro-poor strategy for water and sanitation in Bangladesh.

- Latrine options and the cost of each option for the hardcore poor vary according to region/ location. Therefore, the minimum level of subsidized services needs to be defined at least at upazila level through consultation with different stakeholders i.e. community representatives, NGOs/CBOs, local government agencies, etc. rather than a fixed flat-rate for the whole country.

- Apart from the centralized/ project based subsidized services, local resources (kind/ cash) at the local government institution level needs to be mobilized to assist the hardcore poor on a priority basis based on their poverty ranking.

- Local government institutions, government agencies, and NGOs/ CBOs should provide interest free or with low interest micro-credit facilities to the moderate poor.

- To make the whole process transparent, accountable and effective, an institutional arrangement from community level to central level should be strengthened. Existing WatSan/Taskforce committees at Union and Ward levels both in rural and urban areas should be reviewed to include CBO/NGOs/Civil Society and community representatives if needed. Union and Ward level WatSan committees should steer the whole process.

8.6 Strategies for Improved Urban Sanitation

Strategies for large cities

One of the major problems in large cities is lack of services to slum dwellers. This leaves a large section of urban population without sanitation services. To extend sanitation service to slums the following strategies will be adopted:

- Service provision should be delinked from land tenureship. This will allow the utilities to extend their services to the slums.

- Public-private-community partnership be promoted for effective sanitation service delivery to slums. It is proposed that partnership be forged between public utilities/LGIs, NGOs/private sector and slum dwellers to set up and manage community sanitation solutions in all slums.

- Effective coordination between city planning authorities, city corporations and public utilities must be established in order to ensure appropriate sanitation service delivery.

Furthermore there is a large percentage of floating population without any kind of public toilet facilities.

- Adequate public toilet facilities be constructed at places where people congregate such as railway stations, bus stations, river stations, parks, markets and other public places. City Corporations should build these facilities and be leased out to NGOs/private sector for better operation under a public-private partnership arrangement.

Strategies for small and medium towns

Apart from a few project based initiatives, service delivery mechanism particularly for sanitation is virtually non existent in small and medium towns.

- New service delivery mechanism needs to be established through effective partnership among communities, municipalities, private sector and NGOs.

- A sanitation cell within each municipality will take the initiative to plan, monitor and coordinate all the sanitation programmes including

solid waste and wastewater disposal facilities in respective municipal service area.

- Private sector investment be encouraged for installation, operation and management of public/community sanitation facilities.

Technologies for urban sanitation

A number of technological challenges are to be overcome for achieving adequate sanitation coverage in urban areas. The following strategies should be adopted:

- Low cost technology options are much better than long absence of high cost sophisticated solutions.

- Sewage treatment technologies with greater emphasis on resources recovery and recycling must be given top priority in improving urban sanitation situation. Emphasis should be on less energy intensive technologies e.g. constructed wetland, oxidation ditch, extended aeration, stabilization ponds, etc.

- Appropriate desludging of septic tanks and pit latrines must be enforced and effluent disposed of in a proper manner. Sludge emptying services by City Corporations and Paurashavas must be in place.

- Multiple technology options must be considered including decentralized wastewater management option.

- Medium cost sewerage technologies should be developed based on simplified or modified conventional sewerage technology, particularly for small and medium townships.

- Low-cost appropriate technology (e.g. twin pit, eco-sanitation) should be promoted in peri-urban areas as well as in other small to medium sized urban centers where feasible.

Public utilities

- Policies and practices of public utilities for sanitation services must include provisions for the poorest (e.g., slums, urban fringes etc.)

- Cost recovery mechanism must be devised based on level of services provided.

Institutional arrangement for urban sanitation

- All city corporations must establish a full fledged Sanitation Division to plan, implement, and monitor sanitation programmes in cities.
- All Pourashavas in small and medium towns must establish Sanitation Cells/Units for planning, implementing, and monitoring sanitation programmes.
- Respective public agencies like WASAs, DPHE, LGED will provide technical assistance to the LGIs in urban areas.

8.7 Media Campaign

Improvement of sanitation largely depends on behavioral factors. Media has a tremendous impact on changing human behavior and practices. The following strategies must be adopted to maximize the benefit of media (both electronic and print) campaign for sanitation improvement:

- Sanitation must find a space within media
- Regular reporting of sanitation related important information
- Reporting best practices and success stories
- Reporting of updated progresses
- Particular attention must be given in broadcasting emergency sanitation messages

8.8 Strategies for Sustainability

National Sanitation Focal Point

A well organized institutional setup is a prerequisite for sustainability. As a national focal point, a Sanitation Wing within the Local Government Division of the Ministry of Local Government, Rural Development and Cooperatives (LGRD&C) is to be established to guide the overall national sanitation improvement programme in the country with an objective of achieving 100% sanitation by 2010.

The already constituted Sanation Secretariat within DPHE will be strengthened to monitor sanitation improvement progress and multi-level communication.

The institutional arrangment of the sector as defined in the National policy for Safe Water Supply and Sanitation 1998 will be followed.

Integrated Approach

Sanitation requires priority attention to enhance healthy living and overall development of the nation. An integrated approach combining safe sanitation, hygiene education and promotion and safe water supply ensures improved health and livelihood.

Multi- stakeholders Approach

The successful promotion and implementation of sanitation programmes require that all stakeholders be involved from the pre-planning stage, through implementation to monitoring and evaluation stages.

Multi-sectoral Approach

Sanitation development is essentially multi-sectoral. Education, health, environment, finance, information sectors must work hand in hand for sustainable sanitation improvement.

Sustainable, Appropriate and Affordable Options

Informed choice of a variety of technological options must be available for people considering affordability, cultural acceptance and environmental friendliness.

NGO Facilitation

Non-governmental organizations have shown strong technical and community development skills that could be transferred and expanded for the benefit of the water and sanitation sector. NGO facilitation is extremely important in confidence building in communities/ LGIs to own sanitation development programmes. Government at all levels should build partnership with NGOs and civil society organizations for greater facilitation.

Private Sector Participation

Enabling environment shall be created for increased private sector participation for the promotion of different technology options and improvement of sanitation service delivery. Soft credit and skill development will be promoted by government/ non-government agencies to encourage private sector participation.

Legislation

Appropriate legislation for the enhancement of sanitation service delivery at all levels shall be enacted based on the existing public health and environment related laws and bye-laws.

Ownership and Responsibilities

Although it is accepted that sanitation is a basic household activity, specific institutional structures have to be in place to guide these activities and strengthen the sector. These structures include government agencies and local government institutes responsible for sanitation, hygiene education and water supply as well as NGOs/ civil society organizations. The ownership of the facilities and the responsibility for operation and maintenance shall be that of the households and the communities.

Research and Development

The advancement and upgrading of technologies and participatory hygiene methods through research and development of appropriate and affordable technologies and management systems shall be pursued. Research organizations should be given the responsibility to improve and develop new technologies. The developed technologies should be disseminated and skills transferred to local level for implementation.

8.9 Financing of Sanitation Programmes

Public funding

The government has already set an encouraging trend by allocating development fund for promoting sanitation. However, public funding for sanitation improvement should be further increased from the present level. Decision making for the use of the public fund should be left to LGIs.

Donor funding

Donor agency funding has been declining. In view of the overall health and poverty impact donor funding must be substantially increased for sanitation activities. Donor funding must be channeled in a coordinated manner for optimal use of funds.

Private funding

Private financing, particularly in latrine component manufacturing and

retailing, should be encouraged. Credit and training facility should be made available to assist such private initiatives.

Community resource mobilization

Sector financing is largely contributed by community resources. Awareness raising is crucial for increased mobilization of community resources which is essential for ensuring 100% sanitation coverage within communities.

8.10 Strategies for Monitoring and Evaluation

Regular monitoring is required to measure progress. Acquisition of accurate data is essential to ascertain progress against the national sanitation target. Collection and maintenance of national sanitation data requires intensive work from the grassroots level to national level.

Parameters to be monitored

Sanitation data must be monitored at the village and moholla (neighbourhood) level. The National Sanitation Secretariat shall determine the monitoring mechanism and parameters to be monitored. The monitoring parameters could be based on the experience of Nationwide Sanitation Survey conducted in 2003.

Recommended monitoring mechanism could include:

- Ward level (rural and urban) periodical information on sanitation be sent to respective local government institutions (i.e. union parishads/ pourashavas/city corporations)

- Union Parishads will send the verified data/ information to the respective upazila level in rural areas. Local level representatives from CBOs/ civil society organizations should be included in the verifying process of the information

- Upazila level verified data will be sent directly to the National Sanitation Secretariat through concerned Executive Engineer, DPHE with copy to the concerned Deputy Commissioner (DC). Representatives from CBOs/ civil society organizations should be included in the verification process of the information. Sanitation Secretariat will analyze and further verify the received data and send it to the national sanitation focal point (proposed Sanitation Wing of LGD).

- Pourashava will send the verified data/ information directly to the Sanitation Secretariat through concerned Executive Engineer, DPHE with copy to the concerned Deputy Commissioner (DC). Local level representatives from CBOs/ civil society organizations should be included in the verifying process of the information. Sanitation Secretariat will analyze and further verify the received data and send it to the national sanitation focal point (proposed Sanitation Wing of LGD).

- City corporation level verified data will be sent directly to the sanitation secretariat. Representatives from CBOs/ civil society organizations/ consumer groups should be included in the verifying process of the information. Sanitation Secretariat will analyze and further verify the received data and send it to the national sanitation focal point (proposed Sanitation Wing of LGD).

Recommended monitoring parameters could be:

- Households with hygienic / unhygienic / no latrines

- Public places (e.g., markets, schools, mosques) with hygienic / unhygienic / no latrines

- For urban areas, drainage and waste management data may also be included.

- Basic hygiene practice, e.g., soap use after defecation and before eating should be monitored also.

Data shall be consolidated and preserved at all levels. A synthesized data book will be published annually and distributed by the Sanitation Secretariat.

Monitoring and evaluation protocol

The National Sanitation Secretariat will prepare protocols for monitoring and evaluation of sanitation data. The Secretariat may take assistance from Bangladesh Bureau of Statistics.

The frequency of nationwide monitoring shall be twice a year preferably in March and September and the accumulated results be reported during the observation of sanitation month in October.

Evaluation

- Evaluation may be done for two purposes: (1) to verify and declare totally sanitized villages and neighborhoods, and (2) to recommend remedial steps for better planning.

- Upazilas/UPs/ Paurashavas/Villages/ neighborhoods may be declared 100% sanitized only after third party verification. The third party will consist of representatives from government and non-government organizations and the civil society. The evaluation should be open and transparent.

- Long-term impact assessment such as those involving health and poverty may be conducted by specialized teams.

8.11 Strategies for Emergency Response

Bangladesh, pre-dominantly, is a disaster prone country. Every year millions of sanitation installations are damaged and coverage reduced dramatically by recurring floods and cyclones. The following strategies should be considered to address emergency situations.

- Emergency preparedness programmes must include sanitation components

- Designate flood shelters e.g., schools, colleges, cyclone shelters and other public private institutions with adequate sanitation facilities

- Special motivational activities with key hygienic messages must be undertaken during emergencies

- Delineation of flood prone areas and building sanitation facilities above flood level

- Various sanitation options for emergency situation e.g., hygienic trench latrine facilities at the shelters, mobile toilets, pot defecation for children and aged people must be made available

9

DEVELOPING ACTION PLANS

The national sanitation strategy broadly guides the respective institutions e.g. LGIs, NGOs, public utilities and government agencies to develop their own action plans for achieving 100% sanitation in their implementation areas. The following broad actions will help develop individual action plans:

- Development of national sanitation mapping
- Review and updating of national sanitation mapping
- Assessment of sector progress

9.1 Cost of Implementation

The cost of implementation will be determined by the respective institutions e.g., LGIs, NGOs, public utilities and government agencies at local level considering local context particularly addressing the socio-cultural needs, economic and hydro-geological conditions.

In response to the global call, the water target 10 of the "Millennium Development Goals (MDGs)", subsequently expanded in WSSD in Johannesburg in 2002 to include sanitation target, the Government of Bangladesh set its national target of achieving 100% sanitation by 2010. This challenging target is much ahead of MDGs target. But GoB has realized the importance of sanitation for sustainable development and put emphasis on achieving the target that will have immense impact on poverty reduction.

Following the route of the sanitation campaign the last working session of the SACOSAN 2003, on Bangladesh country paper identified the importance of a National Sanitation Strategy based on which Plan of Action at local level could be prepared. The GoB recognized the need for a National Sanitation Strategy paper and accordingly decided to develop the strategy paper.

The process of developing the National Sanitation Strategy started in a meeting of the National Sanitation Taskforce held on 10 June 2004. A committee was formed comprising ITN-BUET, LGD, DPHE and Sanitation Secretariat with Director of ITN-BUET as its Convenor and was given the responsibility to draft a national sanitation strategy. This decision was highly appreciated in the sector as reflected in different meetings of the Organizing and Finance Committee for National Sanitation Campaign and the meeting with the Development Partners on 28 June 2004. Active participation of UPI, DPHE, LGED, Sanitation Secretariat, WaterAid Bangladesh, WSP-WB, Unicef, WSSCC-B, VERC, Danida, NGO Forum for DWSS, WHO and Plan Bangladesh enriched the national strategy paper.

WaterAid Bangladesh provided the financial support for the development of the strategy including its publication.

A participatory approach was adopted in developing this strategy. Consultative meetings were organized with stakeholders from the central to the grass roots level. Experience gathered from interaction with community people and LGI representatives assisted in formulating this pragmatic strategy paper. Comments from different stakeholders reinforced the strategy paper further. However, this strategy paper is designed as a living document and may be revised from time to time in the light of progress made and changed needs.

Secretary
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Why Borrow for Capacity Building?

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Some sovereign nations do not want to borrow for capacity building. Yes, we see this all the time. But, I ask myself, why? That got me thinking and my thoughts went back to senior year in college.

My college thesis[1] starts out with this quote from Joseph Schumpeter: "Add successively as many mail coaches as you please, you will never get a railway thereby"[2]. The thesis applies theories of creativity to the development of Japan after the Meiji restoration in 1868. In the 1880s, the Ministry of Education spent 66% of its annual budget to hire foreign technicians to teach Japanese students.

Let's fast forward, though. Today's development banks originated in the Marshall Plan that financed reconstruction of Europe after World War II. The plan gave loans to Europeans who were already well educated, had well-developed civil societies and were able to manage their affairs effectively. They had the capacity to take care of their assets and manage to repay their loans.

The Marshall Plan led to the formation of the World Bank and likely influenced the establishment of other development banks. As the challenge in Europe receded, development funds began to flow into underdeveloped countries. During the Cold War, development funds went to places chosen by political expediency – to keep those dominoes from falling. Cold War over, we can still see how politics affects development aid in some places (Iraq or Egypt) but aid is more widespread now, going into every needy country in the world, albeit in differing amounts.

A lot of development aid in the period 1960-1985 went for large-scale infrastructure and engineers made up a significant proportion of development bank or agency staff. Some argue that when engineers look at a problem they are naturally disposed to solve it with an engineering solution – build something to solve the problem. We each play to our strengths, don't we? So, by the late 1980s a lot of infrastructure projects had been built around the world.

By the late 1980s, infrastructure projects built 10-15 years earlier failed or operated at significantly less than capacity. Why? Development professionals concluded that lack of maintenance, spare parts, knowledge and lack of funds were to blame, etc. Enter the notion of capacity building or institutional strengthening with a focus on inventory, training and tariff setting.

[1] Titled: *Developmental Economic Change: Motivation and Effect*
[2] In *The Theory of Economic Development*

Perhaps this was the embedded, but unrecognized problem: the Marshall Plan approach worked because loans went to countries and people who were already educated and had the capacity to take care of assets and repay loans. The infrastructure projects in developing countries went to countries and people who did not have the capacity of the Europeans of the 1940s. They did not have the education, well-developed civil societies or the discipline to repay loan obligations.

Were the development banks wise to take the same approaches with developing countries that the Marshall Plan took with Europe? Doubtful. It may have been better to recognize the weaknesses of developing countries and start with capacity building before making the loans for large infrastructure projects that were otherwise doomed to fail before their time.

Between the development banks and aid agencies, billions upon billions of dollars have gone into infrastructure projects over the last 25-30 years and yet we have not alleviated the problems of the poor as much as hoped. Why? Perhaps because there has been a lack of sufficient commitment or understanding in developing countries about good stewardship of assets and financial assistance. Perhaps the cart came before the horse in building valuable assets for people who did not have the capacity to care for them.

The mission of development banks is to make loans, assuming that bilateral aid agencies will do the capacity building. While this is an excellent idea in theory, especially in light of MDGs, it doesn't always work. If it did, we would see far less suffering among the poor and a lot more debt repayment. What we can see in some places is that bi-lateral agencies compete with each other, applying different approaches and philosophies that often clash. (One agency paid people in Fayoum, Egypt to come to meetings. So, naturally, people working with other donor-funded projects demanded the same payments. This was a problem for the new project because it could not make such payments.)

Reality plays out: country takes the loan, builds the infrastructure; infrastructure fails before its time and the country is not much better off – in fact, maybe worse off since now it has to repay the debt for an asset that no longer works. With exchange rate risk, this problem can become dire. With a country in dire straits, the banks "forgive" the loan and the whole "revolving fund" idea goes down the tubes along with any discipline the country might develop if "forgiveness" of the loan was not possible.

Let us go back to the Meiji in Japan the 1880s. They started with capacity building. They invested significant amounts of money. Combined with a sound cultural foundation, Japan became what it is today and the capacity building investment paid off over and over.

So, why should countries not borrow money for capacity building? This money is an investment in the people who will operate and care for the infrastructure. Are they not equally as important as the physical asset? Could capacity building loans precede infrastructure – or maybe even be a precondition for infrastructure loans. After all, countries that wish to join the European Union are required to qualify and this often means policy reform. If capacity building means that assets last longer, work better and contribute to the sustainability of a utility, then capacity building is not "soft stuff" – it is a good investment with a big payoff.

But, it seems, the words "Capacity Building" turn people off these days – I wonder why?

There have been many capacity building projects around the world over the last 10 years. Let me refer to the institutional strengthening projects of USAID in Egypt, which I know the best. In response to complaints that counterparts lacked spare parts, resources and knowledge, USAID began a number of projects in the early 1990s, which focused on training, tariff setting, inventory control, personnel policies, etc. While these projects did

some good, their benefits were limited by national government policies and the legal framework for the utilities that restricted the extent to which they could reform and improve. In addition, project efforts focused in many cases on relatively low-level utility managers.

What can we learn from this: 1) the best way to do capacity building is in an environment that allows – or even encourages - people to change and improve. This means laying the foundation at the upper reaches of national governments and then building support for reform with the leaders of utility organizations. Otherwise, you run the risk of introducing new approaches and having them fail because of restrictions from above. It makes little sense to empower an organization if it has to live within a bad overall system. 2) Projects that focus on specific functions - like inventory control – will have some impact but not as great an impact as when these functions are part of a more comprehensive approach – like organization development.

We wrote the Guidebook to lay out a rational approach to build a strong foundation that would support further development and continuous improvement. It starts with the legal framework and then moves to leadership and commitment. In other words, it starts with the most important and pervasive influences on an organization – it does not start with inventory control.

Another reason that capacity building may have developed a bad name is that it often plays out into management training courses that often focus on changing behaviors with little or no attention to the building blocks of good management like job descriptions, mission statements, management reports or approaches like Managing by results. It doesn't do much good to train people in Team Building if they don't know what the team is supposed to accomplish. So, it is likely that many well-intentioned training courses have taken place around the world but they have had minimal effect because the students return to organizations without the fundamental building blocks of good management in place.

Again, we wrote the Guidebook to fill the void that we saw in many places – the void of attention to the building blocks for a strong foundation for management.

What would really good Capacity Building be like? Ah – the real question. We are all learning together all of the time. So any implied criticisms in this paper come with the knowledge that life is a journey not a destination – as we learn we find ways to improve and go further.

Great capacity building would start with top level commitment to effective reforms – not the kind of grudging "commitment" that governments are often forced into to get a larger support package.

The capacity building program would be one designed in conjunction with counterparts, based on their own realization of the need to improve. In other words, a capacity building effort without ownership by counterparts is no capacity building program at all.

There are few hard and fast requirements for a capacity building program but there are certain minimum areas of attention:

- **Management Foundation**– on the idea that any management system must be built – it doesn't magically appear
- **Behaviors**
- **Functional Expertise** – on the idea that you cannot expect someone to be an accountant if they don't know the first thing about accounting
- **Management Information Systems** – on the idea that "if you can measure it, you can manage it."

Isn’t it time for us all to have a harder look at capacity building and do it better? After all, management capacity building is one of those empowering efforts that have benefits for years to come – if not decades.

AN INNOVATIVE APPROACH TO URBAN WASTEWATER TREATMENT IN THE DEVELOPING WORLD

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ABSTRACT

Should cities of the developing world invest in the dominant municipal wastewater treatment technology of Western Europe and North America --- conventional primary plus activated sludge? Or, are there alternative "sustainable sanitation" approaches? This paper discusses these issues and makes a specific technological proposal --- the adoption of recent innovations in chemically enhanced primary treatment, known as CEPT, as the appropriate first step in urban wastewater management.

Why is CEPT a superior choice?

- CEPT uses small doses of coagulant salts and flocculant polymers to produce a highly efficient, single stage treatment process that is superior in terms of suspended solids and organic carbon removal to conventional primary treatment alone, but also, in terms of phosphorus removal and energy consumption, to conventional primary plus activated sludge.

- CEPT, because of enhanced settling, results in increased treatment capacity and removal efficiency. As has been demonstrated by retrofitting some of California's largest conventional primary plants, CEPT provides a low-cost way of quickly upgrading overloaded plants.

- New CEPT plants can take advantage of enhanced settling to increase the surface overflow rate and reduce the number of settling tanks. When Hong Kong's new plant switched from conventional primary to CEPT, in the design stage, the number of settling tanks was reduced to two-thirds. In Mexico City it is estimated that capital and O & M costs for CEPT would be about 55% of the cost of conventional primary and secondary biological treatment, including sludge handling.

- CEPT effluent, in contrast to conventional primary effluent, can be effectively disinfected. This is important in controlling public health problems caused by water supply contamination by contact with raw or inadequately treated wastewater.

- CEPT sludge is readily dewatered and processed. The amount of CEPT sludge is generally only 10 to 15% greater than that produced by the removal of suspended solids.

- CEPT is an effective and appropriate first stage treatment process, it may be followed by biological treatment if the incremental effluent improvement, the risk of toxic upsets of the biological process and increased biosolids disposal can be justified and afforded. Subsequent biological treatment plants will be smaller and more efficient because of reduced organic load and increased solubility of the CEPT effluent.

The paper includes a frank discussion of the impediments to the adoption of innovative and appropriate wastewater treatment technologies in the developing world.

While CEPT is already being applied in mega-cities, it is appropriate for small cities as well. Ongoing studies are aimed at reducing the cost and increasing the efficiency of wastewater treatment lagoons frequently used in small cities by combining CEPT and lagoon treatment technologies. CEPT tanks can be used as a pre-lagoon treatment to reduce solids and BOD loading to lagoons or coagulants can be added directly at the lagoon inlet.

Recommendations for needed research are presented.

INTRODUCTION

Population growth in mega-cities and other urban areas of the developing world and the associated water-related pollution and public health problems are a much discussed topic. The important issue is whether the developing world should follow the model of using the municipal wastewater treatment technology of Western Europe and North America or whether there is an alternative "sustainable sanitation" approach?

A committee of the U.S. National Research Council (NRC, 1996) reported on "sustainable water and sanitation services for mega-cities in the developing world." Unfortunately, the report is long on generalities and short on specifics. The authors indicate that "water and sanitation professionals must take a broader view of sanitation to prevent disease resulting from a wide range of activities and multiple exposure routes." On the role of treatment technology, the authors state that "technical innovation should be based on carefully considered performance criteria appropriate to maintaining a healthy environment." The final conclusion notes that, "With appropriate treatment, reclamation and reuse of municipal wastewater for non-potable uses can become an increasingly cost-effective conservation measure."

The issue of appropriate wastewater treatment for the developing world has also been featured in *Water Science and Technology* (Henze et al,1997). Half the papers address the definition and analysis of sustainability, while the other half deal with the technology. Most of the technology papers are concerned with non-conventional (and very expensive) collection systems designed to separate, treat and

dispose of liquid and fecal wastes by different processes. An overview paper by Varis and Somlyody (ibid) addresses the issue of global urbanization and asks the question: "Can sustainability be afforded?" They conclude that the conventional urban wastewater infrastructure of the industrialized world is neither sustainable nor transferable. However, they provide no specific answers as to what is affordable or what should be done to solve the water and sanitation problems of mega-cities.

In another exchange by three academic experts in *Water Quality International,* Keinath (1996) "believes the time has come to seriously consider the direct and deliberate reuse of water for potable uses in the mega-cities of the world." He contends that "treating water to high levels of quality -- is likely to be less costly than further exploiting distant surface and subsurface waters" and recommends focusing research on the further development of advanced oxidation and adsorption processes and membrane technologies. Okun (1996) agrees with Keinath's basic premise, but contends that reuse should be limited to non-potable uses such as agricultural irrigation because this would require only "secondary treatment followed by filtration and chlorination" and thus require no new technology. Alaerts (1997) offers a third perspective, stating that it would be "more cost effective to reduce water demand in factories and in households. Rather than cleaning up a given effluent, we may prefer to promote cleaner production technologies, stimulate in-plant reuse, relocate the plant to less sensitive watersheds, or abolish the industry altogether." He concludes that "innovative and cost-effective technologies are essential components in these schemes." However, he does not identify what these technologies are, nor does he explore the likelihood that developing countries will abolish industries because of environmental concerns.

This paper, prompted by disappointment with the lack of realistic and concrete proposals offered by European and North American water experts, puts forward specific technological proposals in order to encourage the continued vital discussion of which treatment technologies are appropriate for solving the urban sanitation problems of the developing world.

While it is true that some cities (Jakarta, for example) lack a sewage collection system, many urban areas have extensive sewerage systems that discharge untreated wastewater and contaminate adjacent rivers, shallow embayments or coastal waters. Only a small fraction of collected wastewater is treated, usually in "token" secondary plants with conventional primary settling and activated sludge. Such plants frequently suffer from poor performance due to inadequate funds for maintenance and operator training or to biological upsets caused by toxic industrial inputs.

Rather than attempting to prescribe an ultimate effluent end use and its corresponding level of advanced treatment (as in the perspectives of Keinath, Okun and others) , it seems much more useful to try to define the most efficient and cost-effective, minimum level of treatment needed to protect public health. Consider Mexico City as an example.

MEXICO CITY -- A CASE STUDY IN MEGA-CITY NEEDS

The Valley of Mexico, with 21 million inhabitants, covers an area of 1300 km^2. The city lies on an old lake bed on a high plateau with no natural drainage or source of fresh water. It would appear to be a prime candidate for reusing sewage for potable water since most of the drinking water is pumped from deep ground water wells or from distant lower surface water sources. The city produces an average of 75 m^3/s of wastewater and this raw sewage is used to irrigate 85000 ha of agricultural land in the neighboring state of Hidalgo. These crops feed and provide income for the local population. The raw sewage is high in organic, nitrogen and phosphorus nutrients, as well as in fecal coliforms and helminth eggs, a debilitating parasite, in concentrations as high as 250 eggs/L. Because the soil in the valley is poor, the organic material, nitrogen and phosphorus in the wastewater has greatly improved crop yields -- corn production has increased 150%, onion 100%, tomato 94%, etc. (Landa, H., et. al., 1997). The irrigated area receives over 80 kg/ha of nitrogen per year.

Keinath's proposal for reuse of sewage as potable water for Mexico City is mind-boggling when one considers the cost of high-tech tertiary treatment for all or even a significant fraction of the 75 m^3/s of raw sewage. The critical issue in Mexico City's use of raw sewage for irrigation is the high prevalence of enteric and parasitic disease among the more than 100,000 agricultural workers in the irrigated areas (CNA, 1995). Mexico City's pressing need is to find a level of treatment that will protect the workers through helminth egg removal and pathogen inactivation, while allowing continued use of the organics and nutrients for irrigation. Okun advocates reuse of sewage for agriculture, but immediately couples it with the need for secondary treatment prior to disinfection. This is consistent with the thinking of most Western environmental planners and engineers. However, it must be questioned whether the capital and operating costs for full secondary treatment of the wastewater of Mexico City, given its other infrastructure needs, is a necessary or feasible option.

During visits to Mexico City in 1993 -1995, the authors urged the National Water Authority to consider and test chemically enhanced primary treatment (CEPT), as a single-stage treatment process that would result in a high level of suspended solids removal, including helminth eggs, and would thereby produce an effluent that could be effectively and economically disinfected. This proposal became the basis for a number of pilot and full-scale tests in Mexico City (Murcott, et. al.,1996). Additional pilot plant studies on the use of CEPT alone and in combination with high-rate sand filters have been completed (Landa,H. et.al., 1997).

CEPT is very effective in removing helminth eggs to a range of 2 – 5 eggs/L. Polishing sand filters were added to insure an effluent with less than 1 egg/L. The Mexican authorities made a cost evaluation of CEPT treatment in comparison with conventional primary plus activated sludge treatment for a number of proposed plants (CNA, 1995). For example, for the proposed El Salto plant (15 m^3/s treatment capacity and 5.2 m^3/s mean flow) the construction cost (including sludge disposal) of the CEPT plant was estimated at US$70 million while the conventional

primary plus activated sludge facility cost was higher by a factor of 1.85. Annual operating costs were US$4 million for CEPT and US$7 million for the primary plus secondary plant. The annual cost of the CEPT chemicals is more than offset by the high energy cost for secondary aeration tanks.

SOUTHERN CALIFORNIA -- A CASE STUDY IN RETROFITTING CHEMICALLY ENHANCED PRIMARY TREATMENT

In 1985, the passage of California's ocean protection plan required that all treatment plants with ocean outfalls had to achieve suspended solids removal of 75% or greater. At this time, the four largest Southern California plants all had conventional primary treatment; three, the City and County of Los Angeles and Orange County, had partial secondary treatment while San Diego had only primary treatment. Because of rapid population growth, the plants were over-loaded by a factor of two or more above their original design capacity. Plant operators, faced with poor performance due to overloaded conditions, met the State effluent requirement by turning to a century-old potable water treatment process -- the addition of trivalent metal salts, to increase solids removal by coagulation and flocculation. They retrofitted their plants for CEPT treatment quickly and at very low cost.

Physical-chemical treatment of wastewater was a well-known technology that had fallen into disfavor in the second half of the 1900's because lime, the preferred chemical at high doses, produced very large quantities of additional sludge. The new twist in California in 1985 was the combination of a low dose of ferric chloride (~25 mg/L) as a primary coagulant together with a minuscule amount of an anionic polymer (~ 0.2 mg/L) as a flocculant. The CEPT process improved treatment efficiency considerably with only a marginal increase in primary sludge production over that due to increased solids removal.

At Pt. Loma, San Diego's overloaded conventional primary plant, suspended solids removal increased to about 85% after the CEPT retrofit. BOD removal increased to more than 55% and phosphorus removal (by precipitation as ferric phosphate) to 85%. Even more impressive was the fact that the increased CEPT pollutant removal efficiencies were obtained at average surface overflow rates of up to 4.5 m/h, about three times larger than commonly used in the design of conventional primary settling tanks. (Morrissey and Harleman, 1992).

San Diego occupies a unique place in the history of urban wastewater treatment in the USA. In the late 1980's, the City was under intense pressure and a federal court order to comply with the EPA requirement to add an expensive secondary treatment plant. Certain city officials questioned the value of spending two billion dollars to obtain a small increase in BOD removal for an already clean CEPT effluent that was being discharged through a long ocean outfall. Their arguments were: (1) extensive monitoring had shown no degradation of the ocean following the 1985 CEPT upgrade, and (2) since San Diego is at the short-end of California's fresh water allocation, it would be more sensible and much less costly to construct a new tertiary plant to treat a fraction of San Diego's wastewater for reuse. Scripps scientists, who had been monitoring the CEPT effluent, strongly supported this viewpoint and San Diego joined with Boston and others in requesting a National

Academy of Engineering review of wastewater management in coastal urban areas. The study was completed (NRC, 1993) and Congress subsequently passed a special secondary treatment waiver for San Diego allowing it to continue CEPT treatment at Point Loma and to build a new water reclamation plant to treat about 15% of its wastewater for reuse on land.

Other plants, such as the City of Los Angeles' Hyperion facility, that had partial secondary treatment, were able to double their secondary flow capacity after CEPT implementation. This was related to the decreased BOD loading to the secondary stage and the fact that the BOD remaining in the CEPT effluent was largely soluble and readily oxidizable.

The first use of low dose chemically enhanced primary treatment in North America was in several Canadian primary plants. These facilities started using CEPT in the early 1980's (Heinke,G. et.al., 1980) in order to reduce the discharge of phosphorus into the Great Lakes. In Europe, a similar process is known as "direct precipitation." For example, in Norway, higher doses (100 - 250 mg/L) of metal salt coagulant are used to meet the requirement for 95% phosphorus removal, with no biological treatment. More recently, chemical treatment with lamella plates has been promoted in France and French Canada at very high overflow rates. In these plants CEPT is followed by aerated biofilters with sludge removal by periodic back-washing. The result, because of the elimination of secondary clarifiers, is a compact, although expensive, treatment plant that can be located in congested urban areas.

IMPEDIMENTS TO CEPT IN THE DEVELOPING WORLD

It is reasonable to ask why, if CEPT is such an efficient and cost-effective treatment technology, is it not more widely known and used. There are several reasons: (1) The California CEPT upgrades were carried out by plant operators who provided no exposure of their results in the technical literature; (2) There are few "basic research" papers on CEPT because the process cannot be studied generically in university laboratories. Bench-scale and pilot plant tests must be done at the site to determine effective coagulant chemicals and dosages. (3) There is a widespread belief that chemical treatment produces “too much sludge.” The fact is that low dose CEPT produces only 10 to 15% more sludge than that resulting from the removal of suspended solids. (4) Private engineering design firms are reluctant to use what they consider to be new approaches. A recent study by the American Consulting Engineers Council reported that three-fourths of their respondents avoid using innovative technology because they are afraid they could be sued if something goes wrong. This is a common "red herring" used to justify the continuation of past practice. (5) There is greater profit in designing plant expansions than in retrofitting and upgrading existing plants with CEPT. (6) The practice in the USA is for a municipality to engage a firm on a non-competitive basis to design a plant, ask bids for construction and then operate the plant with city employees. This discourages innovation because the only competition is in the construction. In contrast, the European practice of bidding on a design/build/operate package encourages competition through the use of cost-effective innovative treatment processes. European design firms who engage in this type of bidding have their own research

laboratories to insure that they understand and advance the treatment processes they propose.

There are now a growing number of examples of CEPT being tested and implemented in the developing world. Their objective is to protect public health, in a cost-effective manner, by first building the minimum level of wastewater treatment that permits effective removal of pollutants and deactivation of pathogens. Because of the increased surface overflow rate compared to conventional primary treatment, CEPT provides the minimum cost per unit volume of wastewater treated. There is no constraint on future biological upgrades; in fact, CEPT technology insures that any subsequent biological treatment, if it can be justified, will be more efficient and smaller in both size and cost.

CEPT EXPERIENCE IN HONG KONG

In 1994 the British government of Hong Kong appointed an International Review Panel (including the first author) to resolve a conflict over plans for the collection and treatment of sewage from the most populated areas of Kowloon and Hong Kong Island. The long range government plan called for a conventional primary treatment plant within the harbor at Stonecutters Island (SCI) and effluent discharge through a long (20+ km) ocean outfall into southern waters. The mainland government complained that the treatment was inadequate and that pollution would be exported from the harbor to Chinese territorial waters.

The Panel completed its review in 1995, recommended that (1) the initial treatment at SCI be upgraded to CEPT, (2) a pilot plant study of the CEPT process and (3) the long outfall be postponed. Subsequently the government redesigned the conventional primary as a CEPT plant and in doing so reduced the number of settling tanks to two-thirds by taking advantage of a higher surface overflow rate. (Harleman, Harremoes & Qian, 1997)

In May 1997, Hong Kong completed construction of the world's largest CEPT plant having a maximum capacity of 40 m^3/s and a 20 m^3/s average flow. Operating data from the CEPT plant show removals of the order of 85% for suspended solids and 74% for BOD with a dosage of only 10 mg/L of ferric chloride. The surface overflow rate of about 60 m/d is roughly twice that for conventional primary treatment. The use of seawater for flushing toilets undoubtedly contributes to the remarkable efficiency of the Hong Kong CEPT plant.

In April 2000 the Hong Kong government appointed a new International Review Panel (again including the first author) to address the issue of completing the collection and treatment of all of Hong Kong Island's sewage and meeting ammonia water quality standards. The Government plan again proposed construction of the long southern outfall in order to achieve ammonia objectives by multi-port diffuser dilution. In November 2000, the Panel submitted its report (IRP 2000) and recommended elimination of the long outfall, by-passing secondary treatment and going directly to nitrification of the CEPT effluent at SCI using compact biological aerated filters. Discharge of the tertiary effluent will meet water quality standards at the local SCI outfall. The Government, in its initial response (EPD Hong Kong

2001) decided to move ahead with the EPD recommendations. In the view of the IRP this may ultimately result in a saving of the order of one billion US dollars.

CEPT EXPERIENCE IN BRAZIL

Bench-scale and full-plant CEPT demonstration tests have been successfully completed, first in Sao Paulo, under the sponsorship of the state wastewater agency. (SABESP, 1996) Next, in Rio de Janeiro, in 1997, the World Bank requested a demonstration of CEPT technology at an existing treatment plant. The objective was to show whether CEPT technology should be used in future treatment plants designed to solve severe eutrophication problems within Guanabara Bay. One of the major treatment objectives is low-cost phosphorus removal, the limiting nutrient controlling the large algal blooms that cause oxygen depletion and odors in the Bay. Tests of CEPT showed that it is possible to remove about 90% of the phosphate as well as high levels of TSS and BOD. (Harleman and Murcott, 1998) The first two CEPT treatment plants in Rio have been constructed by CEDAE, the state agency, and have begun operation.

In l998 it was decided to use the Brazil CEPT experience to provide Master of Engineering thesis opportunities for Massachusetts Institute of Technology students. Site visits to design, test and collect data on innovative treatment processes were made. The focus was on municipalities which have overloaded and poorly functioning plants. In Brazil, most wastewater treatment in medium size cities is by open lagoons at the edge of the urban area. The usual method of upgrading existing lagoon performance and treatment capacity is by cleaning and reconstructing the lagoons and installing surface aeration units. However, in addition to the initial costs, most cities cannot afford the large annual costs to run and maintain the aerators.

Students obtained data on anaerobic and facultative lagoons serving a coastal community having a large variation in seasonal population. A numerical model (Ferrara and Harleman, 1980) was used to predict the performance of the wastewater treatment lagoons. The calibrated model was then used to design two treatment upgrade alternatives for a city which had planned to upgrade existing lagoons by installing aerators. (Chagnon, 1999)

In the first treatment upgrade alternative, a small CEPT tank is placed in front of the first lagoon. This reduces the solids and BOD load on the lagoons and eliminates the need for aerators. The second alternative used an in-lagoon CEPT concept whereby chemical coagulants are added directly at the inlet of the first lagoon, again eliminating aerators. This type of CEPT lagoon, first successfully used in Scandinavia (Hanaeus, 1991), would be expected to perform better in the warmer climate of Brazil. A comparative cost study showed that both alternatives were less expensive, in capital and O & M costs, than the original aerated lagoon design. (Cabral, et al, 2000)

CONCLUSIONS AND RECOMMENDATIONS

Public health is the major water-related environmental concern in urban areas of the developing world. In many instances, drinking water and receiving water sources are contaminated by raw or inadequately treated wastewater effluents. Even when conventional primary treatment exists, its effluent cannot be effectively disinfected.

The objective of initial wastewater treatment investments or upgrades of existing treatment facilities should be a high-flow rate, low-cost treatment technology such as CEPT, that provides a high level of suspended solids removal, thereby permitting effective pathogen inactivation by disinfection.

The issue is not one of chemical versus biological treatment. Chemically enhanced primary treatment is the most cost-effective first step, it can always be followed at a later stage by more advanced biological treatment processes if they can be justified and afforded.

Most CEPT studies in developing countries have been carried out on a short-term ad-hoc basis with little time and effort devoted to exploration and research. There is a clear need to develop long-range research and field studies at several existing treatment plants having different raw waste characteristics.

The following topics are recommended for further research:

- The interaction of metal salts as coagulants and anionic polymers as flocculants. This would explore the optimization of combinations of metal salts and polymer dosages for maximum removal efficiency at high surface overflow rates;

- The trade-off between various proportions of metal salts and cationic polymers as primary coagulants. This would offer potential savings in sludge production which might offset the higher cost of the polymers;

- The efficiency improvements in CEPT technology through controlled mixing of coagulants and flocculants. This would demonstrate the effectiveness of mixing and flocculation devices upstream of settling tanks;

- The effectiveness of recycling waste potable water treatment sludge and/or CEPT sludge. There is evidence that either may be effective in reducing coagulant doses;

- The efficiency of combining CEPT, with primary effluent filtration or CEPT with aerated biofilters. The latter effectively uses the highly soluble BOD remaining after CEPT and, by backwashing, eliminates the cost and space required by secondary clarifiers.

- The cost and enery savings of CEPT versus activated sludge wastewater treatment plants.

- The interaction of CEPT and wastewater lagoons with either pre-lagoon CEPT treatment or in-lagoon chemical treatment. Collection of data on operating CEPT/lagoon combinations to improve numerical modeling of lagoons to optimize final effluent quality and ultimate sludge disposal.

- The potential uses of processed CEPT sludge for agricultural applications. Collection of data on effectiveness of nutrients in the sludge.

- The disinfection by UV, or other options, following CEPT treatment.

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The Future of Chemically Enhanced Primary Treatment: Evolution Not Revolution

by

Denny S. Parker, James Barnard, Glen T. Daigger, Rudy J. Tekippe and Eric J. Wahlberg

Harleman and Murcott challenge the professionals in the wastewater industry to adopt a specific technology, chemically enhanced primary treatment (CEPT). They opine that its lack of broader acceptance is due to lack of publications covering the practice, absence of basic research, concerns over sludge production, risk adverse design consultants, the profit motive of design consultants who are aligned with more expensive solutions, and the lack of competitiveness in technology applications in the USA.

There is value in reviewing any technology, innovative or well proven, and encouraging its unfettered consideration. However in this case, Harleman and Murcott move well beyond an objective technical assessment of CEPT technology. Their claim of the neglect of this technology by international water quality experts caused a member of the Editorial Board of Water 21 to invite us to submit this discussion. We accepted this responsibility and believe Harleman and Murcott should be held accountable for their blanket attack on the professional integrity of a broad class of environmental engineering professionals.

The senior discusser has been involved in process development of particle separation processes throughout his 31 years of consulting engineering practice. This has included involvement in various CEPT projects throughout his career. And all of our firms have been involved in investigation, research and application of CEPT. We will demonstrate that CEPT is both a well-established tool and one that is well documented in the literature. Furthermore, we will show by our involvement in projects that have included CEPT that we do not regard it as a high-risk venture. And finally, those who broadly question the ethics of design consultants should have more to back it up than mere opinions and statements of generalities. Indeed, challenging another party's professionalism without well-documented and substantiated information starts the accusers down a very slippery slope.

Harleman and Murcott's selective use of literature citations only inadequately reflects the extent of contributions in technology development for the developing world. It is patently unfair to demonstrate that there is little interest on the part of the water quality profession in appropriate technologies by picking a single IWA conference volume on futuristic concepts for integrated wastewater system design, when its principal focus was not on wastewater treatment technology for centralized treatment plants. There have been a number of IWA conferences that presented a very wide array of centralized treatment technologies specifically proposed as appropriate technology for developing countries (Wang et al., 1991, Ho and Mathew, 1993, El-Gohary, 1995, Lima et al., 1996, Mara et al., 1996 and Khanna and Kaul, 1996). Research has reflected the following

treatment technologies for centralized treatment: oxidation ponds, aerated lagoons, anaerobic lagoons, land treatment and disposal, anaerobic reactors of various configurations, pond treatment prior to reuse, activated sludge including sequencing batch reactors, evaporation systems, solids processing systems and separate industrial wastewater treatment systems. Our review revealed that CEPT is not featured in these volumes. This may indicate either that it has limited application or that it is considered already at the state of development where the technology can be transferred to developing countries without further research. Or, on the other hand, will Harleman and Murcott imply in their rebuttal that the more than three hundred investigators with papers in these IWA volumes have a bias against CEPT or that they lack creativity?

Reading Harleman and Murcott's article might lead the reader to believe that all relevant applications of CEPT began with the work of Canadian engineers in the early eighties (who indeed made valuable contributions) or by the operators of California treatment plants in the mid-eighties (who indeed also made valuable contributions) or as a result of Professor Harleman's recent advocacy of CEPT. In fact, our review shows a steady and consistent development and practical application of CEPT beginning at least 35 years ago. Our own reference list shows 76 investigators (consulting engineers, municipal engineers, scientists and operators) who have advanced CEPT technology. These investigators (many with multiple contributions) are from the following countries: USA (59), Canada (7), Scandinavia (7), Israel (2), Australia (1) and Bulgaria (1). A technology assessment should have at its heart a thorough literature review and an acknowledgement of prior work. Will Harleman and Murcott acknowledge in their rebuttal that almost without exception they have overlooked the work of these investigators?

History of CEPT Development

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The earliest reported practice of CEPT seems to be in England as early as 1870 and it also is stated that it was used extensively in the 1890s and early 1900s in the USA before the development of biological treatment. It is also stated that CEPT had a resurgence in the 1930s in the USA (Metcalf & Eddy, Inc., 1991), but for these periods of practice we could find no useful technical articles in our libraries or files.

CEPT: a response to eutrophication concerns. In the 1960s, with eutrophication problems in the Great Lakes, specific objectives for phosphorus reduction appeared on the near-term horizon for many municipal dischargers. This was before the development of proven systems for biological phosphorus removal, and technologists turned to chemical addition for reliable treatment. A major equipment vendor, Dorr Oliver, advanced an innovative two-step system consisting of CEPT followed by activated sludge treatment. Termed the "Phosphate Extraction Process," it was postulated that if the pH was adjusted to between 9.5 to 10 with lime in the primary clarifier, carbon dioxide generation in the aeration basins would be sufficient to decrease the pH to an acceptable range while achieving 90 percent phosphorus removal across the entire process (Albertson and Sherwood, 1967). Basic research at bench-scale explored such

variables as the effect of lime dosage and pH on residual BOD, COD and phosphorus along with the influence of sludge recirculation to the CEPT flocculation zone.

At the same time, chemical suppliers developed application technology. For instance, the Dow Chemical developed their CEPT concept around low dose applications of ferric chloride as the primary coagulant with supplemental anionic polymer. The investigators named it "The Dow Process for Phosphorus Removal." Starting initially with basic research at bench-scale, the work progressed almost immediately went to full-scale tests at Grayling and Lake Odessa, Michigan (Wukash, 1968, Dow Chemical Company, 1967a, and Dow Chemical Company, 1967b). These studies dealt with the practical issues of locating appropriate coagulant addition points in plants without designed-in flocculation facilities. Dow extended their work at Buffalo, New York, Benton Harbor, Michigan and Cleveland, Ohio. At Fe dosages of 14 to 20 mg/l with 0.5 mg/l of anionic polymer, 64 to 80 percent suspended solids (SS) removals were obtained compared to 0 to 40 percent in the controls (Johnson et al., 1969, Dow Chemical Company, 1970a and 1970b). It was found that performance was highly sensitive to the polymer addition point and if polymer was added to the process too far ahead of the primary sedimentation tanks, floc breakup would occur in the conveyance facilities.

Later, Heinke et al. (1980) conducted CEPT testing at the Windsor, Sarnia and CCIW plants in Ontario. At the Windsor plant, optimum performance was achieved with ferric chloride (17 mg/l as Fe) and 0.3 mg/l of anionic polymer. It should be noted that Heinke et al. (1980) confirmed the earlier work in the Dow Process in that it was shown that CEPT increases the particle settling rates and removal efficiency. Further, they showed that the technology allowed higher surface overflow rates than previously had been employed in design of primary clarifiers in Canada.

In parallel with the work of Dorr Oliver and Dow Chemical, Allied Chemical made strides with its aluminum products (Allied Chemical Corporation, 1970). Success was shown with alum in CEPT applications, such as at Windsor, Ontario (Allied, Chemical Corporation, 1973).

Wilson et al. (1975) report successful full-scale trials on use of CEPT with alum and polymer at Tampa, Florida. CEPT was shown capable of SS and BOD removals of 83 and 44 percent, respectively. Later, basic research in the laboratory by Dentel and Gosset (1987) showed that regions of raw wastewater coagulation with alum were similar to that occurring in water treatment, provided that some of the differences are accounted for.

Parallel European development of CEPT technology started in the early 1970s and was concentrated in Scandinavia, largely out of concerns over algal blooms. Erickson (1973) reported on early CEPT trials in Sweden. Testing resulted in the full-scale application at two plants with low iron dosages. While not much benefit was seen in terms of SS removal improvements with CEPT, after subsequent biological treatment the final effluent phosphorus objectives were realized. Odegaard (1992) reported on developments in Norway where 28 of the plants provided CEPT alone without subsequent biological treatment. This report reflects years of practical work with CEPT optimization. It was

believed that for the weak, fresh and cold wastewater typical in Norway, CEPT technology was especially appropriate. Average BOD and SS removals of 82 and 87 percent were obtained due to the low concentration of soluble BOD, albeit with much higher chemical dosages than used with the Dow Process in North America.

Odegaard's (1998) basic research on CEPT has been on the influence of organic polymers as supplements to metal salt additions. He showed a considerable enhancement to floc settling rates allowing higher surface overflow rates than when the metal salt was used alone, confirming earlier practical experience in North America. Of perhaps more significance, it was shown at bench-scale that cationic polymers could be substituted for metal salts to minimize sludge production when no phosphorus removal was required. The best removals overall were achieved with a combination of metal salts and organic polymer. As shown earlier in North America, using polymer as a supplemental coagulant could minimize metal salt usage.

CEPT as part of a physical/chemical flowsheet for secondary treatment. The development of CEPT continued in the USA in the 1970s. Some of the work took place because of the interest in CEPT as the first step in a treatment scheme followed by activated carbon. For example, the work of Shuckrow and Bonner (1971), Feige and Berg (1973) and Burns and Shell (1973) is of interest. Here, various coagulant comparisons were made such as low dose iron to lime and alum to lime at pilot- and full-scale. Basic research in the laboratory by Bowen and DiGiano (1975) involved settling column tests and adaptation of the water treatment jar testing procedures of Tekippe and Ham (1970) for CEPT. This allowed the development of design methodologies that enabled the engineer to select optimum coagulant dosages, pH values, flocculation intensities and sedimentation times for CEPT. It was shown that alum could not sustain as high a clarifier surface overflow rate for the same removal as that obtained with lime and also that alum sludges were more difficult to dewater.

The use of CEPT followed by activated carbon did not prove to be an unqualified success in warmer climates with septic wastewater. More than 10 municipal plants were built with this flowsheet, but all but one failed due to process or mechanical reasons and were taken out of service. Roll and Crocker (1996) describe the efforts of plant staff to keep the Niagara Falls plant in effective operation under very trying circumstances.

CEPT coupled with biological treatment for advanced wastewater treatment. At the same time as the work on physical chemical treatment, California investigators continued work on CEPT followed by biological treatment. The CEPT work was at full-scale with lime as the primary coagulant and focused on optimizing CEPT for maximizing the effectiveness of downstream nitrification (Horstkotte et al., 1974). With the use of lime at pH 10.2 and with iron as a supplemental coagulant, BOD and SS removals with CEPT were 66 and 87 percent respectively, compared to 40 and 75 percent in the control. When primary effluent pH was less than 11.0, acid production and carbon dioxide generation in the activated sludge process was sufficient to rapidly decrease the pH in the aeration basins to a normal operating range. Research was extended to include demonstration of centrifugal sludge classification and lime recovery through recalcination in a multiple

hearth furnace (Parker et al., 1974a, 1975). This test work served as the basis for design of two large wastewater treatment plants, one in California and one Australia (e.g. see Eisenhauer et al., 1976 and Philp, 1985). The work also formed the basis of a USEPA report on process design on CEPT with lime (Parker et al., 1974b).

The California work on CEPT followed by a nitrifying process has been followed up by a number of engineers and research investigators. Interest transitioned from using lime in the primary to the use of aluminum or iron compounds (usually supplemented by polymer) largely because this simplified sludge management. The senior discusser was involved in process design in the 1980s of two secondary treatment plants that were constructed downstream of CEPT using iron salts. One is located in Cleveland (Ohio) and is a Trickling Filter/Solids Contact plant and the other is in Appleton (Wisconsin) and is a nitrifying activated sludge plant. Andersson and Rosen (1989) report on how ferric chloride addition to the primary treatment stage effected organic load reductions in addition to phosphorus removal and thereby improved nitrification in two Swedish activated sludge plants. The work was extended to show the significant influence of supplemental polymer addition on increasing SS removal (Andersson et al., 1997).

Galil and Rebhun (1990) showed that the reduction in organic levels with CEPT with either lime or alum as the coagulant allowed a remarkable reduction in the size of the aeration tank required for nitrification in the downstream activated sludge process. And the City of Atlanta (Georgia) has alternatively used aluminum and iron products in a CEPT mode ahead of a nitrifying activated sludge plant to meet its interim phosphorus removal requirements at its largest plant as it transitions to full biological phosphorus removal. Sedlak (1992) and Daigger and Parker (2000) review other full-scale work using CEPT ahead of the activated sludge process. Also, similar work with fixed film processes (biological aerated filters and trickling filter technology) has been done at Windsor, Ontario with CEPT at low iron dosages preceding the biological processes. Chemical addition to the primary tank gained a double benefit from the coagulant in that it reduced both phosphorus and organics, resulting in an overall optimized design for nitrification and phosphorus removal (Newbigging et al., 1995 and Parker et al., 1998).

CEPT for ocean disposal. The late 1960s and 1970s saw another impetus for CEPT development. Ocean dischargers on the West Coast of the USA could reasonably predict that regulatory agencies would require an upgrading of treatment from conventional primary to biological treatment. Recognizing the high cost of secondary treatment and the lack of a demonstrable benefit for high degrees of BOD removal for effluents discharged through deep ocean outfalls, agencies sought a more cost-effective and appropriate combination of treatment and dilution than existed for their inland counterparts. For instance, CEPT research was done at pilot and plant-scale at San Francisco, California (City and County of San Francisco, 1967, Brown and Caldwell, 1971) and Seattle, Washington (Brown and Caldwell, 1978a). The senior discusser participated in the pilot-scale CEPT work for both municipalities.

The City and County of San Francisco (1967) modified the Dow Process with purposeful seawater addition with a Fe dose of 8 mg/l and an anionic polymer dosage of 0.2 to 0.4

mg/l anionic polymer. The test was very successful and resulted in SS removals of 76 to 80 percent. However, it was later reported that the use of seawater caused severe corrosion of the existing tank internal equipment.

In Seattle, both lime and alum were tested at pilot-scale during different periods. Basic research was conducted on the effects of coagulant dosage, flocculation conditions, solids production, use of secondary coagulants (e.g. polymer with alum and iron with lime), sludge recycle and the use of seawater to provide magnesium for coagulation in the lime system. It was found that particulate BOD was removed to the same extent as the suspended matter, but that soluble BOD was only marginally removed. Both systems were capable of removing 94 percent of the influent SS. During the full-scale trials with alum, SS removals decreased to 84 percent but chemical application points were possibly not optimized during the short test periods.

The West Coast USA dischargers were confounded when the USEPA issued uniform secondary treatment requirements in 1974 that allowed no exceptions for deep ocean disposal. Publicly elected representatives, utility managers and engineering consultants lobbied for a change in the law to allow for lower cost alternatives to full biological treatment such as CEPT or blends of biological and primary effluents. In the same period, the senior discusser was the project manager for wastewater facilities planning for the City of Santa Cruz and Santa Cruz County (California). We argued against the USEPA's rigid position that only biological secondary treatment alternatives be considered. We favored CEPT consisting of low dosage iron and polymer as a more cost-effective. The compromise was for the City to include the alternative in the project report as an initial step (Brown and Caldwell, 1978b). Once the US Congress passed the "ocean waiver" discharge permit provision and the USEPA promulgated the implementation regulations, the City of Santa Cruz engaged the senior discusser's firm to prepare their application and to complete the design. Pilot- and field-scale studies were used to optimize the use of preaeration for flocculation with low dosage iron followed with polymer addition prior to the existing primary tanks (Volpe et al., 1987). The constructed plant easily met California's required monthly average 75 percent SS removal criterion with coagulation with low dose ferric chloride and polymer.

However, getting an ocean waiver approval process established by the US Congress provided no assurance that a permit for discharge would ultimately be obtained. Often, public hearings associated with the consideration of the discharge permits by USEPA brought out an electorate activated by environmentalists who took the position that anything less than secondary treatment was bad for ocean water quality. Rather than suffer continual controversy, a number of agencies backed away from the ocean waiver process and either declined to apply for waivers, abandoned their applications mid-process or did not renew them after one or two permit terms. If this negative public reaction had not occurred, there would be many more holders of ocean waiver permits in the USA today (and likely more CEPT plants).

The City of San Diego, California was a case where an ocean waiver application was not completed by mandated deadlines and therefore no ocean waiver permit was issued by

the USEPA. Highly vocal public opposition discouraged the City from submitting an application. However, prominent scientists at the University of California Scripps Institute of Oceanography strongly advocated the position that their investigations showed that no harm was being caused by the existing deep ocean outfall serving the City's large Point Loma primary wastewater treatment plant. This cut the ground out from under the protesting groups. With this scientific backing, the City decided to reconfigure the system in a manner that would leave the Point Loma as a CEPT facility and to take what would have been spent on secondary treatment to build upstream water reclamation plants for a portion of the flow. The City applied for and received from a US federal judge a number of stays in the City's deadlines for secondary treatment completion at Point Loma, despite the legal and technical opposition of the USEPA. Ultimately, they were successful in getting a waiver granted directly by the US Congress.

The experience of several California ocean dischargers with CEPT using low dosage iron and polymer is summarized and compared by Ooten et al. (1993). Recently, progress on one of these CEPT plants was reviewed by Hetherington et al. (1999).

Other West Coast agencies lacking permits with ocean waiver provisions proceeded with planning for full biological treatment. In California, the City of Los Angeles' Hyperion Treatment plant was in this position. In the 1980s, engineers on City and program management consultant (CH2M HILL) staff did not fail to look at CEPT as a potential technology to reduce the size and cost of the secondary treatment expansion. A detailed comparison was made of capital and operating costs of CEPT (based upon plant experience with low dosage ferric chloride with polymer) and conventional primaries ahead of activated sludge treatment was made. All of the impacts were considered and summarized, such as the marginal increase in sludge with CEPT as well as the reduced oxygen requirements of the planned downstream oxygen activated sludge system. It was found that there was a net total cost increase with CEPT (Chaudary et al., 1989). After more years of operating experience with CEPT and high rate activated sludge treatment, operators at the Hyperion plant returned to the issue of comparing that process configuration to conventional primary treatment followed by activated sludge. They subsequently developed a proposal that was different than the plan the City had adopted. They showed a sludge production increase just as in the original study; but in this case found a net total cost decrease (Shao et al., 1996).

The issue was looked at again in the nineties by the City and the design consultant (Black & Veatch). In the final design of the Hyperion plant, the City decided to provide for the addition of ferric chloride but also provided adequate secondary treatment capacity to handle design flows if this chemical were not added. The reasoning was that the supply or price of chemicals was uncertain so the City did not want to have to rely on them. But it was decided to retain the chemical addition capability and among the reasons was that iron addition controlled sulfide and struvite formation in the digesters. The Hyperion case example makes the point that those involved with CEPT applications can have professional differences of opinion. Indeed, the same individual may "change sides" in an argument when new information becomes available.

The National Research Council (1993) has evaluated treatment technologies useful for ocean disposal. Engineering studies showed that while CEPT was significantly less expensive than biological treatment, it had no cost advantage when coupled with biological treatment over a conventional primary treatment/biological treatment flowsheet. This was shown to be the case for both the low and high dosage forms of CEPT.

Recently, two of the discussers have been involved in the revaluation of CEPT to optimize its efficiency. These investigations have been oriented to identifying organic polymers that could substitute for metal coagulants and to extending the usefulness of jar tests and settling column tests to allow more rapid field optimization of optimum coagulant dosages and application points and to identify where flocculation opportunities are best enhanced in existing CEPT systems (Wahlberg et al., 1998 and Parker et al., 2000). For the studies on substitution of polymer, no benefit could be shown beyond that achieved by flocculation without any coagulant addition. The procedures have been also been used to reconfigure some existing and design new CEPT tanks that employ low iron dosages. The latter work was completed for the Orange County Sanitation District, a current holder of an ocean waiver permit in California.

Summary of CEPT development. Overall, the reader should conclude from this review that the CEPT technology has been well developed after at least 35 years of basic and applied research at bench-, pilot- and field-scale. There is a wealth of research and practical experience to draw upon. In addition to the cited references, recent design manuals and textbooks do a good job of presenting design approaches for CEPT (e.g., Bouker et al, 1987, Sedlack, 1992, and WEF and ASCE, 1998).

CEPT in Hong Kong

Two of the discussers were involved as treatment technology consultants advising the Honk Kong based firm conducting the independent review of Stage II of the Strategic Sewage Disposal Scheme for the Hong Kong government. This occurred at the same time as Professor Harleman's first involvement as an International Review Panel member. The reports of the two groups are bound in the same volume and should be considered together (Pypun, 1995 and Yi et al., 1995).

Harleman and Murcott are in error when they assert that Professor Harleman was instrumental in arguing that the conventional primary treatment planned for Stonecutter's Island in Stage I of the plan should be replaced with CEPT. In fact, the consultant (Montgomery Watson) had planned on CEPT using low lime (pH 9.7) treatment for the first stage of construction.

Harleman and Murcott are correct that it was the panel's recommendation to increase the surface overflow rate of the primary sedimentation tanks and that low dose iron should be used, however the iron was to replace lime as a coagulant. It should be noted that the independent consultants (Pypun, 1995) had previously concluded under Option 9 for

Stage II that a shift should be made to low dose iron treatment with polymer at higher surface overflow rates. This was based on our prior North American experience with CEPT. The fact that Professor Harleman and the rest of the panel would draw the same conclusions for Stage I is not surprising, since they also had access to information from North American CEPT practice.

The 1995 Hong Kong review had the same intended effect as the Value Engineering studies typically conducted in North America and elsewhere, i.e. to recommend changes in design which will save the owner money initially or over the long term. Such peer reviews are a normal aspect of one's professional career.

In the paper, the impression is created that the Hong Kong plant is fully operational. Only a fraction of wastewater is reaching the plant and it is in a fresher state than it will be ultimately. When the 17 km interceptor tunnel is completed, the bulk of the wastewater containing a portion of seawater will be discharged to the tunnel and pumped out. Anaerobic conditions and sulfide development can be expected due to the long residence times and high wastewater temperature. A degree of hydrolysis of the particulate matter could result, likely resulting in lower BOD and SS removals than is reported by Harleman and Murcott. Once the system is full operational, these effects should be tested and analyzed.

CEPT in Developing Countries

Harleman and Murcott assert that CEPT technology is particularly applicable to the developing world. It could be an appropriate first step of treatment in individual cases, but no claim should be made for universal applicability, as there are many competing technologies. Selection of a treatment system should involve a careful engineering evaluation that includes a host of considerations, such as desired water quality, affordability, practical aspects of implementation, alternative technologies and, of course, cost considerations. For example in Brazil, anaerobic pre-treatment systems have been developed that remove 60 percent of the BOD while producing substantially less sludge (Sandino and Yee-Batista, 2000). When this is followed by pond systems, low overall sludge production and little or no power is used. In South Africa, anaerobic pond systems followed by algae ponds resulted in no sludge production in seven years while treating very strong wastewater. The addition of a simple trickling filter captured the algae and produced effluents with BOD less than 10 mg/L and ammonia was reduced from 70 to less than 5 mg/L. The plant used little power and no chemicals (Barnard and Meiring, 1995). On the other hand, Nenov (1995) concluded that CEPT was particularly appropriate for discharges to the Black Sea. When compared to activated sludge it had lower capital and operating costs and could achieve relatively high BOD and SS removals at high surface overflow rates.

The authors also mention the recent start-up of two treatment plants (ETE's Pavuna and Sarapui) incorporating CEPT as part of the Guanabara Bay clean-up effort for Rio de Janeiro. It should be noted that a consulting engineering firm (Black & Veatch)

recommended this process to CEDAE, the implementing agency, as early as 1996, and had completed preliminary designs almost a year earlier than the pilot testing efforts cited by the authors. These plants were designed with the intent of subsequently building an activated sludge stage.

An obvious example of where CEPT can easily be screened out as a potential treatment alternative is the case of many small island nations that have no infrastructure for in-country production of coagulant chemicals, and all chemicals have to be shipped in at high cost. It is obvious that in such cases, there are more appropriate technologies.

CEPT and Nutrient Removal

Harleman and Murcott refer several times to the removal of phosphorus but hardly ever to the removal of nitrogen. Organic carbon compounds are required and in many instances only limited primary treatment or none at all is used in order to allow sufficient carbon for denitrification. The alternative is to import carbon (e.g. methanol) for denitrification. The main energy cost in nitrogen removal is for nitrification and much of the energy is recuperated during the denitrification process. Not mentioned at all is the effect of chemicals on the pH of subsequent processes for downstream nitrification. There are instances where CEPT must include pH correction to allow for nitrification. Denitrification using internal carbon sources is also required in many cases to counter the drop in pH in low alkalinity water. In some cases, these considerations tend to counter the benefits of CEPT.

The references to phosphorus removal are also rather selective. The removal of 85 percent of phosphorus is sometimes achieved in activated sludge plants without a great deal of effort. Chemical precipitation requires heavy dosages to achieve low effluent phosphorus levels. Two of the discussers were involved in recent studies at a plant in Oregon, USA where it was shown that by utilizing biological phosphorus removal with chemical polishing, alum consumption could be reduced from 70 to 20 mg/L.

CEPT and chemical phosphorus removal were considered seriously in South Africa in the early 1970s. The main reason for the wide adoption of biological phosphorus removal was the problem of salt addition to the wastewater with chemicals used in CEPT. Recycling in inland situations increases salinity and using chemicals could further impair the value of the effluent.

Research Needs

Harleman and Murcott provide a listing of research needs, but the discussers find most of the topics have already been adequately addressed. Indeed, most of the research areas are no longer basic research issues at all and are most appropriately addressed as part of the study and implementation phases of actual projects. We do agree with the call for more research on UV disinfection of CEPT effluents, since the technology is in the early stages

of development for low UV transmittance wastewaters. Also, there has been interesting bench-scale work done with aerating and recycling primary sludge to improve its flocculation potential so as to increase colloidal and soluble BOD removal in primary clarifiers (Huang and Li, 2000). With the promise of enhancing primary treatment without chemical addition, it should be extended at least to pilot-scale.

Curiously, Harleman and Murcott are silent on a more recent development of CEPT, ballasted sedimentation, that is being pilot-tested all over the USA for treatment of CSOs, SSOs and for excess flows at wastewater treatment plants (e.g., see Chang et al., 1998). There is much to be learned as the first full-scale plants go into operation.

Professional Discourse on Treatment Alternatives: Turning Down the Volume

For Harleman and Murcott to impugne the integrity of a class of professional engineers daily engaged in wastewater technology applications does nothing positive to influence decision-makers on the merits of their positions. Indeed, in making inflammatory and undocumented accusations against this group, Harleman and Murcott raise questions about their own professional ethics rather than direct attention to CEPT technology.

The discussers have never encountered consulting engineers in their own firms or in firms with which they have worked with who would make recommendations about technology that was oriented to increasing their client's costs. On the contrary, every pressure on the design consultant is in the opposite direction, which is to competitively deliver cost-effective projects that demonstrate the value of our services. In fact, those of us in practice know that engineering selections are highly competitive and in many cases the best ideas presented in the competition for selection are the most important aspect of the selection process.

The authors asserted that doing away with the USA practice of design and construction and the adoption of design/build/operate (DBO) schemes will result in more frequent adoption of CEPT. Recent DBO projects in Dublin and Bangkok seemed to belie this statement. For example, in Bangkok the high temperature and flat topography resulted in highly septic and well-hydrolyzed wastewater. On this account, not only did CEPT not feature in any of the designs that were offered, primary tanks were mostly not even considered.

Harleman and Murcott claim that the CEPT technology has been overlooked by international experts; we have shown that this is not the case. And as demonstrated by the examples reviewed herein, design consultants do not view the use of CEPT technology as a high-risk proposition nor do they avoid it due to any particular prejudice. We have pointed to examples where our firms were involved in its development and application. And there are rich sources of information on both the theoretical and practical aspects of CEPT applications to draw on with many full-scale examples. We are quite willing to recommend its use in cases when a cost-effectiveness evaluation shows it to be appropriate. But any alternative must have a full and fair evaluation before

adopting it, including an assessment of existing facilities, effluent requirements and alternative processes. Where CEPT fits use it!

If Harleman and Murcott want to encourage further consideration of their concepts, they should publish the scientific and technical bases for their broad judgements about the wide applicability of the CEPT technology. This should be published in a journal where other investigators can offer discussions.

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Rebuttal by Harleman and Murcott to the Parker et al. discussion paper: "The Future of Chemically Enhanced Primary Treatment: Evolution Not Revolution".

We welcome the discussion of our paper prepared by five distinguished members of the US environmental engineering consulting profession. Their discussion provides a wealth of supplemental information on the history and development of chemically enhanced primary treatment (CEPT) in the industrialized world. They argue that the future of CEPT is evolution and not revolution

We argue in our paper that enormous water pollution problems related to inadequately treated wastewater in the large cities of the developing world requires innovative, revolutionary thinking, not the complacency of "evolutionary" solutions. Parker et al. devote three paragraphs (out of 12 pages) to CEPT in developing countries -- the main focus of our paper. They state: "it [CEPT] could be an appropriate first step of treatment in individual cases, but no claim should be made for universal applicability, as there are many competing technologies." What are their "competing technologies"?

In Brazil, they suggest the use of anaerobic pre-treatment (UASB) followed by pond systems, and in South Africa, anaerobic pond systems followed by algae ponds followed by trickling filters to capture algae. If these are the "competing technologies," we can confidently restate our claim that CEPT is the most environmentally sound and cost effective first-stage treatment system for large urban areas where the large space requirements and odor problems of anaerobic wastewater treatment processes and wastewater stabilization ponds make them impractical.

Parker et al. cite many IWA conference volumes in the 1990s that purport to deal with centralized wastewater treatment technology appropriate to developing countries. We agree that CEPT is not featured in these volumes and this is the prime reason for writing our paper.

We find it both strange and significant that the words "public health" do not appear in the Parker et al. paper. Their emphasis is on "CEPT as part of a physical/chemical flow sheet for secondary treatment,"on "CEPT coupled with biological treatment for advanced wastewater treatment," and on "CEPT and Nutrient Removal." These advanced wastewater treatment processes are not relevant to the major public health needs of megacities in the developing world. For this reason we recommend CEPT, as a first-stage treatment process that produces an effluent that can be effectively disinfected. The use of CEPT + disinfection, at about half the cost, energy use and operational difficulties of

conventional primary + activated sludge, would allow the goal of full treatment in these cities to be attained more rapidly.

CEPT, in addition to providing BOD and TSS removals that equal or approach secondary treatment levels, is also effective in phosphorus removal. If, at a later stage of urban development, nitrification or denitrification is deemed necessary and affordable, the cost-effective solution would be to skip secondary treatment and go directly to biological aerated filters (BAF) that have the advantage of not requiring additional clarifiers.

Parker et al. have criticized us for including, as one of six impediments to CEPT in the developing world, the comment that profit motive may drive the use of inappropriate treatment technology. They refer to this as a "blanket attack on the professional integrity of a broad class of environmental engineering professionals." We certainly do not intend a blanket attack on US or European professionals. We can, however, provide support for our statement from the following:

"To find solutions to their environmental problems, developing countries usually seek the assistance of engineers and scientists from developed countries. Many times, however, either out of ignorance of the local condition or due to financial motivations, these experts come out with solutions which are far from being considered as the 'most appropriate.' As a result, the basic objective of protecting the environment is not achieved." (Curi, 1985)

Based on extensive experience in developing countries, we have seen too many conventional primary + activated sludge plants that are treating only a fraction of the municipal wastewater. In most cases the effluent from these plants is ultimately mingled with and overwhelmed by the remaining raw sewage discharges to form a stream or river with no discernable protection of the public health. For example, in Sao Paulo, about 30% of the wastewater flow is treated to the secondary level, yet the Tiete River flowing through the city center is essentially an open sewer. Similarly, in Beijing, about 25% of urban wastewater is treated in a token activated sludge plant at Gao Bei Dian while the remaining raw sewage is discharged directly to canals and rivers. Many other examples could be cited. We have also observed that there is a bias against CEPT related to a perception of second class status because it not been widely adopted in the Western world.

Parker et al. refer to the treatment plant costs in the National Research Council (1993) study in which we and Glen Daigger participated. Parker et al. state: "Engineering studies showed that while CEPT was significantly less expensive than conventional primary plus biological treatment, it had no cost advantage when coupled with biological treatment." We agree with the first-half of the quotation. The NRC total cost figures provided by Mr. Daigger do indeed show that the cost of CEPT is 60% of conventional primary treatment plus activated sludge. The

second half of the quotation simply reinforces our argument that CEPT should not be followed by activated sludge because there is no environmental benefit in a CEPT + activated sludge plant that produces a small increase in TSS and BOD removals at great expense. The 1993 NRC cost figures also show that the capital cost of CEPT is somewhat greater that of conventional primary treatment. This is no longer true. The NRC costs do not reflect the fact that CEPT results in a downsizing of the plant because overflow rates at least twice that for conventional primary treatment are now common. (Harleman et al. 1997)

We appreciate the careful documentation of the development of the City of Los Angeles' Hyperion plant by Parker et al. Here is a case in which the early experience with CEPT clearly showed the downsizing capability of CEPT in both the primary tanks and in the size and efficiency of the activated sludge plant. The excuse for not taking advantage of CEPT in the final plant because of uncertainty in the supply or cost of chemicals is weak. Fortunately the same argument has not been put forward to avoid using the same chemicals in potable water treatment.

Likewise the Parker et al. argument against the use of CEPT by small island nations is weak. CEPT has been successfully demonstrated at full-scale by the authors in Hawaii's two main treatment plants at Sand Island and Honouliuli. (Harleman and Murcott 1996) Because of the higher cost of shipping metal salts we tested ferric chloride and as an alternative the use of cationic polymers. Our recommendation was to use 2 to 3 mg/L of cationic polymer as the sole coagulant. This low dose gave 80% TSS removal and 50% BOD removal. A recent study in The Netherlands (Mels and van N. 2000) also compared ferric chloride and cationic polymers. They showed that in terms of chemical costs the reduced dosage (4 mg/L) of polymer and the higher polymer cost (7.5 times higher than the ferric per mg of active product) was about equal to the higher dosage and lower unit cost of the iron salt. There is also a saving in sludge processing because the polymer produces no additional chemical sludge.

A further argument in favor of CEPT by island states or nations is on account of energy savings outweighing chemical costs. At present, Hawaii imports more than three-quarters of its energy resources in the form of fossil fuels. Conventional primary treatment + activated sludge uses considerably more energy than CEPT. Thus, the cost of importing chemicals is cheaper than the cost of importing fossil fuels. In addition, most of Puerto Rico's municipal wastewater plants are using CEPT as a low cost way of upgrading overloaded plants.

In regard to "CEPT in Hong Kong" Parker et al. state: "Harleman and Murcott are in error when they assert that Professor Harleman was instrumental in arguing that conventional primary treatment planned for Stonecutters Island in Stage I of the plan should be replaced with CEPT. In fact, the consultant (Montgomery Watson) had planned on CEPT using low lime (pH9.7) treatment for the first stage of construction."

The Montgomery Watson (MW) plan (referred to above) was reviewed by Professor Harleman as a member of the first Hong Kong International Review Panel (IRP) in 1994/95. Several major problems ultimately led to its rejection:

(1) the use of lime was intended as a temporary measure at Stonecutters Island (SCI) to provide a degree of disinfection (ineffective in our opinion at a pH of 9.7) of the effluent until such time as a long (20+ km) and expensive ocean outfall would be constructed. At that time the SCI plant would revert to conventional primary treatment, thus losing both the downsizing capability and increased pollutant removal of the coagulant.

(2) A dose of 120 mg/L of lime is required to obtain a pH of 9.7. Although MW calls this “low dose” it produces an enormous quantity of hard-to- dewater sludge. In fact, the sludge produced by the lime is equal to that produced by TSS removal (assumed to be 65%.)

The acronym CEPT (which we first proposed more than 10 years ago) was never intended to include the use of lime (either low or high dose) as a primary coagulant. In our terminology, CEPT means use of iron or aluminum salts at a low dosage. The Hong Kong CEPT plant at SCI, which uses only10 mg/L of ferric chloride and produces an effluent essentially equivalent to secondary treatment, is a prime example.

It is not our intention to engage in a “we got there first” debate; however, in relation to comments on our work in Brazil we would like to set the record straight. In relation to the recent start-up of two CEPT plants in Brazil, Parker at al. state: “It should be noted that a consulting engineering firm (Black & Veatch) recommended this process --- as early as 1996 --- almost a year earlier than the pilot testing efforts cited by the authors.” In fact, we made our first presentation and full plant tests promoting the use of CEPT in Brazil in 1995. (Harleman and Murcott, 1995)

Parker et al write: "If Harleman and Murcott want to encourage further consideration of their concepts, they should publish their scientific and technical bases for their broad judgements about the wide applicability of the CEPT technology." We have already published extensively on chemical wastewater treatment, both in peer reviewed publications and technical reports. We did not feel the need to revisit or cite all our previous publications or early CEPT history in this Water 21 article. More than 20 publications can be found on our Web sites at:

http://web.mit.edu/civenv/html/people/faculty/harleman.html
http://web.mit.edu/civenv/html/people/faculty/murcott.html

We are delighted that engineers at the consulting firms represented in Parker et al. are actively engaged in the developing world. We must all work harder to convince regional and local authorities that the normal wastewater treatment technologies of the Western world are not necessarily the most effective first step in protecting the public health of their constituency.

As environmental engineering educators, we are not in competition with the reputable environmental engineering consultants who prepared the rebuttal to our paper. While they design and build treatment plants, we train present and future generations of engineers to think outside the box. Our role is to challenge the status quo, to raise hard questions, to point out critical issues and possible directions. But whether we are consultants or academics, our ethical responsibility as engineers and as human beings should be to address and solve critical water pollution problems not only in our nation but in the rest of the world.

We welcome this exchange of ideas not simply as a means to promote a specific technology but more generally to put forward the pressing need for innovative, revolutionary thinking in order to solve the water pollution and public health problems of the 21st century.

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An Introduction to Chemically Enhanced Primary Treatment

Introduction

Chemically Enhanced Primary Treatment (CEPT) is the process by which chemicals, typically metal salts and/or polymers in the form of organic polyelectrolytes, are added to primary sedimentation basins. The chemicals cause the suspended particles to clump together via the processes of coagulation and flocculation. The particle aggregates, or flocs, settle faster thereby enhancing treatment efficiency, measured as removal of solids, organic matter and nutrients from the wastewater. The chemicals utilized in CEPT are the same ones commonly added in potable water treatment (e. g. ferric chloride, aluminum sulfate), and there are practically no residual metals in the supernatant (Harleman and Murcott, 1992).

CEPT may be implemented using a dedicated "CEPT tank" (i. e. a settling tank specially designed for CEPT), or by retrofitting a conventional primary treatment facility, or stabilization ponds (Ødegaard et al., 1987; Hanaeus, 1991a,b,c). The later two incarnations of CEPT are relevant when upgrading overloaded or underdesigned existing systems (Harleman and Murcott, 1992).

CEPT has many important advantages over conventional treatment. It offers a cheaper, simpler and more efficient alternative to conventional treatment, as is discussed in the following sections. Most importantly, it is the least expensive wastewater treatment process in which the effluent can be effectively disinfected.

Financial Benefits of CEPT

CEPT allows the sedimentation basins to operate at higher overflow rates, while still maintaining a high removal rates of total suspended solids (TSS) and biochemical oxygen demand (BOD). Hence the treatment infrastructure can be smaller, which reduces capital costs. Additionally, CEPT provides the opportunity for either reducing the size of subsequent treatment units, or increasing the capacity of existing conventional treatment plants, such as activated sludge basins. The addition of metal salts and/or a polymer will only

require tanks for the chemicals and injection equipment. Table 1 presents data comparing the costs of primary treatment, secondary biological treatment, and chemically enhanced primary treatment.

Table 1: Comparison of Treatment Costs (National Research Council, 1992)

	Capital Costs ($\$/10^3 m^3.d^{-1}$)	O&M Costs ($\$/10^6 m^3$)	Total Costs ($\$/10^6 m^3$)
Conventional Primary Treatment	3.1 — 4.2	0.8 — 0.9	1.7 — 2.1
Conventional Primary + Biological Secondary Treatment	9.1 — 9.8	1.2 — 1.6	3.5 — 4.3
Chemically Enhanced Primary Treatment	4.2 — 5.3	0.9 — 1.1	2.1 — 2.6

CEPT costs minimally more than primary treatment, and only about half as much as secondary treatment. Yet, the removal efficiencies show CEPTs superiority, as discussed in the next section.

Efficiency of CEPT

Table 2 illustrates how CEPT enhances the removal of TSS and its associated BOD, through chemical coagulation and flocculation, followed by settling of the floc. The data, based on a survey of 100 wastewater treatment plants in the United States, show CEPTs superior efficiencies over conventional primary treatment. Moreover, when combined with the cost analysis presented in Table 1, it can be said that CEPT is highly competitive with biological secondary treatment.

CEPT is ideal for a coastal city since the removal of TSS is very high and the decrease in BOD is sufficient so as to not impact oxygen concentrations in the ocean. This is the case in two of the largest operating CEPT facilities in the world (San Diego and Hong Kong). Hong Kong's Stone Cutter's Island plant also benefits from increased performance due to seawater addition (Harleman et al., 1997).

CEPT is also appropriate for in-land wastewater facilities, and is utilized for phosphorus removal by a number of facilities discharging their effluent into the Great Lakes (Harleman and Murcott, 1992). Indeed, while biological secondary treatment removes TSS and BOD at a very high efficiency, it does not effectively remove phosphorus and produces nitrates (Harleman and Morrissey, 1992). If this effluent does not undergo nutrient removal before it is released into a body of water, eutrophication can occur. The algal blooms often accompanying this kind of nutrient loading deprive the water body of oxygen, which is equivalent releasing a high-BOD effluent into that body of water. CEPT effectively removes a high amount of phosphorus, which is usually the limiting nutrient in fresh water systems.

Finally, in developing countries, the primary objective of any sanitation system is disinfection, due to the high levels of morbidity incurred by water-borne illnesses. CEPT is the least expensive method of treatment in which the effluent can be appropriately disinfected (Harleman and Murcott, 2001b,a).

Table 2: Comparison of Removal Efficiencies (National Research Council, 1992)

	TSS (%)	BOD (%)	TP (%)	TN[1] (%)	FOG[2] (%)
Conventional Primary Treatment	55	35	20	15	51
Conventional Primary + Biological Secondary Treatment	91	85	30	31	98
Chemically Enhanced Primary Treatment	85	57	85	37	71

Ease of Implementation

A conventional primary treatment process consists of bar screens, a grit chamber, and a settling tank (or primary clarifier) (see Figure 1). To upgrade a conventional primary treatment facility to a CEPT facility, all that is needed is the addition of a chemical coagulant (and optionally a flocculent) as shown in Figure 1. With CEPTs high surface overflow rate, the sedimentation basins will not need to be large when compared to conventional primary sedimentation basins (Harleman et al., 1997).

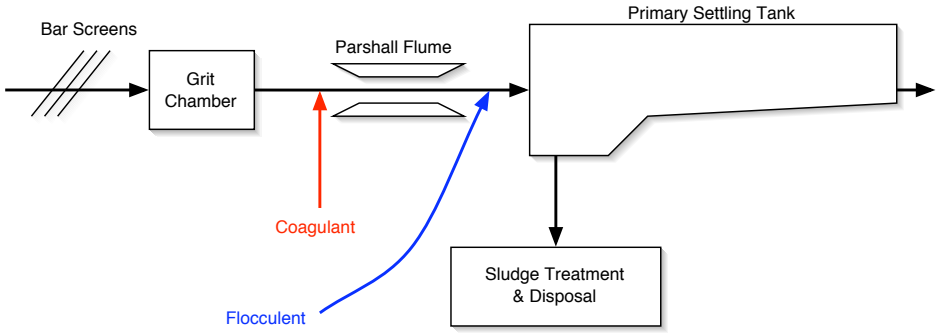

Figure 1: Schematic of Conventional Primary Treatment and CEPT

[1]Total Nitrogen
[2]Fats, Oils and Grease

Conclusion

CEPT is an efficient, cost-effective and easily implemented wastewater treatment technology. The addition of chemical coagulants and/or polyelectrolytes allows for the increased removal of phosphorus, suspended solids and its associated biochemical oxygen demand. The increased removal efficiencies allow for the design of smaller basins and greater overflow rates.

CEPT has been used for over one hundred years, yet it is not as commonly found as would be expected upon analysis of its performance. The misconception is that CEPT dramatically increased sludge production. However, CEPT is used today with a minimal coagulant dosage (10 - 50 mg/L), and the chemicals themselves make only a slight contribution to the total sludge production. The greatest portion of the increase of sludge production is due to the increased solids removal in the settling tank. And that is precisely CEPT's goal.

CEPT treatment does not preclude secondary or tertiary treatment. It makes any subsequent treatment smaller and less costly due to the increased efficiency. CEPT is a relatively simple technology providing a low-cost and effective treatment, which is easily implemented over existing infrastructure (Harleman and Murcott, 1992, 2001b,a).

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Wastewater Treatment for Mega-Cities in the Developing World

Frédéric Chagnon

Donald R.F. Harleman

ADB - September 20, 2005

Massachusetts Institute of Technology

Outline

Public Health in Developing Countries

Staged Wastewater Treatment

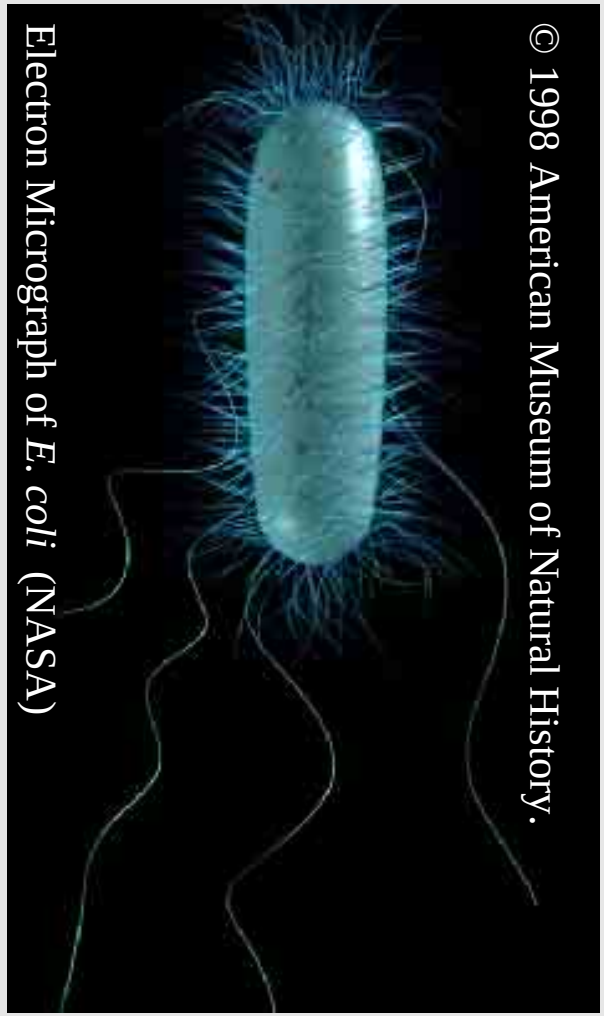
Chemically Enhanced Primary Treatment

Sanitation in Developing Countries

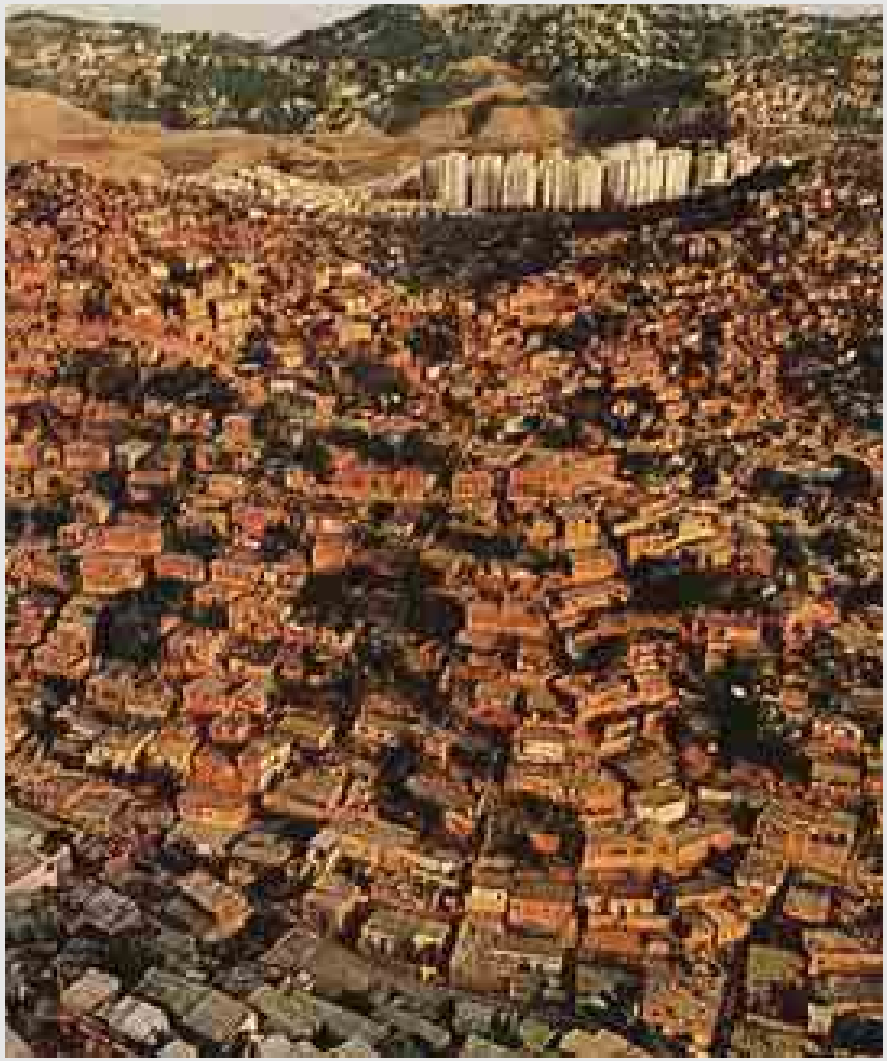
- 3 billion without appropriate sanitation
- 2 billion more urban dwellers in next 20 years
- 95% sewage untreated before discharge

Sanitation Related Public Health

- Diseases
  - Water is Transmission Pathway:
- Women & children most affected
  - 1.5 million children die each year from diarrhoeal disease
- Large improvements conferred by appropriate water and sanitation
- Environmental quality benefits from sanitation



Urban Areas & Slums



Sanitation & Development

- Costs of poor sanitation
  - Human morbidity (lost productivity; healthcare services)
  - Environmental degradation (loss of ecosystem services)
  - Foregone revenues
- Appropriate infrastructure alleviates poverty
  - Stimulates economic growth
  - Narrows socio-economic gap
  - Increases productivity
  - Improves health
- Women & children stand to gain most
  - Children more vulnerable to disease
  - Women have more contact with water/wastewater

Outline

Public Health in Developing Countries

Staged Wastewater Treatment

Chemically Enhanced Primary Treatment

Constraints

- Objectives are to improve public health and environmental quality

- Strict environmental regulations
- Limited budgets, high costs
- Limited capacity/willingness to pay on consumer behalf

- Resulting “partial treatment” financially wasteful, no public health benefit, little environmental improvements

Constraints

- Limited cost recovery possibility
  - User charges incentive to serve users
  - User charges incentive to limit waste
  - But possible limited ability or willingness to pay (initially)
- Limited operating capacity
  - No previous experience with wastewater treatment
  - Simple treatment = learn basics and build-up capacity

$\Rightarrow$ Start with affordable tariffs (that fully recover O&M) and simple technology (for which capacity to operate easy & quick to build)

Non-Phased Development

- Initial wastewater treatment to high environmental standard
- Cost recovery through user charges difficult (no capacity/willingness to pay)
- Limited technical capacity for operations
- Only part of a city's wastewater can be collected and treated
- Wastewater treatment plants and infrastructure may not be operated properly
  - Not able to pay for O&M
  - Not technically able to properly operate

Phased Development

- Prioritization of problems to be tackled
- Comprehensive design of sanitation infrastructure and treatment
  - Meets environmental standards
  - Designed for future growth
- Staged implementation
  - Start with full wastewater collection and simple affordable treatment, build-up gradually
  - First priority is to treat 100% of wastewater to level where disinfection effective to mitigate public health problems
  - Subsequent implementation of planned/designed secondary treatment to comply with environmental regulations

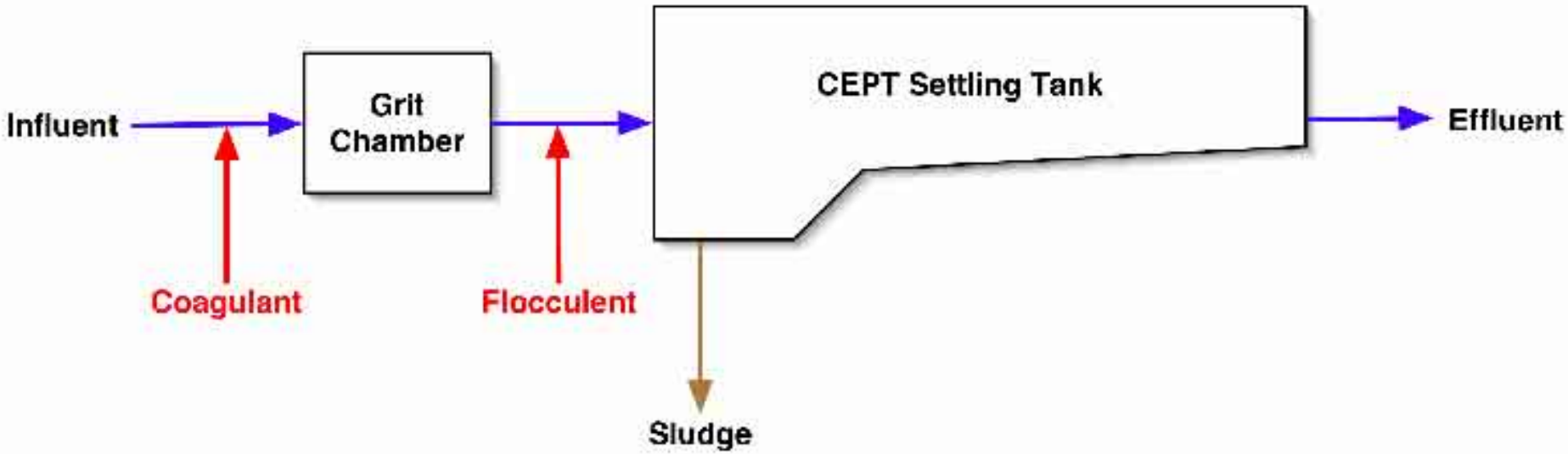
Outline

Public Health in Developing Countries

Staged Wastewater Treatment

Chemically Enhanced Primary Treatment

CEPT



- Chemicals added to clump smaller particles together into larger particles
- Larger particles settle faster
- Enhanced version of conventional primary treatment
- Can be followed by secondary treatment and/or outfall

Primary Efficiency

Conventional Primary Treatment

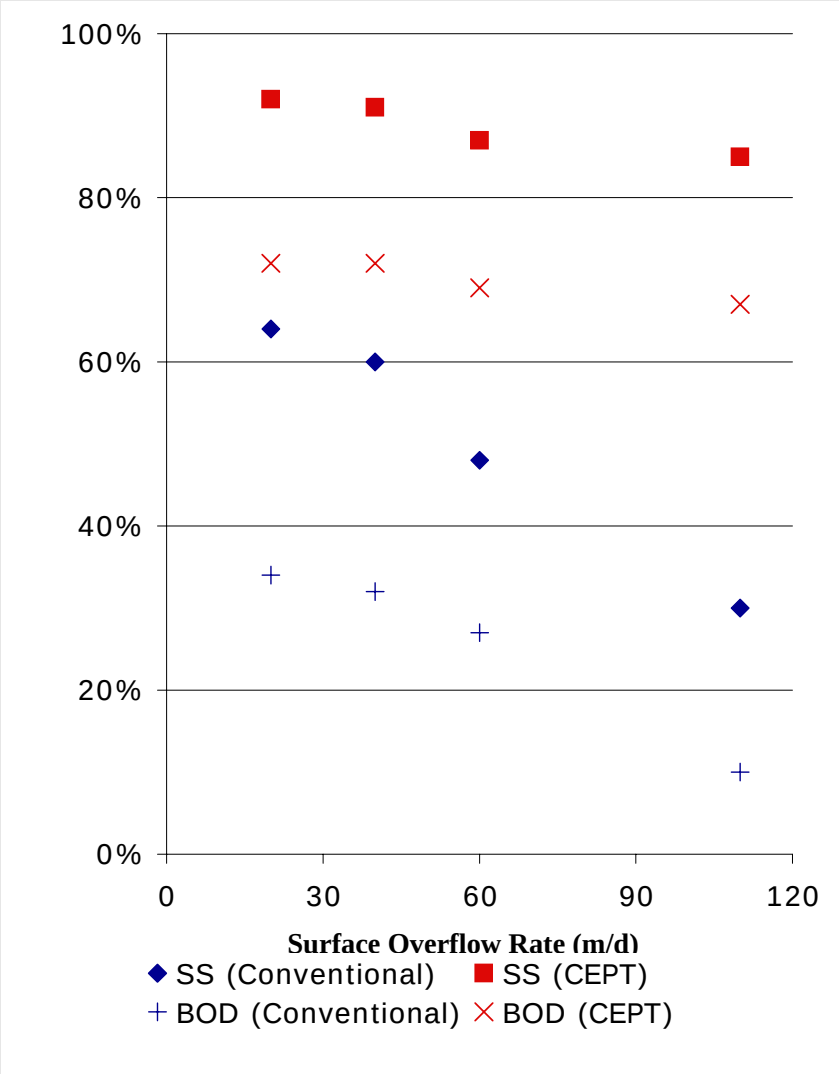
Overflow Rate (m/d)	% Removal			
	BOD	SS	Phosphorus	Pathogens
30–50	25–40	40–70	5–10	50–60

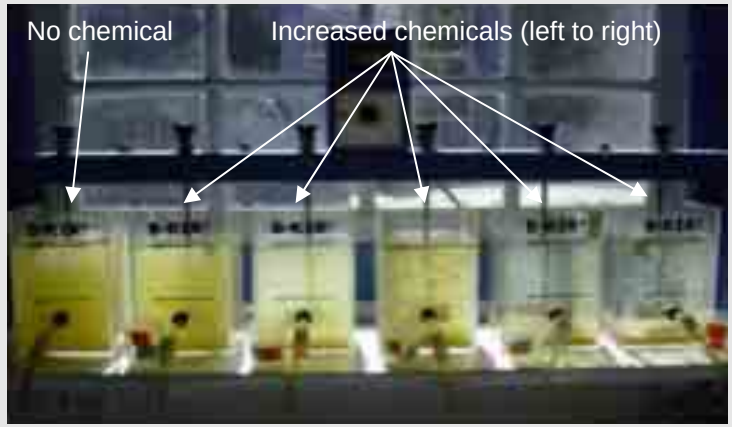
Chemically Enhanced Primary Treatment

Overflow Rate (m/d)	% Removal			
	BOD	SS	Phosphorus	Pathogen
60–120	40–70	60–90	70–90	80–90

Simple technologies
Low energy and operator skill requirements

Primary Treatment



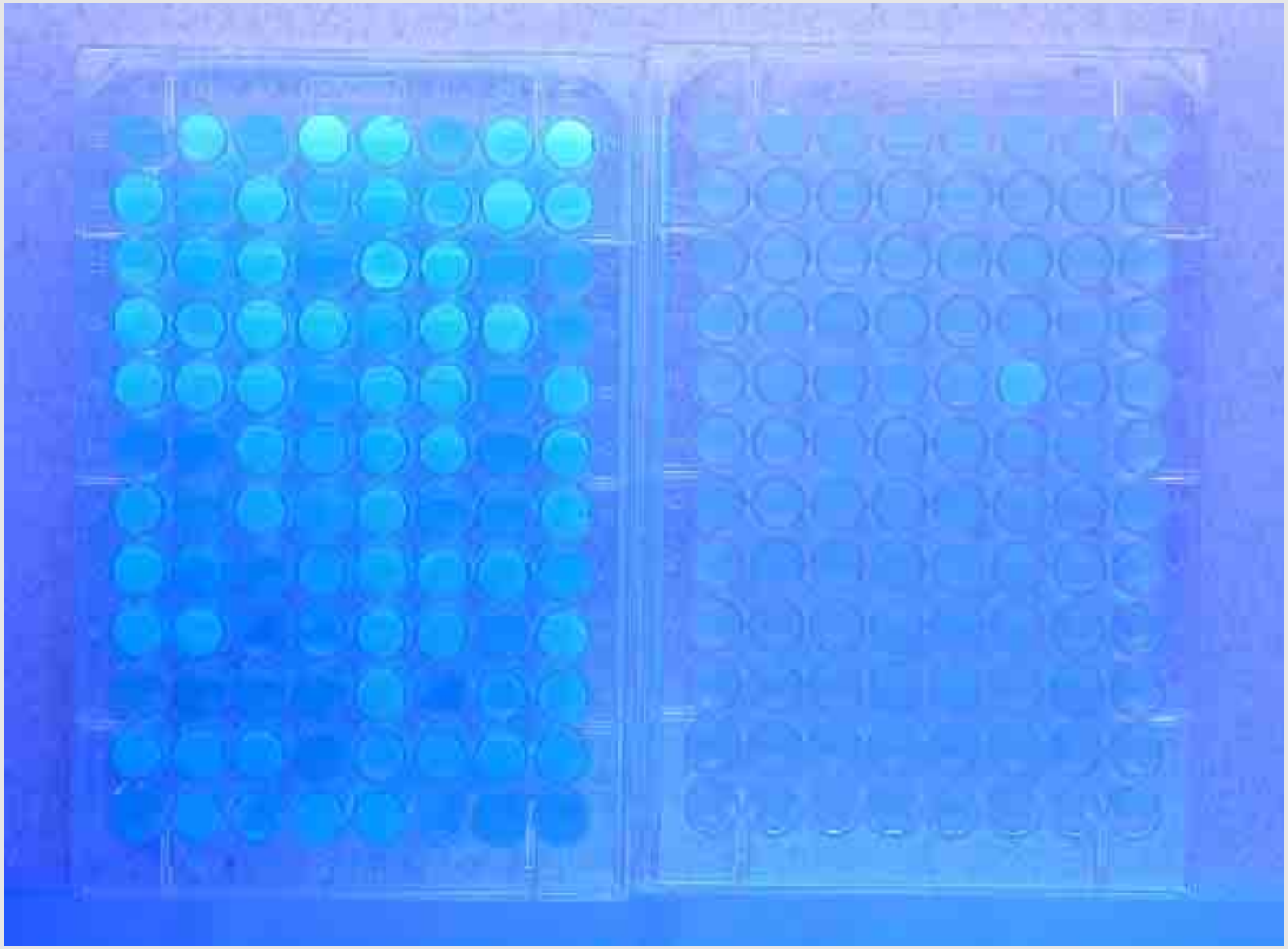


- CEPT vs. Conventional Primary
  - Higher BOD & SS removal
  - Operates at higher overflow rate
  - Smaller area requirement
  - Lower Capital Cost
  - Greater resilience to flow variation
  - Reduced size of subsequent secondary treatment
  - Effluent can be disinfected
  - Larger amount of sludge produced
  - Higher O&M (chemicals)

Bench-Scale CEPT

Massachusetts Institute of Technology

Disinfection of CEPT Effluent



Cost Comparison

	Capital Costs (US$M/$m^3.s^{-1}$)	O&M Costs (US$M/$m^3.s^{-1}$/yr)
PT without Disinfection	1.5	0.2
CEPT + Disinfection	**1.3**	**0.5**
PT + AS + Disinfection	5.0	1.0

Construction costs based on plant capacity;

O&M costs based on average daily flow (1/2 plant capacity).

Massachusetts Institute of Technology

Advantages of CEPT as 1st Stage

Effluent can be disinfected

2x-3x conventional primary surface OFR

Approaches biological secondary treatment removal efficiencies for BOD and TSS

Reduces size of subsequent treatment

High phosphorus removal

Conclusion

- Appropriate wastewater treatment & collection is desirable and has high Return on Investment
- Recovery of Operation & Maintenance costs through user fees critically important
- Tradeoffs necessary between desire for high environmental standards, affordability and technical capacity

→ **PHASED DEVELOPMENT**

- CEPT is a flexible and low-cost treatment technology
- Appropriate for initial stage

Wastewater from production activities in craft villages and some mitigation solutions

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I. INTRODUCTION

Production in craft villages is an economic form quite typical of Vietnam rural areas, particularly in the development of traditional handicraft. The policy for renovating the economy has blown fresh vitality to traditional handicrafts. According to the recent data [1], Vietnam has nearly 1,450 craft villages distributed in the 58 provinces and cities, especially in the Red River Delta with about 800 villages. Over the past 10 years, Vietnam craft villages have achieved the growth rate of 8% per year according to their outputs. The main occupations practiced in villages are textile-dyeing, agro-food processing, waste recycling, fine arts handicraft, and porcelain & construction materials.

Besides the encouraging signs for the traditional handicraft development, a disturbing reality is the high risk of pollution from these activities, especially wastewater pollution. The pollution risk is generated by the production characteristics – petty, scattered, obsolescent technology as well as unprompted development. On the other hand, due to the lack of the knowledge, people do not understand damaging impacts of their activities on their health.

The population density is often high in the craft villages, so the lack of the production space leads to the interposition of residence and production areas. Since production expands, the pollution caused by chemicals and wastes have contaminated the living environment, particularly in the waste recycling and agro-food processing villages.

The rural infrastructure is in a poor condition. Only about 20% of production establishments having proper workshops, 86% have electricity supply, 37% have their work mechanized and more than 60% do their work by hands.

2. POLLUTION CAUSED BY WASTEWATER IN SOME TYPICAL OCCUPATION VILLAGES OF VIET NAM

The water pollution, especially water pollution, from village production is a pressing problem that is catching the community's attention, could be presented as follows.

Agro-food processing cottage

This is the most long-standing occupation in Vietnam's villages but has been scattered in different households. In the whole Vietnam, there are 197 agro-food processing villages making up 13.58% of the 1,450 occupation villages. This kind of production not only meets the food demand but also provide the material sources for other processing industries.

Agro-food processing consumes a huge volume of water and most of it is discharged directly after use. Wastewater from craft villages is rich in inorganic matter and highly biodegradable. At present, the effluent is not treated before being discharged outside. The stagnated

wastewater in the sewage may cause air pollution with anaerobic digestion, soil pollution with over nutrients and the underground water pollution by penetrating into soil. Therefore, ground water in these areas is found to be seriously polluted with high concentrations of COD, TS and NH_4^+. Water from drilling wells of Tan Do and Ninh Van villages have the sign of coliform contamination. In Hai Thanh, a fish sauce production village, water taken from the well was heavily polluted with COD=186 mg/l. In many craft villages, villagers have to buy fresh water from other places. On the other hand, the majority of the refuse from agro-food production are used for livestock feeding, which also contributes to the water pollution.

Table 1
Waste water characteristics at the agro-food processing

ChØ tiªu	TCCP 5945-1995	Tinh bét B×nh Minh	Bón Phó §«	N-íc m¾m H¶i Thanh *	NÊu r-îu T©n §«	§Ëu phô Quang B×nh
PH	**5.5-9**	4.6	6.1	9.59	-	5.1
SS (mg/l)	**100**	926	414	10	266	1764
COD (mg/l)	**100**	1858	2967	597	3868	1271
BOD_5 (mg/l)	**50**	743	1850	250	1700	1080
ΣN (mg/l)	**60**	145.6	20.9	9.62	1002	67
ΣP (mg/l)	**6**	27.5	2.79	0.034	44.2	23

According to health survey, community health in these villages is significantly influenced by the production activities. The most popular diseases are gynecology (13-38%), digestion (8-30%), dermatitis (4.5-23%), respiration (6-18%), ophthalmic (9-15%). The main reasons are low environment quality and shortage of clean water. The rate of occupational diseases in Duong Lieu (Ha Tay) and Vu Hoi (Thai Binh) noodle villages is 70%, in Phu Do noodle and Tan Do alcohol villages is 50%.

Waste recycling villages

These villages make use of waste as raw materials and therefore reduce input cost and also contribute to mitigation of environmental pollution. Presently, the development of these villages creates network of waste, scraps and raw materials collecting. These kinds of villages are encouraged to develop. There are 3 sub-groups: waste paper, waste metal and waste plastic recycling, mostly concentrated in the Northern part.

The waste recycling villages in existence are in small numbers, but the proportion of mechanization of 50-70%, is much higher than that in others. Some large-scale occupation villages attract large numbers of local laborers. For example, the plastic recycling village of Minh Khai, Hung Yen contain more than 4,000 workers; the waste paper recycling village of Duong O, Bac Ninh with an annual productivity of 12,000 tons of paper attracts 5,000 workers; the iron and aluminum recycling village of Van Chang, Nam Dinh, which consumes roughly tons of wastage on a daily basic, has 3,000 employees. As newly-established craft villages engage in household scale production, the dynamic and creative spirit in monitoring and diversifying product lines have been brought into full play by villagers, whose incomes and living standards are relatively high.

As for waste paper recycling villages, the soaking, cooking and grinding of materials produce the main source of wastewater. The unrestrained discharge of untreated wastewater into surface water has adversely affected the environmental quality. This wastewater contains

extra chemicals, pulp and high organic contents, which results in near zero amount of dissolved oxygen. Pulp and fiber left in wastewater raise the level of canals, ponds and lakes. In Duong O and Phu Lam villages alone, 1,450 – 3,000 kg COD and over 3,000kg of pulp are pushed out to surface water daily.

As to plastic recycling villages, due to variety of material sources and high proportion of impurities, much water is used to wash scrap. This amount of water is estimated as high as 20-25 m^3/ton of waste plastic. The single waste plastic Minh Khai village produces 445,000 m^3 of wastewater on an annual basis. The composition of this wastewater is very complicated as it carries many organic, inorganic compounds, including toxic substances (from pesticide container, chemicals etc.) and micro-organisms carrying germs.

In metal recycling villages, even though not much water is used, mainly for cooling, cleaning equipment and workshops, wastewater generated by metal treating and coating has relatively high concentrations of noxious chemicals, especially heavy metals.

Table 2
Heavy metal concentration in wastewater in metal recycling villages (mg/l)

TT	Sampling points	Cr^{2+}	∑Fe	Pb^{2+}	Cu^{2+}	Zn^{2+}	Al^{3+}
1	Lead recycling Chi Dao, Bac Ninh	0.04	0.4	0.35	0.1	0.6	-
2	Mechanic Van Chang, Nam Dinh	63 -187	12	0.9	1.5	8.7	10.4
3.	Bronze casting Phuoc Kieu	0.2	7.6	0.6	3.1	1.8	2.1
4.	Mechanic Xuan Tien, Nam Dinh	0.8	0.3	0.44	3.25	2.15	0.32
	TCVN 5945-1995	**1**	**5**	**0.1**	**1**	**2**	**-**

The heavy pollution due to indiscriminate collection and discarding has affected the ecology and human health to a serious extent. It is impossible for fish to grow in most of these villages' lakes and ponds because they are subject to a large quantity of wastewater of high concentrations beyond the self-cleaning capacity of the environment and garbage has raised the level of lake bed and blocked its stream. An international survey team once hired some children in Van Chang village to look for aquatic organisms in the 1 km section of river flowing past the village, but no living creatures were found.

Survey results have revealed that the percentage of occupational diseases in recycling villages is 15-25% higher than in non-production villages. About 30-45% of children and women are afflicted with diseases, primarily respiration diseases, bronchitis, pneumonia in children and gyneacology in women. Life expectancy in these villages is low, ranging from 55 to 65. There are frequent outbreaks of epidemic such as diarrhea, sore eyes, poisoning especially in metal recycling villages. [3]

Textile and dying villages

With the initial demands for and self-sufficiency of garment, textile and dying villages have gradually been established and passed down from generation to generation and continue to live on until today. There are a total of 173 textile and dying villages in the whole country, making up 10% of craft villages, of which 85.5% concentrated in the Northern provinces.

Wastewater pollution presents the biggest environmental problem in the textile-dying craft villages. Large amounts of water are discharged together with chemicals and dye stuffs (about 10-30% dye stuffs and 85-90% chemicals used are discharged together with wastewater). Properties of wastewater in some typical textile-dying villages are presented as follows:

Table 3
Properties of wastewater in some typical textile-dying villages

No	Names of villages	Amount of wastewater m^3/day	Wastewater quality criteria				
			pH	COD	BOD_5	SS	Color
1.	CoChat silworm coccoons unwinding, Nam Dinh	100	-	6076	2400	764	4110
2.	Phuong La textile and dying, Thai Binh	960	8-9.7	320-900	72 -410	14	77-139
3.	Tuong Giang textile and dying, Bac Ninh	1.266	8-9.8	120-350	100	55-284	190-250
4.	Dong Yen silworm coccoons unwinding Quang Nam	20	7.2	632	241	517	69
5.	Bao Loc silworm coccoons unwinding Lam Dong	500	7.8	1.020	780	215	466
6.	Nam Cao silk weaving – thai Binh	-	8.2	372	212	375	260
7.	Thai Phuong textile and dying, Thai Binh	-	6.9	312	272	205	195
	VN standards 5945-1995 (B)		**5.5-9**	**100**	**50**	**100**	

The results of healthcare surveys in textile and dying villages [2] have shown that diseases like rhinitis, sore throat and nervous debility are widespread among workers in these villages. Production is the cause for 20% of the diseases in silk weaving village of Bao Loc, Lam Dong and silkworm cocoons unwinding village of Dong Yen, Quang Nam and 55% in textile and dying village of Thai Phuong, Thai Binh. This figure is 70% for the silkworm cocoons unwinding village of Co Chat, Nam Dinh.

Fine art handicraft villages

Of 1,450 craft villages in whole country, fine art handicraft villages are in a majority: 618 villages. The principal handicraft types include: rattan and bamboo weaving, embroidery, sea grass products, woodwork, lacquer painting, pottery, sculpture, silver carving etc.

As far as the water environment is concerned, lacquer and silver carving villages produce the most pollution. The amount of water consumed is not high, but comprises high concentrations of pollutants. In the lacquer villages of Ha Thai (Ha Tay), the COD, the BOD, SS contents are 1.8 to 3.5 times higher than the allowed level. In silver carving villages, many chemicals such as H_2SO_4,HNO_3 ... are used for coating. Therefore, wastewater from coating has low pH level, cyanide sometimes reaches 0.75 mg/l (1.5 times higher than allowed level) and mercury concentration also exceeds the allowed level. The horn handicraft village of Do Hai, Nam Dinh annually consumes 100 tons of cattle's horns; but the surface water here had the pH level of 4.4, SS and COD exceeds the allowed level dozens of times. Similarly to most of other craft villages, this wastewater, mixed with domestic wastewater, is flushed into the common canal.

III. SOLUTIONS FOR WASTEWATER POLLUTION MINIMIZATION IN CRAFT VILLAGES

In order to improve the current environmental status, reasonable production development planning is of foremost importance.

Environmental management solutions

Environmental policy: Develop appropriate policies for encouraging technology innovation in craft villages towards environmental friendly technologies and products. Besides, there should be a mechanism to apply policy “polluter pays” in craft villages.

Establishing local environment management mechanism including clean environment group, developing environmental programs in the villages (environmental protection statues, penalty regulations, environmental fees and funds, etc)

Local authorities should develop regulations on environmental management, special staffs responsible for environmental problems to help management authorities to have throughout understanding of implementing environmental related regulations, waste treatment in order to develop encouragement policies to initiatives for mitigating negative impacts on environment as well as provide timely decision to cope with problems arisen during production activities in craft villages. ***For craft villages, management in commune level is a core in environmental management as authorities can get close contact with each household to successfully implement management solutions.***

Clustering craft villages in rural areas

This model is suitable with newly-developed craft villages engaged in small scale industry. The cluster is built in the vicinity of villages, which is favorable for overall planning and still retains exclusive advantages of production in craft villages.

A number of projects for clustering craft villages in an area with appropriate infrastructure and waste treatment system have been carried out in the Phong Khe waste paper recycling village, Da Hoi ion village, Dong Ky woodwork village, Duong Noi textile village, van Chang mechanics village and Minh Khai waste plastic village. However, the master plans for these industrial clusters are not well developed and implemented causing difficulties in dealing with environmental problems in these clusters. According to the master plan, waste water from each household will be collected after preliminary treatment and brought to the concentrated treatment system.

The pressing demand for small and medium industrial clusters for craft villages results from the need for better life, the pressure on the environment and accords with the rural industrialization, modernization policies of Vietnam. However, concrete directions and guidelines are crucially important for localities to conduct planning and space organization, sensibly arrange industrial production establishments and rural occupation establishments scattered in villages into medium and small scale industrial complexes and to avoid production expansion from being turned into population displacement.

Environmental education

Build mass education program, enhancing people’s awareness of environmental protection in craft villages, especially in use and discharge of wastewater into the environment. Besides, it is necessary to open on-the-spot classes on pollution prevention and treatment in craft villages.

Appropriate technical solutions

In many craft villages, if timely survey and assessment of the production states are conducted in great details, sensible technical solutions might be put forward for improvement of water environment in the villages. It is necessary to combine production area re-arranging, application of cleaner technologies and construction of wastewater treatment system according to the villages' production reality. Recently, the Institute for Environmental Science and Technology has brought the experimental model of pollution prevention and wastewater treatment system villages into operation in some craft villages: waste paper recycling village of Phu Lam, Bac Ninh, the textile and dying village of Tri Nhan, Ha Tay, Zinc coated iron establishment in Khai Hung, Ha Tay, which has delivered promising results and has reasonable cost.

IV. CONCLUSION

It is important for managing agencies, research and environmental technology transfer institutions to pay attention to the environmental pollution caused by wastewater in craft villages in order to find out appropriate and feasible solutions in the production context of craft villages. As a matter of fact, concentrated wastewater treatment is only used in well-established and developed industrial clusters of craft villages. In the short term, preliminary treatment solutions are needed for each establishment to reduce pollutants before discharging into receiving bodies. Looking for funding and financial support from international organizations is also crucial for helping craft villages to solve environmental sanitation and wastewater. However, the prime importance is that environmental sanitation in general and wastewater pollution in particular in craft villages must be understood throughout and dealt with by the local residents themselves.

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UNDP-World Bank
Water and Sanitation Program

Institutional Development of the Urban Water and Sanitation Sector in Chile

by Raquel Alfaro

These Urban Environmental Sanitation Working Papers have not been formally published and this is an opportunity to share this information more widely to:

- stimulate discussion and to broaden thinking within the sector, and in particular, to encourage dialogue within and among our clients in developing countries; and
- build more awareness of the Program among UES clients.

Working Paper produced in November 1997

Bringing Optimal Water and Sanitation Services to the Poor
Three Essays on the Experiences of EMOS
(The Municipal Works Company of Santiago, Chile)

In these three essays Raquel Alfaro, Civil Engineer and Master in Production Management of the University of Strathclyde, Scotland, recounts the successful policies and practices which led EMOS, Municipal Sanitation Company of Santiago, Chile to its position as a model among Latin American utilities. At the same time, Alfaro shares her personal vision of what a public utility should be - at once an enterprise guided by commercial principles of efficiency and a spirit of social obligation. Given her professional history with EMOS, of which she was General Manager from 1990 until her retirement in 1996, Alfaro knows very well the limits and possibilities of the utility companies. Her confidence in the capacity of other companies to match the achievements of EMOS should be encouraging to all readers interested in the water and sanitation sector.

The first essay: *Linkages between Municipalities and Utilities: An Experience in Overcoming Urban Poverty* explores the responsibilities of the utility companies and those of the local governments in extending services to the poor. Alfaro cites the reasons frequently given to explain why the poor are unserved that poor countries lack capital to invest in needed water and sanitation infrastructure, the poor themselves live in circumstances which increase costs beyond their already limited capacity to pay tariffs. For a utility company, however, the right to use resources which are public goods also brings with it an obligation to meet the needs of all citizens. It should also seek to maximize its clientele as a matter of good business. When families cannot meet the costs of service, it is the responsibility of local government, not the utility, to make up the difference.

The second essay, *Institutional Development of the Water and Sanitation Sector in Chile,* traces the history of legal reforms which led to the present institutional environment. It emphasizes the importance of regulation, but also of liberating tariffs and links key reforms to increased service coverate and improved utility performance. In 1989 the General Law on Sanitation Services put public utilities on a footing similar to private ones, obliging them to organize as equity corporations and to bid for concessions from local governments. The Law and Regulations of Tariffs, passed in 1988 and 89 respectively establishes a five year period for applying and reviewing tariffs which must cover costs. The Superintendency of Sanitation Services, created in 1989 establishes an overall regulatory system.

The third essay, *Reaching the Poor with Water and Sanitation Infrastructure - Key Factors Not to Forget*, challenges the believe that the total cost of services is too high for the poor to pay arguing that good management, in particular reduction of losses, increasing the number of connections and maximizing efficiencies through use of a single operating system, can reduce costs and make full service effective.

Tova Maria Solo
UNDP/World Bank Water and Sanitation Program
July, 1997

Institutional Development Of The Urban Water And Sanitation Sector In Chile

Chilean Urban Water and Sanitation sector have been in continuous development since the middle of the 19th century. That is, when the first water and sewerage works started being built in the main cities of the country. The last two major institutional changes started at the end of 1970 decade an a third one is being foreseen shortly.

1. The situation of the urban water and sanitation sector at the end of the 1970 decade.

By the end of the 70th, a large number of public services delivered drinking water or collected wastewater in the main cities of Chile, whose urban population amounted to some 8.5 million people. The urban population of Santiago, the capital city, and the population of the environs' villages, was about 4 million people. This population was been served mainly, by a semiautonomous public drinking water enterprise, Empresa de Agua Potable de Santiago (EAPS). There was also a public sewerage service, Servicio de Alcantarillado de Santiago, and other small drinking water public services. A private company delivered drinking water and collected wastewater in the upper part of the city. The population served by this company was of some 250,000 people.

Supervision and control of the services were also under different government bodies that were responsible for water quality control, technical supervision of the services, and tariffs setting. Chilean quality standards for drinking water followed European and American standards and were closely controlled by the Ministry of Health. Thus, the quality of the water was considered fairly good, while the urban water coverage (table 1) was rather high for a developing country. EAPS, the main water company, had good qualified staff and a good level of technical and administration development. For instance, water meters coverage was near 100 %.

However, in all cities, including Santiago, sewerage coverage was low. In addition, there was no wastewater treatment and safe disposal of the sewage collected. The rate of enteric diseases (typhoid, hepatitis) all over the country was very high. This rate was even higher in the Metropolitan Region than in other regions. This could be attributed to poor hygiene practices due to lack of sewerage in many crowded neighborhoods. Yet, it could be attributed also to untreated sewage discharges to natural water courses crossing the city and in turn feeding irrigation canals.

On the other hand, tariff's level was kept low. Thus, public water companies and services were kept financially supported by the government. Sewerage tariffs' level was extremely low. Companies and services hardly covered water and sewerage operational costs, and they do not covered capital cost at all. Government funds went to assist operational costs of some of the services, and to finance new water and sewerage infrastructure of nearly all of them. There was an annual increase of coverage because the bulk infrastructure was there, yet the annual amount of the investments decreased and systems become overcharged. In addition, the companies did not have funds to proper maintenance, rehabilitation and upgrading of aging systems.

Table 1 shows coverage and annual investment for the period 1965- 1980

Table 1
National Urban Coverage and Annual Investments
1965- 1980

Year	Water Annual %	Sewerage %	Investment million dollars
1965	53.5	25.4	80
1970	66.5	31.1	61
1975	77.4	43.5	58
1980	91.4	67.4	40

Source: Memoria Anual de la Superintendencia de Servicios Sanitarios, 1995
(Superintendency of Sanitary Services, Annual Report, 1995)

2. First Institutional Reform

The first important institutional reform was made by the year 1977. It had as a main objective the integration in one hand of water and sanitation activities to take advantage of scale economies and to optimize and enhance the systems. The new entities were designed to be working on a regional basis. Two semi- autonomous utilities were created, EMOS in the metropolitan region and ESVAL in the 5th region. Eleven regional services were also established, one in each of the remaining 11 regions of the country. EMOS integrated EAPS, Empresa de Alcantarillado de Santiago and the other public water services in the region.

A regulator body was instituted, SENDOS (Servicio Nacional de Obras Sanitarias), as a main division of the Ministry for Public Works. SENDOS was made responsible for central planning, financing and administration of the regional services and became the regulator and controller of services and utilities. SENDOS made tariff's proposal for being presented for approval to the Ministry of Economy.

However, tariffs' level was kept low in the regions and the regional services continued receiving financial assistance from central government. EMOS and ESVAL benefited from water and sewerage integration, had some tariff increases and started to use its own financial resources for investments. In 1980, EMOS received a 26 million dollar's loan from the World Bank to upgrade the water system according with a 70 million dollar's investment plan. This plan included the first master plan for wastewater treatment and safe disposal in the metropolitan region It also included a master plan to extend the sewerage system. In 1986 EMOS received a 60 million dollar's second loan from the World Bank , to be applied in a 150 million dollar's new investment plan, that included the basic works for wastewater treatment.

By the same period SENDOS received a loan from IDB to upgrade regional services.

The missions of the World Bank had a positive influence in the already qualified staff of EMOS that applied the policies and recommendations of the Bank's officials. Operational activities were reinforced with new technologies and procedures. Unaccounted for water, for instance, started as a routine activity, while Planning and Financial activities were strengthened because of the Bank's periodical assessments. By the same time EMOS started to contract out not only designs and construction of infrastructure works but also some maintenance activities. For instance, network maintenance and replacement, metering and bill's distribution, connection's maintenance and replacement, were contracted externally. New contractors and consultants brought new technologies and external developments to the utility. A computerized simulation model of EMOS's water system was made by French and Spanish consultants associated with Chilean consultants. A master plan for maintenance, repair, rehabilitation and replacement of EMOS water distribution system was made by the British Water Research Center associated with Chilean consultants.

Coverage continued increasing throughout the country. However, the low level of tariffs still did not allow all services and utilities to grow in terms of maintenance of the new systems and in terms of maintenance, rehabilitation and replacement of old systems. This was an important constraint for efficient service delivery. There also was no fund allocation to reinforcement of the storage infrastructure, in order to cope with an increasing scarcity of fresh water as cities and population grew. Moreover, the capacity of the water systems to face droughts, big emergencies or not expected local demand increases, was very weak. In the regions, SENDOS's responsibility as a regulator body was mixed with its responsibility as a regional operator.

Table 2 shows national urban coverage and annual investment for the period 1980-1990.

Table 2
National Urban Water and Sewerage Coverage and Annual Investment 1980-1990

Year	Water %	Sewerage %	Annual Investment million dollars
1980	91.4	67.4	40
1985	95.2	75.1	79
1990	97.4	81.8	65

Source: Memoria Anual de la Superintendencia de Servicios Sanitarios, 1995.

3. Second Reform

By the end of the 80th decade (1988- 1989) a second important institutional reform was applied to the Chilean water and sanitation sector. Its main objective was to give financial stability to water and sanitation activities, while reinforcing the regulatory capacity of the government. A set of law and regulations were passed and a regulatory body, totally separated from operational activities, was created. The reform also included laws that allowed the selling of EMOS and ESVAL to private sector. A summary of the new laws is given below :

Ley General de Servicios Sanitarios, 1989 (General law for sanitary services)

Its main features were:

* The law establishes the concession's system. That is, a right granted by the government to public or private companies, to perform water and sanitation activities for an indefinite period of time. Nevertheless the concession right can be lapsed if the concessionaire incurred in the faults contemplated in the law. Four types of concessions were granted: water production; water distribution into a geographical zone; wastewater collection into the same geographical zone (although this concession can be granted to a different concessionaire) and wastewater treatment and safe disposal . Concessions have to be applied for, and are granted after a bidding procedure. A transitory article of the law granted concessions to the companies and services that were performing or that had on going projects for performing water and sanitation activities. Concessions' rights can be sold and transferred.

* Concessionaires have to organize themselves as equity societies. They must have and apply an approved development plan, must charge approved tariffs and meet quality standards and norms. Concessions for water distribution and sewerage collection implies obligatory service within the geographical zone.

Ley de Tarifas , 1988 y Reglamento, 1989. (Tariffs law and regulation of the law)

* Tariffs are set for a period of five years, with adjustments for inflation and other variation of macro-economic indicators, during this period. Charges are calculated according to formulae which follow "long run marginal cost methodology" .Tariffs are adjusted to financial viability , that is to cover the companies operational and capital cost during a period of at least 15 years ahead, taking into account a capital cost of at least 7 % (2 higher points than the normal interest rate in credit instrument investments). Parameter and variable values considered in the calculation are defined by the regulator for a "model of efficiency" theoretical enterprise. The regulator takes into account the different conditions of the services production and delivery, and the development plan of each company.

* Tariff structure consists of a fixed charge and a variable charge for water and the same for sewerage. Water charges have an overprice for over consumption during the peak of demand (summer period).Fixed charges are intended to cover connections and secondary network maintenance costs; and billing and money collection costs. These costs are considered independent of consumption in the short and in the long term. Variable charges are intended to cover all current and capital cost considered variable in the short and in the long term. (Fixed charges represent about 20 % of a typical water and sewerage monthly bill)

* There are no gratuities, nor differences in prices for different type of client. The existing cross subsidy for the first 10 m3 of monthly consumption was eliminated and replaced by a government subsidy targeted in low income families. Companies make a discount to eligible customers, to be reimbursed by municipalities with the funds provided by central government. Municipality qualifies the law income situation.

Ley que crea la Superintendencia de Servicios Sanitarios (SISS), 1989 (Law that creates the Superintendency of Sanitary Services,SISS).

The main responsibilities given by this law to the regulator body are:

* The implementation and supervision of the concessions system, including concession transfers, bidding and lapsing.

* The implementation and supervision of the tariff system, including tariff's setting and control.

* The setting of technical standards for design, construction and exploitation of water and sanitation works and control of standard's compliance.

LEYES QUE CREAN LAS SOCIEDADES ANONIMAS (S. A) EMOS, ESVAL Y 11 EMPRESAS REGIONALES (Laws that create EMOS S.A., ESVAL S.A and 11 regional equity companies)

These laws created public corporate equity companies. The laws that created EMOS and ESVAL did not set limit to the sale of the shares of these companies. The laws that created the other regional public companies established that at least 51 % of the shares should be kept in the government's hands.

The democratic government in power in 1990 did not sell the public water and sanitation utilities. They were transformed in commercial oriented public corporations affiliated to CORFO (government body) to whom the majority of the shares were entrusted. The companies follow regulations applied to private companies, although their annual budget has to be approved by the Finance Ministry.

With the new orientation and the funds coming from fair tariffs, public companies started a period of enhancement and high investments. The first five year tariff's period began in 1990, and considered a gradual annual raise until to reach the legal limit. This meant, on average, a total increase of about 70 % in real terms, that is without taking into account adjustments for inflation. The second five year tariff's period started in 1995. The average tariff's raise was now about 6 % and was to be maintained until 1999. EMOS in its main system had a water tariff reduction of about 2 %. In 1992 a revision was made in the tariff subsidy system, to facilitate accessibility and to take into account regional differences in tariffs and in average family income. In 1995, central government paid 23 million dollars on this subsidy, but now the government had not need to give financial assistance to any public company. On the contrary, some of the companies as EMOS, were paying shares' dividend to the government.
The growth of public utilities infrastructure was outstanding. New tanks, mains, collectors, water treatment plants, etc., were built in every region. Urban water and sewerage coverage reached the highest levels of Latin America. EMOS, the main utility put special emphasis in water conservation and water resource management to cope with the demand increase. The demand for water and sanitation was increasing as a result of urban developments in the metropolitan region, and because of the extension of water and sanitation systems to poor neighborhoods. EMOS activities for unaccounted for water were reinforced by macrometering, telemetering and telecontrol in strategic points of the water production and distribution system. Rehabilitation and replacement of deteriorated installations, contributed to the reduction of unnaccounted for water.

The first works for wastewater treatment and safe disposal started to be built and operated by the beginning of the 1990th.. EMOS and ESVAL initiated the construction of wastewater discharges interceptors (big collectors). In 1992 the first wastewater treatment plant, a pilot non conventional plant, was built in Santiago. The definitive plan for wastewater treatment in the metropolitan region was completed in 1994. In 1995 the decision of building three large plants was taken, to reach a sewage treatment coverage of about 70 % within 15 years. In other regions, wastewater collectors, non conventional wastewater treatment plans and marine out- falls for safe sewage disposal were designed , and started to be built and to be operated. Cholera was controlled in Chile as a result of emergency measures taken by the Ministry of Health. Yet, it is important to take into account the rise in sewerage coverage and the initiation of the basic works for wastewater treatment and safe disposal in the metropolitan region and in other regions. Other waterborne diseases, as typhoid, decreased from 6,700 cases in the year 1989 to 1,400 in the year 1995. The decrease of typhoid cases was even more important in the metropolitan region, from 4,100 cases in the year 1989 to 390 cases in the year 1995.

Public companies started also a new style of work. Long term regular planning for infrastructure development, working in a coordinated way with municipalities, communities and government bodies was a new managerial feature applied for EMOS and other companies. Comprehensive approach to management and participant and multi-disciplinary work was also part of the new style of work. Water conservation should be understood not only by the company's staff but also by clients, particularly when tariffs were rising. Public companies leaded by EMOS began a full campaign for client education in water conservation and appropriate utilization of water and sewerage infrastructure. Public companies also oriented low income families towards government subsidy, and helped municipalities in the administrative tasks of its implementation. Collective bargaining was now an obligation imposed by the new legal status of the companies. To develop new systems for human resource management, motivation and compensation, was a requisite that the new companies had to face.

New tariffs and increases in efficiency allow many of the companies to elevate its internal rate of return while performing new activities, intensifying others, taking new responsibilities and elevating wages and salaries to market's price. The average profit after taxes of these companies, referred to fixed assets, rose from a negative value of (0.76) % in 1989 to a positive value of 6.3 % in 1995 (data from SISS). EMOS raised its rate of return, from 5.7 % in 1989, to 11.0 % in 1995. It is important to point out that according to international standards the level of EMOS's tariffs is fairly low (0.40 US$ /m3, water and sewerage). Because of its sound financial situation, EMOS was able to treble its annual investments, to pay dividends of shares to the government its main shareholder, and to paid in advance the first loan with the World Bank. . EMOS also decided not to withdraw entirely the second loan with the World Bank.

BOOT contracts were thought to be awarded to the private sector for building and operating the future wastewater treatment plants.

Table 3 shows coverage and annual investments for the period 1990-1995. In this table it is included wastewater coverage in 1989 and in 1995.

Table 3
National Water and Sanitation Urban Coverage and Annual Investments 1990- 1995

Year	Water %	Sewerage %	Wastewater treatment	Investments million dollars
1990	97.4	81.8	8.0 (1989)	65
1991	97.6	83.6		107
1992	97.5	84.7		151
1993	98.0	86.4		182
1994	98.5	87.9		195
1995	98.6	89.2	14.0*	204

Source: Memoria Anual SISS, 1995 (Annual Report SISS, 1995)

* Include marine out-falls.

Third Institutional Reform.

Although most of these public companies are well run, some of them lack business administration capacity, and technological development. On the other hand, large infrastructure investments, yearly increasing, are required. The main investments are required for providing service to new urban population, for upgrading deteriorated systems, for building wastewater treatment plants, for developing new raw water sources, etc. It is required also, new procedures and methods, and new policies and organizational developments. Competition normally leads private companies to constant growth to survive in an always changing business environment. Public companies lack enough flexibility to face a continuous situation of advancement and renewal. Political interference could be also a menace to modern management of public companies. Thus, the sale of the public water and sanitation companies to the private sector, could be an advisable government policy..

By the middle of 1995, the government presented the Congress a proposal of modification of the current law. The government conditioned the sale of public companies to the pass of the new law.

The main aims of the proposal were: to join in one legal document the different laws in action; to prevent power concentration (majority of shares of many sector companies in one hand); to ensure that urban development is supported by water and sanitation infrastructure; and to protect and introduce some forms of competitiveness. The proposal has had many changes as a result of the discussion between the government and the Congress. The government and the Congress have introduced many new articles. The main features of the new law, after the Senate amendments are:

* SISS is being given the power to extend concession zones in order to make them coherent with government plans for urban development. (Development plan, and tariffs if required, would be modified)

* Public bidding is introduced as an obligation for contracting acquisition of goods and services over 150,000 dollars value.

* Power concentration is restricted by limiting the number of shares in one hand according to the quantity and size of the companies.

* Production concessionaires are being given the right to use, with due compensations, the water transport system of a different distribution concessionaire. They are also being given the right to build its own system to transport water to large final consumers. (That is, introducing in the water sector the multicarrier concept)

The main reforms presented by the government and rejected by the Senate are:

* To keep in the hands of the government, at least 35 % of the companies' shares.

* To transfer public companies' water rights to CORFO, to be administrated for this entity.

The law project has to follow the constitutional procedures that consider new discussion in the hamber of Deputies and the Senate. The government can also insist in its rejected proposals.

Summing up, the third institutional reform is being aimed to ensure the sustainability of a business model that has proved successful in the Chilean sanitary sector. Going further to corporate and commercial public companies, the government is considering its privatization . However before that, the government wants to take all the measures to ensure that this new reform allows the country to have its entire urban population served by sound and efficient water and sanitation companies.

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Institutional Development Of The Urban Water And Sanitation Sector In Chile

Chilean Urban Water and Sanitation sector have been in continuous development since the middle of the 19th century. That is, when the first water and sewerage works started being built in the main cities of the country. The last two major institutional changes started at the end of 1970 decade an a third one is being foreseen shortly.

1. The situation of the urban water and sanitation sector at the end of the 1970 decade.

By the end of the 70th, a large number of public services delivered drinking water or collected wastewater in the main cities of Chile, whose urban population amounted to some 8.5 million people. The urban population of Santiago, the capital city, and the population of the environsvillages, was about 4 million people. This population was been served mainly, by a semiautonomous public drinking water enterprise, Empresa de Agua Potable de Santiago (EAPS). There was also a public sewerage service, Servicio de Alcantarillado de Santiago, and other small drinking water public services. A private company delivered drinking water and collected wastewater in the upper part of the city. The population served by this company was of some 250,000 people.

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However, in all cities, including Santiago, sewerage coverage was low. In addition, there was no wastewater treatment and safe disposal of the sewage collected. The rate of enteric diseases (typhoid, hepatitis) all over the country was very high. This rate was even higher in the Metropolitan Region than in other regions. This could be attributed to poor hygiene practices due to lack of sewerage in many crowded neighborhoods. Yet, it could be attributed also to untreated sewage discharges to natural water courses crossing the city and in turn feeding irrigation canals.

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Table 2 shows national urban coverage and annual investment for the period 1980-1990.

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Its main features were:

* The law establishes the concessions system. That is, a right granted by the government to public or private companies, to perform water and sanitation activities for an indefinite period of time. Nevertheless the concession right can be lapsed if the concessionaire incurred in the faults contemplated in the law. Four types of concessions were granted: water production; water distribution into a geographical zone; wastewater collection into the same geographical zone (although this concession can be granted to a different concessionaire) and wastewater treatment and safe disposal . Concessions have to be applied for, and are granted after a bidding procedure. A transitory article of the law granted concessions to the companies and services that were performing or that had on going projects for performing water and sanitation activities. Concessions' rights can be sold and transferred.

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LEYES QUE CREAN LAS SOCIEDADES ANONIMAS (S. A) EMOS, ESVAL Y 11 EMPRESAS REGIONALES (Laws that create EMOS S.A., ESVAL S.A and 11 regional equity companies)

These laws created public corporate equity companies. The laws that created EMOS and ESVAL did not set limit to the sale of the shares of these companies. The laws that created the other regional public companies established that at least 51 % of the shares should be kept in the governments hands.

The democratic government in power in 1990 did not sell the public water and sanitation utilities. They were transformed in commercial oriented public corporations affiliated to CORFO (government body) to whom the majority of the shares were entrusted. The companies follow regulations applied to private companies, although their annual budget has to be approved by the Finance Ministry.

With the new orientation and the funds coming from fair tariffs, public companies started a period of enhancement and high investments. The first five year tariffs period began in 1990, and considered a gradual annual raise until to reach the legal limit. This meant, on average, a total increase of about 70 % in real terms, that is without taking into account adjustments for inflation. The second five year tariff's period started in 1995. The average tariffs raise was now about 6 % and was to be maintained until 1999. EMOS in its main system had a water tariff reduction of about 2 %. In 1992 a revision was made in the tariff subsidy system, to facilitate accessibility and to take into account regional differences in tariffs and in average family income. In 1995, central government paid 23 million dollars on this subsidy, but now the government had not need to give financial assistance to any public company. On the contrary, some of the companies as EMOS, were paying sharesdividend to the government.
The growth of public utilities infrastructure was outstanding. New tanks, mains, collectors, water treatment plants, etc., were built in every region. Urban water and sewerage coverage reached the highest levels of Latin America. EMOS, the main utility put special emphasis in water conservation and water resource management to cope with the demand increase. The demand for water and sanitation was increasing as a result of urban developments in the metropolitan region, and because of the extension of water and sanitation systems to poor neighborhoods. EMOS activities for unaccounted for water were reinforced by macrometering, telemetering and telecontrol in strategic points of the water production and distribution system. Rehabilitation and replacement of deteriorated installations, contributed to the reduction of unnaccounted for water.

The first works for wastewater treatment and safe disposal started to be built and operated by the beginning of the 1990th.. EMOS and ESVAL initiated the construction of wastewater discharges interceptors (big collectors). In 1992 the first wastewater treatment plant, a pilot non conventional plant, was built in Santiago. The definitive plan for wastewater treatment in the metropolitan region was completed in 1994. In 1995 the decision of building three large plants was taken, to reach a sewage treatment coverage of about 70 % within 15 years. In other regions, wastewater collectors, non conventional wastewater treatment plans and marine out- falls for safe sewage disposal were designed , and started to be built and to be operated. Cholera was controlled in Chile as a result of emergency measures taken by the Ministry of Health. Yet, it is important to take into account the rise in sewerage coverage and the initiation of the basic works for wastewater treatment and safe disposal in the metropolitan region and in other regions. Other waterborne diseases, as typhoid, decreased from 6,700 cases in the year 1989 to 1,400 in the year 1995. The decrease of typhoid cases was even more important in the metropolitan

region, from 4,100 cases in the year 1989 to 390 cases in the year 1995.

Public companies started also a new style of work. Long term regular planning for infrastructure development, working in a coordinated way with municipalities, communities and government bodies was a new managerial feature applied for EMOS and other companies. Comprehensive approach to management and participant and multi-disciplinary work was also part of the new style of work. Water conservation should be understood not only by the company's staff but also by clients, particularly when tariffs were rising. Public companies leaded by EMOS began a full campaign for client education in water conservation and appropriate utilization of water and sewerage infrastructure. Public companies also oriented low income families towards government subsidy, and helped municipalities in the administrative tasks of its implementation. Collective bargaining was now an obligation imposed by the new legal status of the companies. To develop new systems for human resource management, motivation and compensation, was a requisite that the new companies had to face.

New tariffs and increases in efficiency allow many of the companies to elevate its internal rate of return while performing new activities, intensifying others, taking new responsibilities and elevating wages and salaries to market's price. The average profit after taxes of these companies, referred to fixed assets, rose from a negative value of (0.76) % in 1989 to a positive value of 6.3 % in 1995 (data from SISS). EMOS raised its rate of return, from 5.7 % in 1989, to 11.0 % in 1995. It is important to point out that according to international standards the level of EMOS's tariffs is fairly low (0.40 US$ /m3, water and sewerage). Because of its sound financial situation, EMOS was able to treble its annual investments, to pay dividends of shares to the government its main shareholder, and to paid in advance the first loan with the World Bank. . EMOS also decided not to withdraw entirely the second loan with the World Bank.

BOOT contracts were thought to be awarded to the private sector for building and operating the future wastewater treatment plants.

Table 3 shows coverage and annual investments for the period 1990-1995. In this table it is included wastewater coverage in 1989 and in 1995.

Table 3
National Water and Sanitation Urban Coverage and Annual Investments 1990- 1995

Year	Water %	Sewerage %	Wastewater treatment	Investments million dollars
1990	97.4	81.8	8.0 (1989)	65
1991	97.6	83.6		107
1992	97.5	84.7		151
1993	98.0	86.4		182
1994	98.5	87.9		195
1995	98.6	89.2	14.0*	204

Source: Memoria Anual SISS, 1995 (Annual Report SISS, 1995)

* Include marine out-falls.

Third Institutional Reform.

Although most of these public companies are well run, some of them lack business administration capacity, and technological development. On the other hand, large infrastructure investments, yearly increasing, are required. The main investments are required for providing service to new urban population, for upgrading deteriorated systems, for building wastewater treatment plants, for developing new raw water sources, etc. It is required also, new procedures and methods, and new policies and organizational developments. Competition normally leads private companies to constant growth to survive in an always changing business environment. Public companies lack enough flexibility to face a continuous situation of advancement and renewal. Political interference could be also a menace to modern management of public companies. Thus, the sale of the public water and sanitation companies to the private sector, could be an advisable government policy..

By the middle of 1995, the government presented the Congress a proposal of modification of the current law. The government conditioned the sale of public companies to the pass of the new law.

The main aims of the proposal were: to join in one legal document the different laws in action; to prevent power concentration (majority of shares of many sector companies in one hand); to ensure that urban development is supported by water and sanitation infrastructure; and to protect and introduce some forms of competitiveness. The proposal has had many changes as a result of the discussion between the government and the Congress. The government and the Congress have introduced many new articles. The main features of the new law, after the Senate amendments are:

* SISS is being given the power to extend concession zones in order to make them coherent with government plans for urban development. (Development plan, and tariffs if required, would be modified)

* Public bidding is introduced as an obligation for contracting acquisition of goods and services over 150,000 dollars value.

* Power concentration is restricted by limiting the number of shares in one hand according to the quantity and size of the companies.

* Production concessionaires are being given the right to use, with due compensations, the water transport system of a different distribution concessionaire. They are also being given the right to build its own system to transport water to large final consumers. (That is, introducing in the water sector the multicarrier concept)

The main reforms presented by the government and rejected by the Senate are:

* To keep in the hands of the government, at least 35 % of the companiesshares.

* To transfer public companieswater rights to CORFO, to be administrated for this entity.

The law project has to follow the constitutional procedures that consider new discussion in the hamber of Deputies and the Senate. The government can also insist in its rejected proposals.

Summing up, the third institutional reform is being aimed to ensure the sustainability of a business model that has proved successful in the Chilean sanitary sector. Going further to corporate and commercial public companies, the government is considering its privatization . However before that, the government wants to take all the measures to ensure that this new reform allows the country to have its entire urban population served by sound and efficient water and sanitation companies.

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FEDERAL WATER POLLUTION CONTROL ACT

[As Amended Through P.L. 107–303, November 27, 2002]

FEDERAL WATER POLLUTION CONTROL ACT

(33 U.S.C. 1251 et seq.)

AN ACT To provide for water pollution control activities in the Public Health Service of the Federal Security Agency and in the Federal Works Agency, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

TITLE I—RESEARCH AND RELATED PROGRAMS

DECLARATION OF GOALS AND POLICY

SEC. 101. (a) The objective of this Act is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. In order to achieve this objective it is hereby declared that, consistent with the provisions of this Act—

(1) it is the national goal that the discharge of pollutants into the navigable waters be eliminated by 1985;

(2) it is the national goal that wherever attainable, an interim goal of water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water be achieved by July 1, 1983;

(3) it is the national policy that the discharge of toxic pollutants in toxic amounts be prohibited;

(4) it is the national policy that Federal financial assistance be provided to construct publicly owned waste treatment works;

(5) it is the national policy that areawide treatment management planning processes be developed and implemented to assure adequate control of sources of pollutants in each State;

(6) it is the national policy that a major research and demonstration effort be made to develop technology necessary to eliminate the discharge of pollutants into the navigable waters, waters of the contiguous zone and the oceans; and

(7) it is the national policy that programs for the control of nonpoint sources of pollution be developed and implemented in an expeditious manner so as to enable the goals of this Act to be met through the control of both point and nonpoint sources of pollution.

(b) It is the policy of the Congress to recognize, preserve, and protect the primary responsibilities and rights of States to prevent, reduce, and eliminate pollution, to plan the development and use (including restoration, preservation, and enhancement) of land and water resources, and to consult with the Administrator in the exercise of his authority under this Act. It is the policy of Congress that the States manage the construction grant program under this Act and implement the permit programs under sections 402 and 404 of

this Act. It is further the policy of the Congress to support and aid research relating to the prevention, reduction, and elimination of pollution, and to provide Federal technical services and financial aid to State and interstate agencies and municipalities in connection with the prevention, reduction, and elimination of pollution.

(c) It is further the policy of Congress that the President, acting through the Secretary of State and such national and international organizations as he determines appropriate, shall take such action as may be necessary to insure that to the fullest extent possible all foreign countries shall take meaningful action for the prevention, reduction, and elimination of pollution in their waters and in international waters and for the achievement of goals regarding the elimination of discharge of pollutants and the improvement of water quality to at least the same extent as the United States does under its laws.

(d) Except as otherwise expressly provided in this Act, the Administrator of the Environmental Protection Agency (hereinafter in this Act called "Administrator") shall administer this Act.

(e) Public participation in the development, revision, and enforcement of any regulation, standard, effluent limitation, plan, or program established by the Administrator or any State under this Act shall be provided for, encouraged, and assisted by the Administrator and the States. The Administrator, in cooperation with the States, shall develop and publish regulations specifying minimum guidelines for public participation in such processes.

(f) It is the national policy that to the maximum extent possible the procedures utilized for implementing this Act shall encourage the drastic minimization of paperwork and interagency decision procedures, and the best use of available manpower and funds, so as to prevent needless duplication and unnecessary delays at all levels of government.

(g) It is the policy of Congress that the authority of each State to allocate quantities of water within its jurisdiction shall not be superseded, abrogated or otherwise impaired by this Act. It is the further policy of Congress that nothing in this Act shall be construed to supersede or abrogate rights to quantities of water which have been established by any State. Federal agencies shall co-operate with State and local agencies to develop comprehensive solutions to prevent, reduce and eliminate pollution in concert with programs for managing water resources.

(33 U.S.C. 1251)

COMPREHENSIVE PROGRAMS FOR WATER POLLUTION CONTROL

SEC. 102. (a) The Administrator shall, after careful investigation, and in cooperation with other Federal agencies, State water pollution control agencies, interstate agencies, and the municipalities and industries involved, prepare or develop comprehensive programs for preventing, reducing, or eliminating the pollution of the navigable waters and ground waters and improving the sanitary condition of surface and underground waters. In the development of such comprehensive programs due regard shall be given to the improvements which are necessary to conserve such waters for the protection and propagation of fish and aquatic life and wildlife, recreational purposes, and the withdrawal of such waters for public

water supply, agricultural, industrial, and other purposes. For the purpose of this section, the Administrator is authorized to make joint investigations with any such agencies of the condition of any waters in any State or States, and of the discharges of any sewage, industrial wastes, or substance which may adversely affect such waters.

(b)(1) In the survey or planning of any reservoir by the Corps of Engineers, Bureau of Reclamation, or other Federal agency, consideration shall be given to inclusion of storage for regulation of streamflow, except that any such storage and water releases shall not be provided as a substitute for adequate treatment or other methods of controlling waste at the source.

(2) The need for and the value of storage for regulation of streamflow (other than for water quality) including but not limited to navigation, salt water intrusion, recreation, esthetics, and fish and wildlife, shall be determined by the Corps of Engineers, Bureau of Reclamation, or other Federal agencies.

(3) The need for, the value of, and the impact of, storage for water quality control shall be determined by the Administrator, and his views on these matters shall be set forth in any report or presentation to Congress proposing authorization or construction of any reservoir including such storage.

(4) The value of such storage shall be taken into account in determining the economic value of the entire project of which it is a part, and costs shall be allocated to the purpose of regulation of streamflow in a manner which will insure that all project purposes, share equitable in the benefits of multiple-purpose construction.

(5) Costs of regulation of streamflow features incorporated in any Federal reservoir or other impoundment under the provisions of this Act shall be determined and the beneficiaries identified and if the benefits are widespread or national in scope, the costs of such features shall be nonreimbursable.

(6) No license granted by the Federal Power Commission for a hydroelectric power project shall include storage for regulation of streamflow for the purpose of water quality control unless the Administrator shall recommend its inclusion and such reservoir storage capacity shall not exceed such proportion of the total storage required for the water quality control plan as the drainage area of such reservoir bears to the drainage area of the river basin or basins involved in such water quality control plan.

(c)(1) The Administrator shall, at the request of the Governor of a State, or a majority of the Governors when more than one State is involved make a grant to pay not to exceed 50 per centum of the administrative expenses of a planning agency for a period not to exceed three years, which period shall begin after the date of enactment of the Federal Water Pollution Control Act Amendments of 1972, if such agency provides for adequate representation of appropriate State, interstate, local, or (when appropriate) international interests in the basin or portion thereof involved and is capable of developing an effective, comprehensive water quality control plan for a basin or portion thereof.

(2) Each planning agency receiving a grant under this subsection shall develop a comprehensive pollution control plan for the basin or portion thereof which—

(A) is consistent with any applicable water quality standards, effluent and other limitations, and thermal discharge regulations established pursuant to current law within the basin;

(B) recommends such treatment works as will provide the most effective and economical means of collection, storage, treatment, and elimination of pollutants and recommends means to encourage both municipal and industrial use of such works;

(C) recommends maintenance and improvement of water quality within the basin or portion thereof and recommends methods of adequately financing those facilities as may be necessary to implement the plan; and

(D) as appropriate, is developed in cooperation with, and is consistent with any comprehensive plan prepared by the Water Resources Council, any areawide waste management plans developed pursuant to section 208 of this Act, and any State plan developed pursuant to section 303(e) of this Act.

(3) For the purposes of this subsection the term "basin" includes, but is not limited to, rivers and their tributaries, streams, coastal waters, sounds, estuaries, bays, lakes, and portions thereof, as well as the lands drained thereby.

(d) [Repealed by section 2021(a) of Public Law 104–66 (109 Stat. 726).]

(33 U.S.C. 1252)

INTERSTATE COOPERATION AND UNIFORM LAWS

SEC. 103. (a) The Administrator shall encourage cooperative activities by the States for the prevention, reduction, and elimination of pollution, encourage the enactment of improved and, so far as practicable, uniform State laws relating to the prevention, reduction, and elimination of pollution; and encourage compacts between States for the prevention and control of pollution.

(b) The consent of the Congress is hereby given to two or more States to negotiate and enter into agreements or compacts, not in conflict with any law or treaty of the United States, for (1) cooperative effort and mutual assistance for the prevention and control of pollution and the enforcement of their respective laws relating thereto, and (2) the establishment of such agencies, joint or otherwise, as they may deem desirable for making effective such agreements and compacts. No such agreement or compact shall be binding or obligatory upon any State a party thereto unless and until it has been approved by the Congress.

(33 U.S.C. 1253)

RESEARCH, INVESTIGATIONS, TRAINING, AND INFORMATION

SEC. 104. (a) The Administrator shall establish national programs for the prevention, reduction, and elimination of pollution and as part of such programs shall—

(1) in cooperation with other Federal, State, and local agencies, conduct and promote the coordination and acceleration of, research, investigations, experiments, training, demonstrations, surveys, and studies relating to the causes, effects, extent, prevention, reduction, and elimination of pollution;

(2) encourage, cooperate with, and render technical services to pollution control agencies and other appropriate public or private agencies, institutions, and organizations, and individuals, including the general public, in the conduct of activities referred to in paragraph (1) of this subsection;

(3) conduct, in cooperation with State water pollution control agencies and other interested agencies, organizations and persons, public investigations concerning the pollution of any navigable waters, and report on the results of such investigations;

(4) establish advisory committees composed of recognized experts in various aspects of pollution and representatives of the public to assist in the examination and evaluation of research progress and proposals and to avoid duplication of research;

(5) in cooperation with the States, and their political subdivisions, and other Federal agencies establish, equip, and maintain a water quality surveillance system for the purpose of monitoring the quality of the navigable waters and ground waters and the contiguous zone and the oceans and the Administrator shall, to the extent practicable, conduct such surveillance by utilizing the resources of the National Aeronautics and Space Administration, the National Oceanic and Atmospheric Administration, the Geological Survey, and the Coast Guard, and shall report on such quality not later than 90 days after the date of convening of each session of Congress; and

(6) initiate and promote the coordination and acceleration of research designed to develop the most effective practicable tools and techniques for measuring the social and economic costs and benefits of activities which are subject to regulations under this Act; and shall transmit a report on the results of such research to the Congress not later than January 1, 1974.

(b) In carrying out the provisions of subsection (a) of this section the Administrator is authorized to—

(1) collect and make available, through publications and other appropriate means, the results of and other information, including appropriate recommendations by him in connection therewith, pertaining to such research and other activities referred to in paragraph (1) of subsection (a);

(2) cooperate with other Federal departments and agencies, State water pollution control agencies, interstate agencies, other public and private agencies, institutions, organizations, industries involved, and individuals, in the preparation and conduct of such research and other activities referred to in paragraph (1) of subsection (a);

(3) make grants to State water pollution control agencies, interstate agencies, other public or nonprofit private agencies, institutions, organizations, and individuals, for purposes stated in paragraph (1) of subsection (a) of this section;

(4) contract with public or private agencies, institutions, organizations, and individuals, without regard to sections 3648 and 3709 of the Revised Statutes (31 U.S.C. 529; 41 U.S.C. 5), referred to in paragraph (1) of subsection (a);

(5) establish and maintain research fellowships at public or nonprofit private educational institutions or research organizations;

(6) collect and disseminate, in cooperation with other Federal departments and agencies, and with other public or private agencies, institutions, and organizations having related responsibilities, basic data on chemical, physical, and biological effects of varying water quality and other information pertaining to pollution and the prevention, reduction, and elimination thereof; and

(7) develop effective and practical processes, methods, and prototype devices for the prevention, reduction, and elimination of pollution.

(c) In carrying out the provisions of subsection (a) of this section the Administrator shall conduct research on, and survey the results of other scientific studies on, the harmful effects on the health or welfare of persons caused by pollutants. In order to avoid duplication of effort, the Administrator shall, to the extent practicable, conduct such research in cooperation with and through the facilities of the Secretary of Health, Education, and Welfare.

(d) In carrying out the provisions of this section the Administrator shall develop and demonstrate under varied conditions (including conducting such basic and applied research, studies, and experiments as may be necessary):

(1) Practicable means of treating municipal sewage, and other waterborne wastes to implement the requirements of section 201 of this Act;

(2) Improved methods and procedures to identify and measure the effects of pollutants, including those pollutants created by new technological developments; and

(3) Methods and procedures for evaluating the effects on water quality of augmented streamflows to control pollution not susceptible to other means of prevention, reduction, or elimination.

(e) The Administrator shall establish, equip, and maintain field laboratory and research facilities, including, but not limited to, one to be located in the northeastern area of the United States, one in the Middle Atlantic area, one in the southeastern area, one in the midwestern area, one in the southwestern area, one in the Pacific Northwest, and one in the State of Alaska, for the conduct of research, investigations, experiments, field demonstrations and studies, and training relating to the prevention, reduction and elimination of pollution. Insofar as practicable, each such facility shall be located near institutions of higher learning in which graduate training in such research might be carried out. In conjunction with the development of criteria under section 403 of this Act, the Administrator shall construct the facilities authorized for the National Marine Water Quality Laboratory established under this subsection.

(f) The Administrator shall conduct research and technical development work, and make studies, with respect to the quality of the waters of the Great Lakes, including an analysis of the present and projected future water quality of the Great Lakes under varying conditions of waste treatment and disposal, an evaluation of the water quality needs of those to be served by such waters, an

evaluation of municipal, industrial, and vessel waste treatment and disposal practices with respect to such waters, and a study of alternate means of solving pollution problems (including additional waste treatment measures) with respect to such waters.

(g)(1) For the purpose of providing an adequate supply of trained personnel to operate and maintain existing and future treatment works and related activities, and for the purpose of enhancing substantially the proficiency of those engaged in such activities, the Administrator shall finance pilot programs, in cooperation with State and interstate agencies, municipalities, educational institutions, and other organizations and individuals, of manpower development and training and retraining of persons in, on entering into, the field of operation and maintenance of treatment works and related activities. Such program and any funds expended for such a program shall supplement, not supplant, other manpower and training programs and funds available for the purposes of this paragraph. The Administrator is authorized, under such terms and conditions as he deems appropriate, to enter into agreements with one or more States, acting jointly or severally, or with other public or private agencies or institutions for the development and implementation of such a program.

(2) The Administrator is authorized to enter into agreements with public and private agencies and institutions, and individuals to develop and maintain an effective system for forecasting the supply of, and demand for, various professional and other occupational categories needed for the prevention, reduction, and elimination of pollution in each region, State, or area of the United States and, from time to time, to publish the results of such forecasts.

(3) In furtherance of the purposes of this Act, the Administrator is authorized to—

(A) make grants to public or private agencies and institutions and to individuals for training projects, and provide for the conduct of training by contract with public or private agencies and institutions and with individuals without regard to sections 3648 and 3709 of the Revised Statutes;

(B) establish and maintain research fellowships in the Environmental Protection Agency with such stipends and allowances, including traveling and subsistence expenses, as he may deem necessary to procure the assistance of the most promising research fellows; and

(C) provide, in addition to the program established under paragraph (1) of this subsection, training in technical matters relating to the causes, prevention, reduction, and elimination of pollution for personnel of public agencies and other persons with suitable qualifications.

(4) The Administrator shall submit, through the President, a report to the Congress not later than December 31, 1973, summarizing the actions taken under this subsection and the effectiveness of such actions, and setting forth the number of persons trained, the occupational categories for which training was provided, the effectiveness of other Federal, State, and local training programs in this field, together with estimates of future needs, recommendations on improving training programs, and such other information and recommendations, including legislative recommendations, as he deems appropriate.

(h) The Administrator is authorized to enter into contracts, with, or make grants to, public or private agencies and organizations and individuals for (A) the purpose of developing and demonstrating new or improved methods for the prevention, removal, reduction, and elimination of pollution in lakes, including the undesirable effects of nutrients and vegetation, and (B) the construction of publicly owned research facilities for such purpose.

(i) The Administrator, in cooperation with the Secretary of the department in which the Coast Guard is operating, shall—

(1) engage in such research, studies, experiments, and demonstrations as he deems appropriate, relative to the removal of oil from any waters and to the prevention, control, and elimination of oil and hazardous substances pollution;

(2) publish from time to time the results of such activities; and

(3) from time to time, develop and publish in the Federal Register specifications and other technical information on the various chemical compounds used in the control of oil and hazardous substances spills.

In carrying out this subsection, the Administrator may enter into contracts with, or make grants to, public or private agencies and organizations and individuals.

(j) The Secretary of the department in which the Coast Guard is operating shall engage in such research, studies, experiments, and demonstrations as he deems appropriate relative to equipment which is to be installed on board a vessel and is designed to receive, retain, treat, or discharge human body wastes and the wastes from toilets and other receptacles intended to receive or retain body wastes with particular emphasis on equipment to be installed on small recreational vessels. The Secretary of the department in which the Coast Guard is operating shall report to Congress the results of such research, studies, experiments, and demonstrations prior to the effective date of any regulations established under section 312 of this Act. In carrying out this subsection the Secretary of the department in which the Coast Guard is operating may enter into contracts with, or make grants to, public or private organizations and individuals.

(k) In carrying out the provisions of this section relating to the conduct by the Administrator of demonstration projects and the development of field laboratories and reseach facilities, the Administrator may acquire land and interests therein by purchase, with appropriated or donated funds, by donation, or by exchange for acquired or public lands under his jurisdiction which he classifies as suitable for disposition. The values of the properties so exchanged either shall be approximately equal, or if they are not approximately equal, the values shall be equalized by the payment of cash to the grantor or to the Administrator as the circumstances require.

(l)(1) The Administrator shall, after consultation with appropriate local, State, and Federal agencies, public and private organizations, and interested individuals, as soon as practicable but not later than January 1, 1973, develop and issue to the States for the purpose of carrying out this Act the latest scientific knowledge available in indicating the kind and extent of effects on health and welfare which may be expected from the presence of pesticides in

the water in varying quantities. He shall revise and add to such information whenever necessary to reflect developing scientific knowledge.

(2) The President shall, in consultation with appropriate local, State, and Federal agencies, public and private organizations, and interested individuals, conduct studies and investigations of methods to control the release of pesticides into the environment which study shall include examination of the persistency of pesticides in the water environment and alternative thereto. The President shall submit reports, from time to time, on such investigations to Congress together with his recommendations for any necessary legislation.

(m)(1) The Administrator shall, in an effort to prevent degradation of the environment from the disposal of waste oil, conduct a study of (A) the generation of used engine, machine, cooling, and similar waste oil, including quantities generated, the nature and quality of such oil, present collecting methods and disposal practices, and alternate uses of such oil; (B) the long-term, chronic biological effects of the disposal of such waste oil; and (C) the potential market for such oils, including the economic and legal factors relating to the sale of products made from such oils, the level of subsidy, if any, needed to encourage the purchase by public and private nonprofit agencies of products from such oil, and the practicability of Federal procurement, on a priority basis, of products made from such oil. In conducting such study, the Administrator shall consult with affected industries and other persons.

(2) The Administrator shall report the preliminary results of such study to Congress within six months after the date of enactment of the Federal Water Pollution Control Act Amendments of 1972, and shall submit a final report to Congress within 18 months after such date of enactment.

(n)(1) The Administrator shall, in cooperation with the Secretary of the Army, the Secretary of Agriculture, the Water Resources Council, and with other appropriate Federal, State, interstate, or local public bodies and private organizations, institutions, and individuals, conduct and promote, encourage contributions to, continuing comprehensive studies of the effects of pollution, including sedimentation, in the estuaries and estuarine zones of the United States on fish and wildlife, on sport and commercial fishing, on recreation, on water supply and water power, and on other beneficial purposes. Such studies shall also consider the effect of demographic trends, the exploitation of mineral resources and fossil fuels, land and industrial development, navigation, flood and erosion control, and other uses of estuaries and estuarine zones upon the pollution of the waters therein.

(2) In conducting such studies, the Administrator shall assemble, coordinate, and organize all existing pertinent information on the Nation's estuaries and estuarine zones; carry out a program of investigations and surveys to supplement existing information in representative estuaries and estuarine zones; and identify the problems and areas where further research and study are required.

(3) For the purpose of this subsection, the term "estuarine zones" means an environmental system consisting of an estuary and those transitional areas which are consistently influenced or affected by water from an estuary such as, but not limited to, salt

marshes, coastal and intertidal areas, bays, harbors, lagoons, inshore waters, and channels, and the term "estuary" means all or part of the mouth of a river or stream or other body of water having unimpaired natural connection with open sea and within which the sea water is measurably diluted with fresh water derived from land drainage.

(o)(1) The Administrator shall conduct research and investigations on devices, systems, incentives, pricing policy, and other methods of reducing the total flow of sewage, including, but not limited to, unnecessary water consumption in order to reduce the requirements for, and the costs of, sewage and waste treatment services. Such research and investigations shall be directed to develop devices, systems, policies, and methods capable of achieving the maximum reduction of unnecessary water consumption.

(2) The Administrator shall report the preliminary results of such studies and investigations to the Congress within one year after the date of enactment of the Federal Water Pollution Control Act Amendments of 1972, and annually thereafter not later than 90 days after the date of convening of each session of Congress. Such report shall include recommendations for any legislation that may be required to provide for the adoption and use of devices, systems, policies, or other methods of reducing water consumption and reducing the total flow of sewage. Such report shall include an estimate of the benefits to be derived from adoption and use of such devices, systems, policies, or other methods and also shall reflect estimates of any increase in private, public, or other cost that would be occasioned thereby.

(p) In carrying out the provisions of subsection (a) of this section the Administrator shall, in cooperation with the Secretary of Agriculture, other Federal agencies, and the States, carry out a comprehensive study and research program to determine new and improved methods and the better application of existing methods of preventing, reducing, and eliminating pollution from agriculture, including the legal, economic, and other implications of the use of such methods.

(q)(1) The Administrator shall conduct a comprehensive program of research and investigation and pilot project implementation into new and improved methods of preventing, reducing, storing, collecting, treating, or otherwise eliminating pollution from sewage in rural and other areas where collection of sewage in conventional, community-wide sewage collection systems is impractical, uneconomical, or otherwise infeasible, or where soil conditions or other factors preclude the use of septic tank and drainage field systems.

(2) The Administrator shall conduct a comprehensive program of research and investigation and pilot project implementation into new and improved methods for the collection and treatment of sewage and other liquid wastes combined with the treatment and disposal of solid wastes.

(3) The Administrator shall establish, either within the Environmental Protection Agency, or through contract with an appropriate public or private non-profit organization, a national clearinghouse which shall (A) receive reports and information resulting from research, demonstrations, and other projects funded under this Act related to paragraph (1) of this subsection and to sub-

section (e)(2) of section 105; (B) coordinate and disseminate such reports and information for use by Federal and State agencies, municipalities, institutions, and persons in developing new and improved methods pursuant to this subsection; and (C) provide for the collection and dissemination of reports and information relevant to this subsection from other Federal and State agencies, institutions, universities, and persons.

(4) SMALL FLOWS CLEARINGHOUSE.—Notwithstanding section 205(d) of this Act, from amounts that are set aside for a fiscal year under section 205(i) of this Act and are not obligated by the end of the 24-month period of availability for such amounts under section 205(d), the Administrator shall make available $1,000,000 or such unobligated amount, whichever is less, to support a national clearinghouse within the Environmental Protection Agency to collect and disseminate information on small flows of sewage and innovative or alternative wastewater treatment processes and techniques, consistent with paragraph (3). This paragraph shall apply with respect to amounts set aside under section 205(i) for which the 24-month period of availability referred to in the preceding sentence ends on or after September 30, 1986.

(r) The Administrator is authorized to make grants to colleges and universities to conduct basic research into the structure and function of fresh water aquatic ecosystems, and to improve understanding of the ecological characteristics necessary to the maintenance of the chemical, physical, and biological integrity of freshwater aquatic ecosystems.

(s) The Administrator is authorized to make grants to one or more institutions of higher education (regionally located and to be designated as "River Study Centers") for the purpose of conducting and reporting on interdisciplinary studies on the nature of river systems, including hydrology, biology, ecology, economics, the relationship between river uses and land uses, and the effects of development within river basins on river systems and on the value of water resources and water related activities. No such grant in any fiscal year shall exceed $1,000,000.

(t) The Administrator shall, in cooperation with State and Federal agencies and public and private organizations, conduct continuing comprehensive studies of the effects and methods of control of thermal discharges. In evaluating alternative methods of control the studies shall consider (1) such data as are available on the latest available technology, economic feasibility including cost-effectiveness analysis, and (2) the total impact on the environment, considering not only water quality but also air quality, land use, and effective utilization and conservation of fresh water and other natural resources. Such studies shall consider methods of minimizing adverse effects and maximizing beneficial effects of thermal discharges. The results of these studies shall be reported by the Administrator as soon as practicable, but not later than 270 days after enactment of this subsection, and shall be made available to the public and the States, and considered as they become available by the Administrator in carrying out section 316 of this Act and by the State in proposing thermal water quality standards.

(u) There is authorized to be appropriated (1) not to exceed $100,000,000 per fiscal year for the fiscal year ending June 30,

1973, the fiscal year ending June 30, 1974, and the fiscal year ending June 30, 1975, not to exceed $14,039,000 for the fiscal year ending September 30, 1980, not to exceed $20,697,000 for the fiscal year ending September 30, 1981, not to exceed $22,770,000 for the fiscal year ending September 30, 1982, such sums as may be necessary for fiscal years 1983 through 1985, and not to exceed $22,770,000 per fiscal year for each of the fiscal years 1986 through 1990, for carrying out the provisions of this section, other than subsections (g)(1) and (2), (p), (r), and (t), except that such authorizations are not for any research, development, or demonstration activity pursuant to such provisions; (2) not to exceed $7,500,000 for fiscal years 1973, 1974, and 1975, $2,000,000 for fiscal year 1977, $3,000,000 for fiscal year 1978, $3,000,000 for fiscal year 1979, $3,000,000 for fiscal year 1980, $3,000,000 for fiscal year 1981, $3,000,000 for fiscal year 1982, such sums as may be necessary for fiscal years 1983 through 1985, and $3,000,000 per fiscal year for each of the fiscal years 1986 through 1990, for carrying out the provisions of subsection (g)(1); (3) not to exceed $2,500,000 for fiscal years 1973, 1974, and 1975, $1,000,000 for fiscal year 1977, $1,500,000 for fiscal year 1978, $1,500,000 for fiscal year 1979, $1,500,000 for fiscal year 1980, $1,500,000 for fiscal year 1981, $1,500,000 for fiscal year 1982, such sums as may be necessary for fiscal years 1983 through 1985, and $1,500,000 per fiscal year for each of the fiscal years 1986 through 1990, for carrying out the provisions of subsection (g)(2); (4) not to exceed $10,000,000 for each of the fiscal years ending June 30, 1973, June 30, 1974, and June 30, 1975, for carrying out the provisions of subsection (p); (5) not to exceed $15,000,000 per fiscal year for the fiscal years ending June 30, 1973, June 30, 1974, and June 30, 1975, for carrying out the provisions of subsection (r); and (6) not to exceed $10,000,000 per fiscal year for the fiscal years ending June 30, 1973, June 30, 1974, and June 30, 1975, for carrying out the provisions of subsection (t).

(v) STUDIES CONCERNING PATHOGEN INDICATORS IN COASTAL RECREATION WATERS.—Not later than 18 months after the date of the enactment of this subsection, after consultation and in cooperation with appropriate Federal, State, tribal, and local officials (including local health officials), the Administrator shall initiate, and, not later than 3 years after the date of the enactment of this subsection, shall complete, in cooperation with the heads of other Federal agencies, studies to provide additional information for use in developing—

(1) an assessment of potential human health risks resulting from exposure to pathogens in coastal recreation waters, including nongastrointestinal effects;

(2) appropriate and effective indicators for improving detection in a timely manner in coastal recreation waters of the presence of pathogens that are harmful to human health;

(3) appropriate, accurate, expeditious, and cost-effective methods (including predictive models) for detecting in a timely manner in coastal recreation waters the presence of pathogens that are harmful to human health; and

(4) guidance for State application of the criteria for pathogens and pathogen indicators to be published under section

304(a)(9) to account for the diversity of geographic and aquatic conditions.

(33 U.S.C. 1254)

GRANTS FOR RESEARCH AND DEVELOPMENT

SEC. 105. (a) The Administrator is authorized to conduct in the Environmental Protection Agency, and to make grants to any State, municipality, or intermunicipal or interstate agency for the purpose of assisting in the development of—

(1) any project which will demonstrate a new or improved method of preventing, reducing, and eliminating the discharge into any waters of pollutants from sewers which carry storm water or both storm water and pollutants; or

(2) any project which will demonstrate advanced waste treatment and water purification methods (including the temporary use of new or improved chemical additives which provide substantial immediate improvement to existing treatment processes), or new or improved methods of joint treatment systems for municipal and industrial wastes;

and to include in such grants such amounts as are necessary for the purpose of reports, plans, and specifications in connection therewith.

(b) The Administrator is authorized to make grants to any State or States or interstate agency to demonstrate, in river basins or portions thereof, advanced treatment and environmental enhancement techniques to control pollution from all sources, within such basins or portions thereof, including nonpoint sources, together with in stream water quality improvement techniques.

(c) In order to carry out the purposes of section 301 of this Act, the Administrator is authorized to (1) conduct in the Environmental Protection Agency, (2) make grants to persons, and (3) enter into contracts with persons, for research and demonstration projects for prevention of pollution of any waters by industry including, but not limited to, the prevention, reduction, and elimination of the discharge of pollutants. No grant shall be made for any project under this subsection unless the Administrator determines that such project will develop or demonstrate a new or improved method of treating industrial wastes or otherwise prevent pollution by industry, which method shall have industrywide application.

(d) In carrying out the provisions of this section, the Administrator shall conduct, on a priority basis, an accelerated effort to develop, refine, and achieve practical application of:

(1) waste management methods applicable to point and nonpoint sources of pollutants to eliminate the discharge of pollutants, including, but not limited to, elimination of runoff of pollutants and the effects of pollutants from inplace or accumulated sources;

(2) advanced waste treatment methods applicable to point and nonpoint sources, including inplace or accumulated sources of pollutants, and methods for reclaiming and recycling water and confining pollutants so they will not migrate to cause water or other environmental pollution; and

(3) improved methods and procedures to identify and measure the effects of pollutants on the chemical, physical, and biological integrity of water, including those pollutants created by new technological developments.

(e)(1) The Administrator is authorized to (A) make, in consultation with the Secretary of Agriculture, grants to persons for research and demonstration projects with respect to new and improved methods of preventing, reducing, and eliminating pollution from agriculture, and (B) disseminate, in cooperation with the Secretary of Agriculture, such information obtained under this subsection, section 104(p), and section 304 as will encourage and enable the adoption of such methods in the agricultural industry.

(2) The Administrator is authorized, (A) in consultation with other interested Federal agencies, to make grants for demonstration projects with respect to new and improved methods of preventing, reducing, storing, collecting, treating, or otherwise eliminating pollution from sewage in rural and other areas where collection of sewage in conventional, community-wide sewage collection systems is impractical, uneconomical, or otherwise infeasible, or where soil conditions or other factors preclude the use of septic tank and drainage field systems, and (B) in cooperation with other interested Federal and State agencies, to disseminate such information obtained under this subsection as will encourage and enable the adoption of new and improved methods developed pursuant to this subsection.

(f) Federal grants under subsection (a) of this section shall be subject to the following limitations:

(1) No grant shall be made for any project unless such project shall have been approved by the appropriate State water pollution control agency or agencies and by the Administrator;

(2) No grant shall be made for any project in an amount exceeding 75 per centum of cost thereof as determined by the Administrator; and

(3) No grant shall be made for any project unless the Administrator determines that such project will serve as a useful demonstration for the purpose set forth in clause (1) or (2) of subsection (a).

(g) Federal grants under subsections (c) and (d) of this section shall not exceed 75 per centum of the cost of the project.

(h) For the purpose of this section there is authorized to be appropriated $75,000,000 per fiscal year for the fiscal year ending June 30, 1973, the fiscal year ending June 30, 1974, and the fiscal year ending June 30, 1975, and from such appropriations at least 10 per centum of the funds actually appropriated in each fiscal year shall be available only for the purposes of subsection (e).

(i) The Administrator is authorized to make grants to a municipality to assist in the costs of operating and maintaining a project which received a grant under this section, section 104, or section 113 of this Act prior to the date of enactment of this subsection so as to reduce the operation and maintenance costs borne by the recipients of services from such project to costs comparable to those for projects assisted under title II of this Act.

(j) The Administrator is authorized to make a grant to any grantee who received an increased grant pursuant to section

202(a)(2) of this Act. Such grant may pay up to 100 per centum of the costs of technical evaluation of the operation of the treatment works, costs of training of persons (other than employees of the grantee), and costs of disseminating technical information on the operation of the treatment works.

(33 U.S.C. 1255)

GRANTS FOR POLLUTION CONTROL PROGRAMS

SEC. 106. (a) There are hereby authorized to be appropriated the following sums, to remain available until expended, to carry out the purposes of this section—

(1) $60,000,000 for the fiscal year ending June 30, 1973; and

(2) $75,000,000 for the fiscal year ending June 30, 1974, and the fiscal year ending June 30, 1975, $100,000,000 per fiscal year for the fiscal years 1977, 1978, 1979, and 1980, $75,000,000 per fiscal year for the fiscal years 1981 and 1982, such sums as may be necessary for fiscal years 1983 through 1985, and $75,000,000 per fiscal year for each of the fiscal years 1986 through 1990;

for grants to States and to interstate agencies to assist them in administering programs for the prevention, reduction, and elimination of pollution, including enforcement directly or through appropriate State law enforcement officers or agencies.

(b) From the sums appropriated in any fiscal year, the Administrator shall make allotments to the several States and interstate agencies in accordance with regulations promulgated by him on the basis of the extent of the pollution problem in the respective States.

(c) The Administrator is authorized to pay to each State and interstate agency each fiscal year either—

(1) the allotment of such State or agency for such fiscal year under subsection (b), or

(2) the reasonable costs as determined by the Administrator of developing and carrying out a pollution program by such State or agency during such fiscal year,

whichever amount is the lesser.

(d) No grant shall be made under this section to any State or interstate agency for any fiscal year when the expenditure of non-Federal funds by such State or interstate agency during such fiscal year for the recurrent expenses of carrying out its pollution control program are less than the expenditure by such State or interstate agency of non-Federal funds for such recurrent program expenses during the fiscal year ending June 30, 1971.

(e) Beginning in fiscal year 1974 the Administrator shall not make any grant under this section to any State which has not provided or is not carrying out as a part of its program—

(1) the establishment and operation of appropriate devices, methods, systems, and procedures necessary to monitor, and to compile and analyze data on (including classification according to eutrophic condition), the quality of navigable waters and to the extent practicable, ground waters including biological monitoring; and provision for annually updating such data and including it in the report required under section 305 of this Act;

(2) authority comparable to that in section 504 of this Act and adequate contingency plans to implement such authority.

(f) Grants shall be made under this section on condition that—

(1) Such State (or interstate agency) filed with the Administrator within one hundred and twenty days after the date of enactment of this section:

(A) a summary report of the current status of the State pollution control program, including the criteria used by the State in determining priority of treatment works; and

(B) such additional information, data, and reports as the Administrator may require.

(2) No federally assumed enforcement as defined in section 309(a)(2) is in effect with respect to such State or interstate agency.

(3) Such State (or interstate agency) submits within one hundred and twenty days after the date of enactment of this section and before July 1 of each year thereafter for the Administrator's approval of its program for the prevention, reduction, and elimination of pollution in accordance with purposes and provisions of this Act in such form and content as the Administrator may prescribe.

(g) Any sums allotted under subsection (b) in any fiscal year which are not paid shall be reallotted by the Administrator in accordance with regulations promulgated by him.

(33 U.S.C. 1256)

MINE WATER POLLUTION CONTROL DEMONSTRATIONS

SEC. 107. (a) The Administrator in cooperation with the Appalachian Regional Commission and other Federal agencies is authorized to conduct, to make grants for, or to contract for, projects to demonstrate comprehensive approaches to the elimination or control of acid or other mine water pollution resulting from active or abandoned mining operations and other environmental pollution affecting water quality within all or part of a watershed or river basin, including siltation from surface mining. Such projects shall demonstrate the engineering and economic feasibility and practicality of various abatement techniques which will contribute substantially to effective and practical methods of acid or other mine water pollution elimination or control, and other pollution affecting water quality, including techniques that demonstrate the engineering and economic feasibility and practicality of using sewage sludge materials and other municipal wastes to diminish or prevent pollution affecting water quality from acid, sedimentation, or other pollutants and in such projects to restore affected lands to usefulness for forestry, agriculture, recreation, or other beneficial purposes.

(b) Prior to undertaking any demonstration project under this section in the Appalachian region (as defined in section 403 of the Appalachian Regional Development Act of 1965, as amended), the Appalachian Regional Commission shall determine that such demonstration project is consistent with the objectives of the Appalachian Regional Development Act of 1965, as amended.

(c) The Administrator, in selecting watersheds for the purposes of this section, shall be satisfied that the project area will not be

affected adversely by the influx of acid or other mine water pollution from nearby sources.

(d) Federal participation in such projects shall be subject to the conditions—

(1) that the State shall acquire any land or interests therein necessary for such project; and

(2) that the State shall provide legal and practical protection to the project area to insure against any activities which will cause future acid or other mine water pollution.

(e) There is authorized to be appropriated $30,000,000 to carry out the provisions of this section, which sum shall be available until expended.

(33 U.S.C. 1257)

POLLUTION CONTROL IN GREAT LAKES

SEC. 108. (a) The Administrator, in cooperation with other Federal departments, agencies, and instrumentalities is authorized to enter into agreements with any State, political subdivision, interstate agency, or other public agency, or combination thereof, to carry out one or more projects to demonstrate new methods and techniques and to develop preliminary plans for the elimination or control of pollution, within all or any part of the watersheds of the Great Lakes. Such projects shall demonstrate the engineering and economic feasibility and practicality of removal of pollutants and prevention of any polluting matter from entering into the Great Lakes in the future and other reduction and remedial techniques which will contribute substantially to effective and practical methods of pollution prevention, reduction, or elimination.

(b) Federal participation in such projects shall be subject to the condition that the State, political subdivision, interstate agency, or other public agency, or combination thereof, shall pay not less than 25 per centum of the actual project costs, which payment may be in any form, including, but not limited to, land or interests therein that is needed for the project, and personal property or services the value of which shall be determined by the Administrator.

(c) There is authorized to be appropriated $20,000,000 to carry out the provisions of subsections (a) and (b) of this section, which sum shall be available until expended.

(d)(1) In recognition of the serious conditions which exist in Lake Erie, the Secretary of the Army, acting through the Chief of Engineers, is directed to design and develop a demonstration waste water management program for the rehabilitation and environmental repair of Lake Erie. Prior to the initiation of detailed engineering and design, the program, along with the specific recommendations of the Chief of Engineers and recommendations for its financing, shall be submitted to the Congress for statutory approval. This authority is in addition to, and not in lieu of, other waste water studies aimed at eliminating pollution emanating from select sources around Lake Erie.

(2) This program is to be developed in cooperation with the Environmental Protection Agency, other interested departments, agencies, and instrumentalities of the Federal Government, and the States and their political subdivisions. This program shall set forth alternative systems for managing waste water on a regional

basis and shall provide local and State governments with a range of choice as to the type of system to be used for the treatment of waste water. These alternative systems shall include both advanced waste treatment technology and land disposal systems including aerated treatment-spray irrigation technology and will also include provisions for the disposal of solid wastes, including sludge. Such program should include measures to control point sources of pollution, area sources of pollution, including acid-mine drainage, urban runoff and rural runoff, and in place sources of pollution, including bottom loads, sludge banks, and polluted harbor dredgings.

(e) There is authorized to be appropriated $5,000,000 to carry out the provisions of subsection (d) of this section, which sum shall be available until expended.

(33 U.S.C. 1258)

TRAINING GRANTS AND CONTRACTS

SEC. 109. (a) The Administrator is authorized to make grants to or contracts with institutions of higher education, or combinations of such institutions, to assist them in planning, developing, strengthening, improving, or carrying out programs or projects for the preparation of undergraduate students to enter an occupation which involves the design, operation, and maintenance of treatment works, and other facilities whose purpose is water quality control. Such grants or contracts may include payment of all or part of the cost of programs or projects such as—

(A) planning for the development or expansion of programs or projects for training persons in the operation and maintenance of treatment works;

(B) training and retraining of faculty members;

(C) conduct of short-term or regular session institutes for study by persons engaged in, or preparing to engage in, the preparation of students preparing to enter an occupation involving the operation and maintenance of treatment works;

(D) carrying out innovative and experimental programs of cooperative education involving alternate periods of full-time or part-time academic study at the institution and periods of full-time or part-time employment involving the operation and maintenance of treatment works; and

(E) research into, and development of, methods of training students or faculty, including the preparation of teaching materials and the planning of curriculum.

(b)(1) The Administrator may pay 100 per centum of any additional cost of construction of treatment works required for a facility to train and upgrade waste treatment works operation and maintenance personnel and for the costs of other State treatment works operator training programs, including mobile training units, classroom rental, specialized instructors, and instructional material.

(2) The Administrator shall make no more than one grant for such additional construction in any State (to serve a group of States, where, in his judgment, efficient training programs require multi-State programs), and shall make such grant after consultation with and approval by the State or States on the basis of (A) the suitability of such facility for training operation and maintenance personnel for treatment works throughout such State or

States; and (B) a commitment by the State agency or agencies to carry out at such facility a program of training approved by the Administrator. In any case where a grant is made to serve two or more States, the Administrator is authorized to make an additional grant for a supplemental facility in each such State.

(3) The Administrator may make such grant out of the sums allocated to a State under section 205 of this Act, except that in no event shall the Federal cost of any such training facilities exceed $500,000.

(4) The Administrator may exempt a grant under this section from any requirement under section 204(a)(3) of this Act. Any grantee who received a grant under this section prior to enactment of the Clean Water Act of 1977 shall be eligible to have its grant increased by funds made available under such Act.

(33 U.S.C. 1259)

APPLICATION FOR TRAINING GRANT OR CONTRACT; ALLOCATION OF GRANTS OR CONTRACTS

SEC. 110. (1) A grant or contract authorized by section 109 may be made only upon application to the Administrator at such time or times and containing such information as he may prescribe, except that no such application shall be approved unless it—

(A) sets forth programs, activities, research, or development for which a grant is authorized under section 109 and describes the relation to any program set forth by the applicant in an application, if any, submitted pursuant to section 111;

(B) provides such fiscal control and fund accounting procedures as may be necessary to assure proper disbursement of and accounting for Federal funds paid to the applicant under this section; and

(C) provides for making such reports, in such form and containing such information, as the Administrator may require to carry out his functions under this section, and for keeping such records and for affording such access thereto as the Administrator may find necessary to assure the correctness and verification of such reports.

(2) The Administrator shall allocate grants or contracts under section 109 in such manner as will most nearly provide an equitable distribution of the grants or contracts throughout the United States among institutions of higher education which show promise of being able to use funds effectively for the purpose of this section.

(3)(A) Payments under this section may be used in accordance with regulations of the Administrator, and subject to the terms and conditions set forth in an application approved under paragraph (1), to pay part of the compensation of students employed in connection with the operation and maintenance of treatment works, other than as an employee in connection with the operation and maintenance of treatment works or as an employee in any branch of the Government of the United States, as part of a program for which a grant has been approved pursuant to this section.

(B) Departments and agencies of the United States are encouraged, to the extent consistent with efficient Administration, to enter into arrangements with institutions of higher education for the full-time, part-time, or temporary employment, whether in the

competitive or excepted service, of students enrolled in programs set forth in applications approved under paragraph (1).

(33 U.S.C. 1260)

AWARD OF SCHOLARSHIPS

SEC. 111. (1) The Administrator is authorized to award scholarships in accordance with the provisions of this section for undergraduate study by persons who plan to enter an occupation involving the operation and maintenance of treatment works. Such scholarships shall be awarded for such periods as the Administrator may determine but not to exceed four academic years.

(2) The Administrator shall allocate scholarships under this section among institutions of higher education with programs approved under the provisions of this section for the use of individuals accepted into such programs, in such manner and accordance to such plan as will insofar as practicable—

(A) provide an equitable distribution of such scholarships throughout the United States; and

(B) attract recent graduates of secondary schools to enter an occupation involving the operation and maintenance of treatment works.

(3) The Administrator shall approve a program of any institution of higher education for the purposes of this section only upon application by the institution and only upon his finding—

(A) that such program has as a principal objective the education and training of persons in the operation and maintenance of treatment works;

(B) that such program is in effect and of high quality, or can be readily put into effect and may reasonably be expected to be of high quality;

(C) that the application describes the relation of such program to any program, activity, research, or development set forth by the applicant in an application, if any, submitted pursuant to section 110 of this Act; and

(D) that the application contains satisfactory assurances that (i) the institution will recommend to the Administrator for the award of scholarships under this section, for study in such program, only persons who have demonstrated to the satisfaction of the institution a serious intent, upon completing the program, to enter an occupation involving the operation and maintenance of treatment works, and (ii) the institution will make reasonable continuing efforts to encourage recipients of scholarships under this section, enrolled in such program, to enter occupations involving the operation and maintenance of treatment works upon completing the program.

(4)(A) The Administrator shall pay to persons awarded scholarships under this section such stipends (including such allowances for subsistence and other expenses for such persons and their dependents) as he may determine to be consistent with prevailing practices under comparable federally supported programs.

(B) The Administrator shall (in addition to the stipends paid to persons under paragraph (1)) pay to the institution of higher education at which such person is pursuing his course of study

such amount as he may determine to be consistent with prevailing practices under comparable federally supported programs.

(5) A person awarded a scholarship under the provisions of this section shall continue to receive the payments provided in this section only during such periods as the Administrator finds that he is maintaining satisfactory proficiency and devoting full time to study or research in the field in which such scholarship was awarded in an institution of higher education, and is not engaging in gainful employment other than employment approved by the Administrator by or pursuant to regulation.

(6) The Administrator shall by regulation provide that any person awarded a scholarship under this section shall agree in writing to enter and remain in an occupation involving the design, operation, or maintenance of treatment works for such period after completion of his course of studies as the Administrator determines appropriate.

(33 U.S.C. 1261)

DEFINITIONS AND AUTHORIZATIONS

SEC. 112. (a) As used in sections 109 through 112 of this Act—

(1) The term "institution of higher education" means an educational institution described in the first sentence of section 101 of the Higher Education Act of 1965 (other than an institution of any agency of the United States) which is accredited by a nationally recognized accrediting agency or association approved by the Administrator for this purpose. For purposes of this subsection, the Administrator shall publish a list of nationally recognized accrediting agencies or associations which he determines to be reliable authority as to the quality of training offered.

(2) The term "academic year" means an academic year or its equivalent, as determined by the Administrator.

(b) The Administrator shall annually report his activities under sections 109 through 112 of this Act, including recommendations for needed revisions in the provisions thereof.

(c) There are authorized to be appropriated $25,000,000 per fiscal year for fiscal years ending June 30, 1973, June 30, 1974, and June 30, 1975, $6,000,000 for the fiscal year ending September 30, 1977, $7,000,000 for the fiscal year ending September 30, 1978, $7,000,000 for the fiscal year ending September 30, 1979, $7,000,000 for the fiscal year ending September 30, 1980, $7,000,000 for the fiscal year ending September 30, 1981, $7,000,000 for the fiscal year ending September 30, 1982, such sums as may be necessary for fiscal years 1983 through 1985, and $7,000,000 per fiscal year for each of the fiscal years 1986 through 1990, to carry out sections 109 through 112 of this Act.

(33 U.S.C. 1262)

ALASKA VILLAGE DEMONSTRATION PROJECTS

SEC. 113. (a) The Administrator is authorized to enter into agreements with the State of Alaska to carry out one or more projects to demonstrate methods to provide for central community facilities for safe water and elimination or control of pollution in those native villages of Alaska without such facilities. Such project

shall include provisions for community safe water supply systems, toilets, bathing and laundry facilities, sewage disposal facilities, and other similar facilities, and educational and informational facilities and programs relating to health and hygiene. Such demonstration projects shall be for the further purpose of developing preliminary plans for providing such safe water and such elimination or control of pollution for all native villages in such State.

(b) In carrying out this section the Administrator shall cooperate with the Secretary of Health, Education, and Welfare for the purpose of utilizing such of the personnel and facilities of that Department as may be appropriate.

(c) The Administrator shall report to Congress not later than July 1, 1973, the results of the demonstration projects authorized by this section together with his recommendations, including and necessary legislation, relating to the establishment of a statewide program.

(d) There is authorized to be appropriated not to exceed $2,000,000 to carry out this section. In addition, there is authorized to be appropriated to carry out this section not to exceed $200,000 for the fiscal year ending September 30, 1978, and $220,000 for the fiscal year ending September 30, 1979.

(e) The Administrator is authorized to coordinate with the Secretary of the Department of Health, Education, and Welfare, the Secretary of the Department of Housing and Urban Development, the Secretary of the Department of the Interior, the Secretary of the Department of Agriculture, and the heads of any other departments or agencies he may deem appropriate to conduct a joint study with representatives of the State of Alaska and the appropriate Native organizations (as defined in Public Law 92–203) to develop a comprehensive program for achieving adequate sanitation services in Alaska villages. This study shall be coordinated with the programs and projects authorized by sections 104(q) and 105(e)(2) of this Act. The Administrator shall submit a report of the results of the study, together with appropriate supporting data and such recommendations as he deems desirable, to the Committee on Environment and Public Works of the Senate and to the Committee on Public Works and Transportation of the House of Representatives not later than December 31, 1979. The Administrator shall also submit recommended administrative actions, procedures, and any proposed legislation necessary to implement the recommendations of the study no later than June 30, 1980.

(f) The Administrator is authorized to provide technical, financial and management assistance for operation and maintenance of the demonstration projects constructed under this section, until such time as the recommendations of subsection (e) are implemented.

(g) For the purpose of this section, the term "village" shall mean an incorporated or unincorporated community with a population of ten to six hundred people living within a two-mile radius. The term "sanitation services" shall mean water supply, sewage disposal, solid waste disposal and other services necessary to maintain generally accepted standards of personal hygiene and public health.

(33 U.S.C. 1263)

LAKE TAHOE STUDY

SEC. 114. (a) The Administrator, in consultation with the Tahoe Regional Planning Agency, the Secretary of Agriculture, other Federal agencies, representatives of State and local governments, and members of the public, shall conduct a thorough and complete study on the adequacy of and need for extending Federal oversight and control in order to preserve the fragile ecology of Lake Tahoe.

(b) Such study shall include an examination of the interrelationships and responsibilities of the various agencies of the Federal Government and State and local governments with a view to establishing the necessity for redefinition of legal and other arrangements between these various governments, and making specific legislative recommendations to Congress. Such study shall consider the effect of various actions in terms of their environmental impact on the Tahoe Basin, treated as an ecosystem.

(c) The Administrator shall report on such study to Congress not later than one year after the date of enactment of this subsection.

(d) There is authorized to be appropriated to carry out this section not to exceed $500,000.

(33 U.S.C. 1264)

IN-PLACE TOXIC POLLUTANTS

SEC. 115. The Administrator is directed to identify the location of in-place pollutants with emphasis on toxic pollutants in harbors and navigable waterways and is authorized, acting through the Secretary of the Army, to make contracts for the removal and appropriate disposal of such materials from critical port and harbor areas. There is authorized to be appropriated $15,000,000 to carry out the provisions of this section, which sum shall be available until expended.

(33 U.S.C. 1265)

HUDSON RIVER PCB RECLAMATION DEMONSTRATION PROJECT

SEC. 116. (a) The Administrator is authorized to enter into contracts and other agreements with the State of New York to carry out a project to demonstrate methods for the selective removal of polychlorinated biphenyls contaminating bottom sediments of the Hudson River, treating such sediments as required, burying such sediments in secure landfills, and installing monitoring systems for such landfills. Such demonstration project shall be for the purpose of determining the feasibility of indefinite storage in secure landfills of toxic substances and of ascertaining the improvement of the rate of recovery of a toxic contaminated national waterway. No pollutants removed pursuant to this paragraph shall be placed in any landfill unless the Administrator first determines that disposal of the pollutants in such landfill would provide a higher standard of protection of the public health, safety, and welfare than disposal of such pollutants by any other method including, but not limited to, incineration or a chemical destruction process.

(b) The Administrator is authorized to make grants to the State of New York to carry out this section from funds allotted to

such State under section 205(a) of this Act, except that the amount of any such grant shall be equal to 75 per centum of the cost of the project and such grant shall be made on condition that non-Federal sources provide the remainder of the cost of such project. The authority of this section shall be available until September 30, 1983. Funds allotted to the State of New York under section 205(a) shall be available under this subsection only to the extent that funds are not available, as determined by the Administrator, to the State of New York for the work authorized by this section under section 115 or 311 of this Act or a comprehensive hazardous substance response and clean up fund. Any funds used under the authority of this subsection shall be deducted from any estimate of the needs of the State of New York prepared under section 516. The Administrator may not obligate or expend more than $20,000,000 to carry out this section.

(33 U.S.C. 1266)

SEC. 117. CHESAPEAKE BAY.

(a) DEFINITIONS.—In this section, the following definitions apply:

(1) ADMINISTRATIVE COST.—The term "administrative cost" means the cost of salaries and fringe benefits incurred in administering a grant under this section.

(2) CHESAPEAKE BAY AGREEMENT.—The term "Chesapeake Bay Agreement" means the formal, voluntary agreements executed to achieve the goal of restoring and protecting the Chesapeake Bay ecosystem and the living resources of the Chesapeake Bay ecosystem and signed by the Chesapeake Executive Council.

(3) CHESAPEAKE BAY ECOSYSTEM.—The term "Chesapeake Bay ecosystem" means the ecosystem of the Chesapeake Bay and its watershed.

(4) CHESAPEAKE BAY PROGRAM.—The term "Chesapeake Bay Program" means the program directed by the Chesapeake Executive Council in accordance with the Chesapeake Bay Agreement.

(5) CHESAPEAKE EXECUTIVE COUNCIL.—The term "Chesapeake Executive Council" means the signatories to the Chesapeake Bay Agreement.

(6) SIGNATORY JURISDICTION.—The term "signatory jurisdiction" means a jurisdiction of a signatory to the Chesapeake Bay Agreement.

(b) CONTINUATION OF CHESAPEAKE BAY PROGRAM.—

(1) IN GENERAL.—In cooperation with the Chesapeake Executive Council (and as a member of the Council), the Administrator shall continue the Chesapeake Bay Program.

(2) PROGRAM OFFICE.—

(A) IN GENERAL.—The Administrator shall maintain in the Environmental Protection Agency a Chesapeake Bay Program Office.

(B) FUNCTION.—The Chesapeake Bay Program Office shall provide support to the Chesapeake Executive Council by—

(i) implementing and coordinating science, research, modeling, support services, monitoring, data

collection, and other activities that support the Chesapeake Bay Program;

(ii) developing and making available, through publications, technical assistance, and other appropriate means, information pertaining to the environmental quality and living resources of the Chesapeake Bay ecosystem;

(iii) in cooperation with appropriate Federal, State, and local authorities, assisting the signatories to the Chesapeake Bay Agreement in developing and implementing specific action plans to carry out the responsibilities of the signatories to the Chesapeake Bay Agreement;

(iv) coordinating the actions of the Environmental Protection Agency with the actions of the appropriate officials of other Federal agencies and State and local authorities in developing strategies to—

(I) improve the water quality and living resources in the Chesapeake Bay ecosystem; and

(II) obtain the support of the appropriate officials of the agencies and authorities in achieving the objectives of the Chesapeake Bay Agreement; and

(v) implementing outreach programs for public information, education, and participation to foster stewardship of the resources of the Chesapeake Bay.

(c) INTERAGENCY AGREEMENTS.—The Administrator may enter into an interagency agreement with a Federal agency to carry out this section.

(d) TECHNICAL ASSISTANCE AND ASSISTANCE GRANTS.—

(1) IN GENERAL.—In cooperation with the Chesapeake Executive Council, the Administrator may provide technical assistance, and assistance grants, to nonprofit organizations, State and local governments, colleges, universities, and interstate agencies to carry out this section, subject to such terms and conditions as the Administrator considers appropriate.

(2) FEDERAL SHARE.—

(A) IN GENERAL.—Except as provided in subparagraph (B), the Federal share of an assistance grant provided under paragraph (1) shall be determined by the Administrator in accordance with guidance issued by the Administrator.

(B) SMALL WATERSHED GRANTS PROGRAM.—The Federal share of an assistance grant provided under paragraph (1) to carry out an implementing activity under subsection (g)(2) shall not exceed 75 percent of eligible project costs, as determined by the Administrator.

(3) NON-FEDERAL SHARE.—An assistance grant under paragraph (1) shall be provided on the condition that non-Federal sources provide the remainder of eligible project costs, as determined by the Administrator.

(4) ADMINISTRATIVE COSTS.—Administrative costs shall not exceed 10 percent of the annual grant award.

(e) IMPLEMENTATION AND MONITORING GRANTS.—

(1) IN GENERAL.—If a signatory jurisdiction has approved and committed to implement all or substantially all aspects of the Chesapeake Bay Agreement, on the request of the chief executive of the jurisdiction, the Administrator—

(A) shall make a grant to the jurisdiction for the purpose of implementing the management mechanisms established under the Chesapeake Bay Agreement, subject to such terms and conditions as the Administrator considers appropriate; and

(B) may make a grant to a signatory jurisdiction for the purpose of monitoring the Chesapeake Bay ecosystem.

(2) PROPOSALS.—

(A) IN GENERAL.—A signatory jurisdiction described in paragraph (1) may apply for a grant under this subsection for a fiscal year by submitting to the Administrator a comprehensive proposal to implement management mechanisms established under the Chesapeake Bay Agreement.

(B) CONTENTS.—A proposal under subparagraph (A) shall include—

(i) a description of proposed management mechanisms that the jurisdiction commits to take within a specified time period, such as reducing or preventing pollution in the Chesapeake Bay and its watershed or meeting applicable water quality standards or established goals and objectives under the Chesapeake Bay Agreement; and

(ii) the estimated cost of the actions proposed to be taken during the fiscal year.

(3) APPROVAL.—If the Administrator finds that the proposal is consistent with the Chesapeake Bay Agreement and the national goals established under section 101(a), the Administrator may approve the proposal for an award.

(4) FEDERAL SHARE.—The Federal share of a grant under this subsection shall not exceed 50 percent of the cost of implementing the management mechanisms during the fiscal year.

(5) NON-FEDERAL SHARE.—A grant under this subsection shall be made on the condition that non-Federal sources provide the remainder of the costs of implementing the management mechanisms during the fiscal year.

(6) ADMINISTRATIVE COSTS.—Administrative costs shall not exceed 10 percent of the annual grant award.

(7) REPORTING.—On or before October 1 of each fiscal year, the Administrator shall make available to the public a document that lists and describes, in the greatest practicable degree of detail—

(A) all projects and activities funded for the fiscal year;

(B) the goals and objectives of projects funded for the previous fiscal year; and

(C) the net benefits of projects funded for previous fiscal years.

(f) FEDERAL FACILITIES AND BUDGET COORDINATION.—

(1) SUBWATERSHED PLANNING AND RESTORATION.—A Federal agency that owns or operates a facility (as defined by the Administrator) within the Chesapeake Bay watershed shall

participate in regional and subwatershed planning and restoration programs.

(2) COMPLIANCE WITH AGREEMENT.—The head of each Federal agency that owns or occupies real property in the Chesapeake Bay watershed shall ensure that the property, and actions taken by the agency with respect to the property, comply with the Chesapeake Bay Agreement, the Federal Agencies Chesapeake Ecosystem Unified Plan, and any subsequent agreements and plans.

(3) BUDGET COORDINATION.—

(A) IN GENERAL.—As part of the annual budget submission of each Federal agency with projects or grants related to restoration, planning, monitoring, or scientific investigation of the Chesapeake Bay ecosystem, the head of the agency shall submit to the President a report that describes plans for the expenditure of the funds under this section.

(B) DISCLOSURE TO THE COUNCIL.—The head of each agency referred to in subparagraph (A) shall disclose the report under that subparagraph with the Chesapeake Executive Council as appropriate.

(g) CHESAPEAKE BAY PROGRAM.—

(1) MANAGEMENT STRATEGIES.—The Administrator, in coordination with other members of the Chesapeake Executive Council, shall ensure that management plans are developed and implementation is begun by signatories to the Chesapeake Bay Agreement to achieve and maintain—

(A) the nutrient goals of the Chesapeake Bay Agreement for the quantity of nitrogen and phosphorus entering the Chesapeake Bay and its watershed;

(B) the water quality requirements necessary to restore living resources in the Chesapeake Bay ecosystem;

(C) the Chesapeake Bay Basinwide Toxins Reduction and Prevention Strategy goal of reducing or eliminating the input of chemical contaminants from all controllable sources to levels that result in no toxic or bioaccumulative impact on the living resources of the Chesapeake Bay ecosystem or on human health;

(D) habitat restoration, protection, creation, and enhancement goals established by Chesapeake Bay Agreement signatories for wetlands, riparian forests, and other types of habitat associated with the Chesapeake Bay ecosystem; and

(E) the restoration, protection, creation, and enhancement goals established by the Chesapeake Bay Agreement signatories for living resources associated with the Chesapeake Bay ecosystem.

(2) SMALL WATERSHED GRANTS PROGRAM.—The Administrator, in cooperation with the Chesapeake Executive Council, shall—

(A) establish a small watershed grants program as part of the Chesapeake Bay Program; and

(B) offer technical assistance and assistance grants under subsection (d) to local governments and nonprofit or-

ganizations and individuals in the Chesapeake Bay region to implement—

(i) cooperative tributary basin strategies that address the water quality and living resource needs in the Chesapeake Bay ecosystem; and

(ii) locally based protection and restoration programs or projects within a watershed that complement the tributary basin strategies, including the creation, restoration, protection, or enhancement of habitat associated with the Chesapeake Bay ecosystem.

(h) STUDY OF CHESAPEAKE BAY PROGRAM.—

(1) IN GENERAL.—Not later than April 22, 2003, and every 5 years thereafter, the Administrator, in coordination with the Chesapeake Executive Council, shall complete a study and submit to Congress a comprehensive report on the results of the study.

(2) REQUIREMENTS.—The study and report shall—

(A) assess the state of the Chesapeake Bay ecosystem;

(B) compare the current state of the Chesapeake Bay ecosystem with its state in 1975, 1985, and 1995;

(C) assess the effectiveness of management strategies being implemented on the date of enactment of this section and the extent to which the priority needs are being met;

(D) make recommendations for the improved management of the Chesapeake Bay Program either by strengthening strategies being implemented on the date of enactment of this section or by adopting new strategies; and

(E) be presented in such a format as to be readily transferable to and usable by other watershed restoration programs.

(i) SPECIAL STUDY OF LIVING RESOURCE RESPONSE.—

(1) IN GENERAL.—Not later than 180 days after the date of enactment of this section, the Administrator shall commence a 5-year special study with full participation of the scientific community of the Chesapeake Bay to establish and expand understanding of the response of the living resources of the Chesapeake Bay ecosystem to improvements in water quality that have resulted from investments made through the Chesapeake Bay Program.

(2) REQUIREMENTS.—The study shall—

(A) determine the current status and trends of living resources, including grasses, benthos, phytoplankton, zooplankton, fish, and shellfish;

(B) establish to the extent practicable the rates of recovery of the living resources in response to improved water quality condition;

(C) evaluate and assess interactions of species, with particular attention to the impact of changes within and among trophic levels; and

(D) recommend management actions to optimize the return of a healthy and balanced ecosystem in response to improvements in the quality and character of the waters of the Chesapeake Bay.

(j) AUTHORIZATION OF APPROPRIATIONS.—There is authorized to be appropriated to carry out this section $40,000,000 for each of fis-

cal years 2001 through 2005. Such sums shall remain available until expended.

(33 U.S.C. 1267)

SEC. 118. GREAT LAKES.

(a) FINDINGS, PURPOSE, AND DEFINITIONS.—

(1) FINDINGS.—The Congress finds that—

(A) the Great Lakes are a valuable national resource, continuously serving the people of the United States and other nations as an important source of food, fresh water, recreation, beauty, and enjoyment;

(B) the United States should seek to attain the goals embodied in the Great Lakes Water Quality Agreement of 1978, as amended by the Water Quality Agreement of 1987 and any other agreements and amendments, with particular emphasis on goals related to toxic pollutants; and

(C) the Environmental Protection Agency should take the lead in the effort to meet those goals, working with other Federal agencies and State and local authorities.

(2) PURPOSE.—It is the purpose of this section to achieve the goals embodied in the Great Lakes Water Quality Agreement of 1978, as amended by the Water Quality Agreement of 1987 and any other agreements and amendments, through improved organization and definition of mission on the part of the Agency, funding of State grants for pollution control in the Great Lakes area, and improved accountability for implementation of such agreement.

(3) DEFINITIONS.—For purposes of this section, the term—

(A) "Agency" means the Environmental Protection Agency;

(B) "Great Lakes" means Lake Ontario, Lake Erie, Lake Huron (including Lake St. Clair), Lake Michigan, and Lake Superior, and the connecting channels (Saint Mary's River, Saint Clair River, Detroit River, Niagara River, and Saint Lawrence River to the Canadian Border);

(C) "Great Lakes System" means all the streams, rivers, lakes, and other bodies of water within the drainage basin of the Great Lakes;

(D) "Program Office" means the Great Lakes National Program Office established by this section;

(E) "Research Office" means the Great Lakes Research Office established by subsection (d);

(F) "area of concern" means a geographic area located within the Great Lakes, in which beneficial uses are impaired and which has been officially designated as such under Annex 2 of the Great Lakes Water Quality Agreement;

(G) "Great Lakes States" means the States of Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, and Wisconsin;

(H) "Great Lakes Water Quality Agreement" means the bilateral agreement, between the United States and Canada which was signed in 1978 and amended by the Protocol of 1987;

(I) "Lakewide Management Plan" means a written document which embodies a systematic and comprehensive ecosystem approach to restoring and protecting the beneficial uses of the open waters of each of the Great Lakes, in accordance with article VI and Annex 2 of the Great Lakes Water Quality Agreement; and

(J) "Remedial Action Plan" means a written document which embodies a systematic and comprehensive ecosystem approach to restoring and protecting the beneficial uses of areas of concern, in accordance with article VI and Annex 2 of the Great Lakes Water Quality Agreement.

(b) GREAT LAKES NATIONAL PROGRAM OFFICE.—The Great Lakes National Program Office (previously established by the Administrator) is hereby established within the Agency. The Program Office shall be headed by a Director who, by reason of management experience and technical expertise relating to the Great Lakes, is highly qualified to direct the development of programs and plans on a variety of Great Lakes issues. The Great Lakes National Program Office shall be located in a Great Lakes State.

(c) GREAT LAKES MANAGEMENT.—

(1) FUNCTIONS.—The Program Office shall—

(A) in cooperation with appropriate Federal, State, tribal, and international agencies, and in accordance with section 101(e) of this Act, develop and implement specific action plans to carry out the responsibilities of the United States under the Great Lakes Water Quality Agreement of 1978, as amended by the Water Quality Agreement of 1987 and any other agreements and amendments,;[1]

(B) establish a Great Lakes system-wide surveillance network to monitor the water quality of the Great Lakes, with specific emphasis on the monitoring of toxic pollutants;

(C) serve as the liaison with, and provide information to, the Canadian members of the International Joint Commission and the Canadian counterpart to the Agency;

(D) coordinate actions of the Agency (including actions by headquarters and regional offices thereof) aimed at improving Great Lakes water quality; and

(E) coordinate actions of the Agency with the actions of other Federal agencies and State and local authorities, so as to ensure the input of those agencies and authorities in developing water quality strategies and obtain the support of those agencies and authorities in achieving the objectives of such agreement.

(2) GREAT LAKES WATER QUALITY GUIDANCE.—

(A) By June 30, 1991, the Administrator, after consultation with the Program Office, shall publish in the Federal Register for public notice and comment proposed water quality guidance for the Great Lakes System. Such guidance shall conform with the objectives and provisions of the Great Lakes Water Quality Agreement, shall be no less restrictive than the provisions of this Act and national water quality criteria and guidance, shall specify numer-

[1] See P.L. 100–688, section 1008.

ical limits on pollutants in ambient Great Lakes waters to protect human health, aquatic life, and wildlife, and shall provide guidance to the Great Lakes States on minimum water quality standards, antidegradation policies, and implementation procedures for the Great Lakes System.

(B) By June 30, 1992, the Administrator, in consultation with the Program Office, shall publish in the Federal Register, pursuant to this section and the Administrator's authority under this chapter, final water quality guidance for the Great Lakes System.

(C) Within two years after such Great Lakes guidance is published, the Great Lakes States shall adopt water quality standards, antidegradation policies, and implementation procedures for waters within the Great Lakes System which are consistent with such guidance. If a Great Lakes State fails to adopt such standards, policies, and procedures, the Administrator shall promulgate them not later than the end of such two-year period. When reviewing any Great Lakes State's water quality plan, the agency shall consider the extent to which the State has complied with the Great Lakes guidance issued pursuant to this section.

(3) REMEDIAL ACTION PLANS.—

(A) For each area of concern for which the United States has agreed to draft a Remedial Action Plan, the Program Office shall ensure that the Great Lakes State in which such area of concern is located—

(i) submits a Remedial Action Plan to the Program Office by June 30, 1991;

(ii) submits such Remedial Action Plan to the International Joint Commission by January 1, 1992; and

(iii) includes such Remedial Action Plans within the State's water quality plan by January 1, 1993.

(B) For each area of concern for which Canada has agreed to draft a Remedial Action Plan, the Program Office shall, pursuant to subparagraph (c)(1)(C) of this section, work with Canada to assure the submission of such Remedial Action Plans to the International Joint Commission by June 30, 1991, and to finalize such Remedial Action Plans by January 1, 1993.

(C) For any area of concern designated as such subsequent to the enactment of this Act, the Program Office shall (i) if the United States has agreed to draft the Remedial Action Plan, ensure that the Great Lakes State in which such area of concern is located submits such Plan to the Program Office within two years of the area's designation, submits it to the International Joint Commission no later than six months after submitting it to the Program Office, and includes such Plan in the State's water quality plan no later than one year after submitting it to the Commission; and (ii) if Canada has agreed to draft the Remedial Action Plan, work with Canada, pursuant to subparagraph (c)(1)(C) of this section, to ensure the submission of such Plan to the International Joint Commission within

two years of the area's designation and the finalization of such Plan no later than eighteen months after submitting it to such Commission.

(D) The Program Office shall compile formal comments on individual Remedial Action Plans made by the International Joint Commission pursuant to section 4(d) of Annex 2 of the Great Lakes Water Quality Agreement and, upon request by a member of the public, shall make such comments available for inspection and copying. The Program Office shall also make available, upon request, formal comments made by the Environmental Protection Agency on individual Remedial Action Plans.

(E) REPORT.—Not later than 1 year after the date of enactment of this subparagraph, the Administrator shall submit to Congress a report on such actions, time periods, and resources as are necessary to fulfill the duties of the Agency relating to oversight of Remedial Action Plans under—

(i) this paragraph; and

(ii) the Great Lakes Water Quality Agreement.

(4) LAKEWIDE MANAGEMENT PLANS.—The Administrator, in consultation with the Program Office shall—

(A) by January 1, 1992, publish in the Federal Register a proposed Lakewide Management Plan for Lake Michigan and solicit public comments;

(B) by January 1, 1993, submit a proposed Lakewide Management Plan for Lake Michigan to the International Joint Commission for review; and

(C) by January 1, 1994, publish in the Federal Register a final Lakewide Management Plan for Lake Michigan and begin implementation.

Nothing in this subparagraph shall preclude the simultaneous development of Lakewide Management Plans for the other Great Lakes.

(5) SPILLS OF OIL AND HAZARDOUS MATERIALS.—The Program Office, in consultation with the Coast Guard, shall identify areas within the Great Lakes which are likely to experience numerous or voluminous spills of oil or other hazardous materials from land based facilities, vessels, or other sources and, in consultation with the Great Lakes States, shall identify weaknesses in Federal and State programs and systems to prevent and respond to such spills. This information shall be included on at least a biennial basis in the report required by this section.

(6) 5-YEAR PLAN AND PROGRAM.—The Program Office shall develop, in consultation with the States, a five-year plan and program for reducing the amount of nutrients introduced into the Great Lakes. Such program shall incorporate any management program for reducing nutrient runoff from nonpoint sources established under section 319 of this Act and shall include a program for monitoring nutrient runoff into, and ambient levels in, the Great Lakes.

(7) 5-YEAR STUDY AND DEMONSTRATION PROJECTS.—(A) The Program Office shall carry out a five-year study and demonstration projects relating to the control and removal of toxic

pollutants in the Great Lakes, with emphasis on the removal of toxic pollutants from bottom sediments. In selecting locations for conducting demonstration projects under this paragraph, priority consideration shall be given to projects at the following locations: Saginaw Bay, Michigan; Sheboygan Harbor, Wisconsin; Grand Calumet River, Indiana; Ashtabula River, Ohio; and Buffalo River, New York.

(B) The Program Office shall—

(i) by December 31, 1990, complete chemical, physical, and biological assessments of the contaminated sediments at the locations selected for the study and demonstration projects;

(ii) by December 31, 1990, announce the technologies that will be demonstrated at each location and the numerical standard of protection intended to be achieved at each location;

(iii) by December 31, 1992, complete full or pilot scale demonstration projects on site at each location of promising technologies to remedy contaminated sediments; and

(iv) by December 31, 1993, issue a final report to Congress on its findings.

(C) The Administrator, after providing for public review and comment, shall publish information concerning the public health and environmental consequences of contaminants in Great Lakes sediment. Information published pursuant to this subparagraph shall include specific numerical limits to protect health, aquatic life, and wildlife from the bioaccumulation of toxins. The Administrator shall, at a minimum, publish information pursuant to this subparagraph within 2 years of the date of the enactment of this title.

(8) ADMINISTRATOR'S RESPONSIBILITY.—The Administrator shall ensure that the Program Office enters into agreements with the various organizational elements of the Agency involved in Great Lakes activities and the appropriate State agencies specifically delineating—

(A) the duties and responsibilities of each such element in the Agency with respect to the Great Lakes;

(B) the time periods for carrying out such duties and responsibilities; and

(C) the resources to be committed to such duties and responsibilities.

(9) BUDGET ITEM.—The Administrator shall, in the Agency's annual budget submission to Congress, include a funding request for the Program Office as a separate budget line item.

(10) COMPREHENSIVE REPORT.—Within 90 days after the end of each fiscal year, the Administrator shall submit to Congress a comprehensive report which—

(A) describes the achievements in the preceding fiscal year in implementing the Great Lakes Water Quality Agreement of 1978 and shows by categories (including judicial enforcement, research, State cooperative efforts, and general administration) the amounts expended on Great

Lakes water quality initiatives in such preceding fiscal year;

(B) describes the progress made in such preceding fiscal year in implementing the system of surveillance of the water quality in the Great Lakes System, including the monitoring of groundwater and sediment, with particular reference to toxic pollutants;

(C) describes the long-term prospects for improving the condition of the Great Lakes; and

(D) provides a comprehensive assessment of the planned efforts to be pursued in the succeeding fiscal year for implementing the Great Lakes Water Quality Agreement of 1978, which assessment shall—

(i) show by categories (including judicial enforcement, research, State cooperative efforts, and general administration) the amount anticipated to be expended on Great Lakes water quality initiatives in the fiscal year to which the assessment relates; and

(ii) include a report of current programs administered by other Federal agencies which make available resources to the Great Lakes water quality management efforts.

(11) CONFINED DISPOSAL FACILITIES.—(A) The Administrator, in consultation with the Assistant Secretary of the Army for Civil Works, shall develop and implement, within one year of the date of enactment of this paragraph, management plans for every Great Lakes confined disposal facility.

(B) The plan shall provide for monitoring of such facilities, including—

(i) water quality at the site and in the area of the site;

(ii) sediment quality at the site and in the area of the site;

(iii) the diversity, productivity, and stability of aquatic organisms at the site and in the area of the site; and

(iv) such other conditions as the Administrator deems appropriate.

(C) The plan shall identify the anticipated use and management of the site over the following twenty-year period including the expected termination of dumping at the site, the anticipated need for site management, including pollution control, following the termination of the use of the site.

(D) The plan shall identify a schedule for review and revision of the plan which shall not be less frequent than five years after adoption of the plan and every five years thereafter.

(12) REMEDIATION OF SEDIMENT CONTAMINATION IN AREAS OF CONCERN.—

(A) IN GENERAL.—In accordance with this paragraph, the Administrator, acting through the Program Office, may carry out projects that meet the requirements of subparagraph (B).

(B) ELIGIBLE PROJECTS.—A project meets the requirements of this subparagraph if the project is to be carried out in an area of concern located wholly or partially in the United States and the project—

(i) monitors or evaluates contaminated sediment;

(ii) subject to subparagraph (D), implements a plan to remediate contaminated sediment; or

(iii) prevents further or renewed contamination of sediment.

(C) PRIORITY.—In selecting projects to carry out under this paragraph, the Administrator shall give priority to a project that—

(i) constitutes remedial action for contaminated sediment;

(ii)(I) has been identified in a Remedial Action Plan submitted under paragraph (3); and

(II) is ready to be implemented;

(iii) will use an innovative approach, technology, or technique that may provide greater environmental benefits, or equivalent environmental benefits at a reduced cost; or

(iv) includes remediation to be commenced not later than 1 year after the date of receipt of funds for the project.

(D) LIMITATION.—The Administrator may not carry out a project under this paragraph for remediation of contaminated sediments located in an area of concern—

(i) if an evaluation of remedial alternatives for the area of concern has not been conducted, including a review of the short-term and long-term effects of the alternatives on human health and the environment; or

(ii) if the Administrator determines that the area of concern is likely to suffer significant further or renewed contamination from existing sources of pollutants causing sediment contamination following completion of the project.

(E) NON-FEDERAL SHARE.—

(i) IN GENERAL.—The non-Federal share of the cost of a project carried out under this paragraph shall be at least 35 percent.

(ii) IN-KIND CONTRIBUTIONS.—The non-Federal share of the cost of a project carried out under this paragraph may include the value of in-kind services contributed by a non-Federal sponsor.

(iii) NON-FEDERAL SHARE.—The non-Federal share of the cost of a project carried out under this paragraph—

(I) may include monies paid pursuant to, or the value of any in-kind service performed under, an administrative order on consent or judicial consent decree; but

(II) may not include any funds paid pursuant to, or the value of any in-kind service performed under, a unilateral administrative order or court order.

(iv) OPERATION AND MAINTENANCE.—The non-Federal share of the cost of the operation and maintenance of a project carried out under this paragraph shall be 100 percent.

(F) MAINTENANCE OF EFFORT.—The Administrator may not carry out a project under this paragraph unless the non-Federal sponsor enters into such agreements with the Administrator as the Administrator may require to ensure that the non-Federal sponsor will maintain its aggregate expenditures from all other sources for remediation programs in the area of concern in which the project is located at or above the average level of such expenditures in the 2 fiscal years preceding the date on which the project is initiated.

(G) COORDINATION.—In carrying out projects under this paragraph, the Administrator shall coordinate with the Secretary of the Army, and with the Governors of States in which the projects are located, to ensure that Federal and State assistance for remediation in areas of concern is used as efficiently as practicable.

(H) AUTHORIZATION OF APPROPRIATIONS.—

(i) IN GENERAL.—In addition to other amounts authorized under this section, there is authorized to be appropriated to carry out this paragraph $50,000,000 for each of fiscal years 2004 through 2008.

(ii) AVAILABILITY.—Funds made available under clause (i) shall remain available until expended.

(13) PUBLIC INFORMATION PROGRAM.—

(A) IN GENERAL.—The Administrator, acting through the Program Office and in coordination with States, Indian tribes, local governments, and other entities, may carry out a public information program to provide information relating to the remediation of contaminated sediment to the public in areas of concern that are located wholly or partially in the United States.

(B) AUTHORIZATION OF APPROPRIATIONS.—There is authorized to be appropriated to carry out this paragraph $1,000,000 for each of fiscal years 2004 through 2008.

(d) GREAT LAKES RESEARCH.—

(1) ESTABLISHMENT OF RESEARCH OFFICE.—There is established within the National Oceanic and Atmospheric Administration the Great Lakes Research Office.

(2) IDENTIFICATION OF ISSUES.—The Research Office shall identify issues relating to the Great Lakes resources on which research is needed. The Research Office shall submit a report to Congress on such issues before the end of each fiscal year which shall identify any changes in the Great Lakes system with respect to such issues.

(3) INVENTORY.—The Research Office shall identify and inventory, Federal, State, university, and tribal environmental research programs (and, to the extent feasible, those of private organizations and other nations) relating to the Great Lakes system, and shall update that inventory every four years.

(4) RESEARCH EXCHANGE.—The Research Office shall establish a Great Lakes research exchange for the purpose of facilitating the rapid identification, acquisition, retrieval, dissemination, and use of information concerning research projects which are ongoing or completed and which affect the Great Lakes system.

(5) RESEARCH PROGRAM.—The Research Office shall develop, in cooperation with the Coordination Office, a comprehensive environmental research program and data base for the Great Lakes system. The data base shall include, but not be limited to, data relating to water quality, fisheries, and biota.

(6) MONITORING.—The Research Office shall conduct, through the Great Lakes Environmental Research Laboratory, the National Sea Grant College program, other Federal laboratories, and the private sector, appropriate research and monitoring activities which address priority issues and current needs relating to the Great Lakes.

(7) LOCATION.—The Research Office shall be located in a Great Lakes State.

(e) RESEARCH AND MANAGEMENT COORDINATION.—

(1) JOINT PLAN.—Before October 1 of each year, the Program Office and the Research Office shall prepare a joint research plan for the fiscal year which begins in the following calendar year.

(2) CONTENTS OF PLAN.—Each plan prepared under paragraph (1) shall—

(A) identify all proposed research dedicated to activities conducted under the Great Lakes Water Quality Agreement of 1978;

(B) include the Agency's assessment of priorities for research needed to fulfill the terms of such Agreement; and

(C) identify all proposed research that may be used to develop a comprehensive environmental data base for the Great Lakes system and establish priorities for development of such data base.

(3) HEALTH RESEARCH REPORT.—(A) Not later than September 30, 1994, the Program Office, in consultation with the Research Office, the Agency for Toxic Substances and Disease Registry, and Great Lakes States shall submit to the Congress a report assessing the adverse effects of water pollutants in the Great Lakes System on the health of persons in Great Lakes States and the health of fish, shellfish, and wildlife in the Great Lakes System. In conducting research in support of this report, the Administrator may, where appropriate, provide for research to be conducted under cooperative agreements with Great Lakes States.

(B) There is authorized to be appropriated to the Administrator to carry out this section not to exceed $3,000,000 for each of fiscal years 1992, 1993, and 1994.

(f) INTERAGENCY COOPERATION.—The head of each department, agency, or other instrumentality of the Federal Government which is engaged in, is concerned with, or has authority over programs relating to research, monitoring, and planning to maintain, enhance, preserve, or rehabilitate the environmental quality and natural resources of the Great Lakes, including the Chief of Engineers of the Army, the Chief of the Soil Conservation Service, the Commandant of the Coast Guard, the Director of the Fish and Wildlife Service, and the Administrator of the National Oceanic and Atmospheric Administration, shall submit an annual report to the Ad-

ministrator with respect to the activities of that agency or office affecting compliance with the Great Lakes Water Quality Agreement of 1978.

(g) RELATIONSHIP TO EXISTING FEDERAL AND STATE LAWS AND INTERNATIONAL TREATIES.—Nothing in this section shall be construed—

(1) to affect the jurisdiction, powers, or prerogatives of any department, agency, or officer of the Federal Government or of any State government, or of any tribe, nor any powers, jurisdiction, or prerogatives of any international body created by treaty with authority relating to the Great Lakes; or

(2) to affect any other Federal or State authority that is being used or may be used to facilitate the cleanup and protection of the Great Lakes.

(h) AUTHORIZATIONS OF GREAT LAKES APPROPRIATIONS.—There are authorized to be appropriated to the Administrator to carry out this section not to exceed—

(1) $11,000,000 per fiscal year for the fiscal years 1987, 1988, 1989, and 1990, and $25,000,000 for fiscal year 1991;

(2) such sums as are necessary for each of fiscal years 1992 through 2003; and

(3) $25,000,000 for each of fiscal years 2004 through 2008.

(33 U.S.C. 1268)

SEC. 119. LONG ISLAND SOUND.—(a) The Administrator shall continue the Management Conference of the Long Island Sound Study (hereinafter referred to as the "Conference") as established pursuant to section 320 of this Act, and shall establish an office (hereinafter referred to as the "Office") to be located on or near Long Island Sound.

(b) ADMINISTRATION AND STAFFING OF OFFICE.—The Office shall be headed by a Director, who shall be detailed by the Administrator, following consultation with the Administrators of EPA regions I and II, from among the employees of the Agency who are in civil service. The Administrator shall delegate to the Director such authority and detail such additional staff as may be necessary to carry out the duties of the Director under this section.

(c) DUTIES OF THE OFFICE.—The Office shall assist the Management Conference of the Long Island Sound Study in carrying out its goals. Specifically, the Office shall—

(1) assist and support the implementation of the Comprehensive Conservation and Management Plan for Long Island Sound developed pursuant to section 320 of this Act, including efforts to establish, within the process for granting watershed general permits, a system for promoting innovative methodologies and technologies that are cost-effective and consistent with the goals of the Plan;

(2) conduct or commission studies deemed necessary for strengthened implementation of the Comprehensive Conservation and Management Plan including, but not limited to—

(A) population growth and the adequacy of wastewater treatment facilities,

(B) the use of biological methods for nutrient removal in sewage treatment plants,

(C) contaminated sediments, and dredging activities,

(D) nonpoint source pollution abatement and land use activities in the Long Island Sound watershed,

(E) wetland protection and restoration,

(F) atmospheric deposition of acidic and other pollutants into Long Island Sound,

(G) water quality requirements to sustain fish, shellfish, and wildlife populations, and the use of indicator species to assess environmental quality,

(H) State water quality programs, for their adequacy pursuant to implementation of the Comprehensive Conservation and Management Plan, and

(I) options for long-term financing of wastewater treatment projects and water pollution control programs.

(3) coordinate the grant, research and planning programs authorized under this section;

(4) coordinate activities and implementation responsibilities with other Federal agencies which have jurisdiction over Long Island Sound and with national and regional marine monitoring and research programs established pursuant to the Marine Protection, Research, and Sanctuaries Act;

(5) provide administrative and technical support to the conference;

(6) collect and make available to the public publications, and other forms of information the conference determines to be appropriate, relating to the environmental quality of Long Island Sound;

(7) not more than two years after the date of the issuance of the final Comprehensive Conservation and Management Plan for Long Island Sound under section 320 of this Act, and biennially thereafter, issue a report to the Congress which—

(A) summarizes the progress made by the States in implementing the Comprehensive Conservation and Management Plan;

(B) summarizes any modifications to the Comprehensive Conservation and Management Plan in the twelve-month period immediately preceding such report; and

(C) incorporates specific recommendations concerning the implementation of the Comprehensive Conservation and Management Plan; and

(8) convene conferences and meetings for legislators from State governments and political subdivisions thereof for the purpose of making recommendations for coordinating legislative efforts to facilitate the environmental restoration of Long Island Sound and the implementation of the Comprehensive Conservation and Management Plan.

(d) GRANTS.—(1) The Administrator is authorized to make grants for projects and studies which will help implement the Long Island Sound Comprehensive Conservation and Management Plan. Special emphasis shall be given to implementation, research and planning, enforcement, and citizen involvement and education.

(2) State, interstate, and regional water pollution control agencies, and other public or nonprofit private agencies, institutions, and organizations held to be eligible for grants pursuant to this subsection.

(3) Citizen involvement and citizen education grants under this subsection shall not exceed 95 per centum of the costs of such work. All other grants under this subsection shall not exceed 50 per centum of the research, studies, or work. All grants shall be made on the condition that the non-Federal share of such costs are provided from non-Federal sources.

(e) ASSISTANCE TO DISTRESSED COMMUNITIES.—

(1) ELIGIBLE COMMUNITIES.—For the purposes of this subsection, a distressed community is any community that meets affordability criteria established by the State in which the community is located, if such criteria are developed after public review and comment.

(2) PRIORITY.—In making assistance available under this section for the upgrading of wastewater treatment facilities, the Administrator may give priority to a distressed community.

(f) AUTHORIZATIONS.—(1) There is authorized to be appropriated to the Administrator for the implementation of this section, other than subsection (d), such sums as may be necessary for each of the fiscal years 2001 through 2005.

(2) There is authorized to be appropriated to the Administrator for the implementation of subsection (d) not to exceed $40,000,000 for each of fiscal years 2001 through 2005.

(33 U.S.C. 1269)

SEC. 120. LAKE CHAMPLAIN BASIN PROGRAM.

(a) ESTABLISHMENT.—

(1) IN GENERAL.—There is established a Lake Champlain Management Conference to develop a comprehensive pollution prevention, control, and restoration plan for Lake Champlain. The Administrator shall convene the management conference within ninety days of the date of enactment of this section.

(2) IMPLEMENTATION.—The Administrator—

(A) may provide support to the State of Vermont, the State of New York, and the New England Interstate Water Pollution Control Commission for the implementation of the Lake Champlain Basin Program; and

(B) shall coordinate actions of the Environmental Protection Agency under subparagraph (A) with the actions of other appropriate Federal agencies.

(b) MEMBERSHIP.—The Members of the Management Conference shall be comprised of—

(1) the Governors of the States of Vermont and New York;

(2) each interested Federal agency, not to exceed a total of five members;

(3) the Vermont and New York Chairpersons of the Vermont, New York, Quebec Citizens Advisory Committee for the Environmental Management of Lake Champlain;

(4) four representatives of the State legislature of Vermont;

(5) four representatives of the State legislature of New York;

(6) six persons representing local governments having jurisdiction over any land or water within the Lake Champlain basin, as determined appropriate by the Governors; and

(7) eight persons representing affected industries, nongovernmental organizations, public and private educational institutions, and the general public, as determined appropriate by the trigovernmental Citizens Advisory Committee for the Environmental Management of Lake Champlain, but not to be current members of the Citizens Advisory Committee.

(c) TECHNICAL ADVISORY COMMITTEE.—(1) The Management Conference shall, not later than one hundred and twenty days after the date of enactment of this section, appoint a Technical Advisory Committee.

(2) Such Technical Advisory Committee shall consist of officials of: appropriate departments and agencies of the Federal Government; the State governments of New York and Vermont; and governments of political subdivisions of such States; and public and private research institutions.

(d) RESEARCH PROGRAM.—The Management Conference shall establish a multi-disciplinary environmental research program for Lake Champlain. Such research program shall be planned and conducted jointly with the Lake Champlain Research Consortium.

(e) POLLUTION PREVENTION, CONTROL, AND RESTORATION PLAN.—(1) Not later than three years after the date of the enactment of this section, the Management Conference shall publish a pollution prevention, control, and restoration plan for Lake Champlain.

(2) The Plan developed pursuant to this section shall—

(A) identify corrective actions and compliance schedules addressing point and nonpoint sources of pollution necessary to restore and maintain the chemical, physical, and biological integrity of water quality, a balanced, indigenous population of shellfish, fish and wildlife, recreational, and economic activities in and on the lake;

(B) incorporate environmental management concepts and programs established in State and Federal plans and programs in effect at the time of the development of such plan;

(C) clarify the duties of Federal and State agencies in pollution prevention and control activities, and to the extent allowable by law, suggest a timetable for adoption by the appropriate Federal and State agencies to accomplish such duties within a reasonable period of time;

(D) describe the methods and schedules for funding of programs, activities, and projects identified in the Plan, including the use of Federal funds and other sources of funds;

(E) include a strategy for pollution prevention and control that includes the promotion of pollution prevention and management practices to reduce the amount of pollution generated in the Lake Champlain basin; and

(F) be reviewed and revised, as necessary, at least once every 5 years, in consultation with the Administrator and other appropriate Federal agencies.

(3) The Administrator, in cooperation with the Management Conference, shall provide for public review and comment on the draft Plan. At a minimum, the Management Conference shall conduct one public meeting to hear comments on the draft plan in the State of New York and one such meeting in the State of Vermont.

(4) Not less than one hundred and twenty days after the publication of the Plan required pursuant to this section, the Administrator shall approve such plan if the plan meets the requirements of this section and the Governors of the States of New York and Vermont concur.

(5) Upon approval of the plan, such plan shall be deemed to be an approved management program for the purposes of section 319(h) of this Act and such plan shall be deemed to be an approved comprehensive conservation and management plan pursuant to section 320 of this Act.

(f) GRANT ASSISTANCE.—(1) The Administrator may, in consultation with participants in the Lake Champlain Basin Program, make grants to State, interstate, and regional water pollution control agencies, and public or nonprofit agencies, institutions, and organizations.

(2) Grants under this subsection shall be made for assisting research, surveys, studies, and modeling and technical and supporting work necessary for the development and implementation of the Plan.

(3) The amount of grants to any person under this subsection for a fiscal year shall not exceed 75 per centum of the costs of such research, survey, study and work and shall be made available on the condition that non-Federal share of such costs are provided from non-Federal sources.

(4) The Administrator may establish such requirements for the administration of grants as he determines to be appropriate.

(g) DEFINITIONS.—In this section:

(1) LAKE CHAMPLAIN BASIN PROGRAM.—The term "Lake Champlain Basin Program" means the coordinated efforts among the Federal Government, State governments, and local governments to implement the Plan.

(2) LAKE CHAMPLAIN DRAINAGE BASIN.—The term "Lake Champlain drainage basin" means all or part of Clinton, Franklin, Warren, Essex, and Washington counties in the State of New York and all or part of Franklin, Hamilton, Grand Isle, Chittenden, Addison, Rutland, Bennington, Lamoille, Orange, Washington, Orleans, and Caledonia counties in Vermont, that contain all of the streams, rivers, lakes, and other bodies of water, including wetlands, that drain into Lake Champlain.

(3) PLAN.—The term "Plan" means the plan developed under subsection (e).

(h) NO EFFECT ON CERTAIN AUTHORITY.—Nothing in this section—

(1) affects the jurisdiction or powers of—

(A) any department or agency of the Federal Government or any State government; or

(B) any international organization or entity related to Lake Champlain created by treaty or memorandum to which the United States is a signatory;

(2) provides new regulatory authority for the Environmental Protection Agency; or

(3) affects section 304 of the Great Lakes Critical Programs Act of 1990 (Public Law 101–596; 33 U.S.C. 1270 note).

(i) AUTHORIZATION.—There are authorized to be appropriated to the Environmental Protection Agency to carry out this section—

(1) $2,000,000 for each of fiscal years 1991, 1992, 1993, 1994, and 1995;

(2) such sums as are necessary for each of fiscal years 1996 through 2003; and

(3) $11,000,000 for each of fiscal years 2004 through 2008.

(33 U.S.C. 1270)

SEC. 121. LAKE PONTCHARTRAIN BASIN.

(a) ESTABLISHMENT OF RESTORATION PROGRAM.—The Administrator shall establish within the Environmental Protection Agency the Lake Pontchartrain Basin Restoration Program.

(b) PURPOSE.—The purpose of the program shall be to restore the ecological health of the Basin by developing and funding restoration projects and related scientific and public education projects.

(c) DUTIES.—In carrying out the program, the Administrator shall—

(1) provide administrative and technical assistance to a management conference convened for the Basin under section 320;

(2) assist and support the activities of the management conference, including the implementation of recommendations of the management conference;

(3) support environmental monitoring of the Basin and research to provide necessary technical and scientific information;

(4) develop a comprehensive research plan to address the technical needs of the program;

(5) coordinate the grant, research, and planning programs authorized under this section; and

(6) collect and make available to the public publications, and other forms of information the management conference determines to be appropriate, relating to the environmental quality of the Basin.

(d) GRANTS.—The Administrator may make grants—

(1) for restoration projects and studies recommended by a management conference convened for the Basin under section 320; and

(2) for public education projects recommended by the management conference.

(e) DEFINITIONS.—In this section, the following definitions apply:

(1) BASIN.—The term ''Basin'' means the Lake Pontchartrain Basin, a 5,000 square mile watershed encompassing 16 parishes in the State of Louisiana and 4 counties in the State of Mississippi.

(2) PROGRAM.—The term ''program'' means the Lake Pontchartrain Basin Restoration Program established under subsection (a).

(f) AUTHORIZATION OF APPROPRIATIONS.—

(1) IN GENERAL.—There is authorized to be appropriated to carry out this section $20,000,000 for each of fiscal years 2001

through 2005. Such sums shall remain available until expended.

(2) PUBLIC EDUCATION PROJECTS.—Not more than 15 percent of the amount appropriated pursuant to paragraph (1) in a fiscal year may be expended on grants for public education projects under subsection (d)(2).

(33 U.S.C. 1273)

SEC. 121. WET WEATHER WATERSHED PILOT PROJECTS.[1]

(a) IN GENERAL.—The Administrator, in coordination with the States, may provide technical assistance and grants for treatment works to carry out pilot projects relating to the following areas of wet weather discharge control:

(1) WATERSHED MANAGEMENT OF WET WEATHER DISCHARGES.—The management of municipal combined sewer overflows, sanitary sewer overflows, and stormwater discharges, on an integrated watershed or subwatershed basis for the purpose of demonstrating the effectiveness of a unified wet weather approach.

(2) STORMWATER BEST MANAGEMENT PRACTICES.—The control of pollutants from municipal separate storm sewer systems for the purpose of demonstrating and determining controls that are cost-effective and that use innovative technologies in reducing such pollutants from stormwater discharges.

(b) ADMINISTRATION.—The Administrator, in coordination with the States, shall provide municipalities participating in a pilot project under this section the ability to engage in innovative practices, including the ability to unify separate wet weather control efforts under a single permit.

(c) FUNDING.—

(1) IN GENERAL.—There is authorized to be appropriated to carry out this section $10,000,000 for fiscal year 2002, $15,000,000 for fiscal year 2003, and $20,000,000 for fiscal year 2004. Such funds shall remain available until expended.

(2) STORMWATER.—The Administrator shall make available not less than 20 percent of amounts appropriated for a fiscal year pursuant to this subsection to carry out the purposes of subsection (a)(2).

(3) ADMINISTRATIVE EXPENSES.—The Administrator may retain not to exceed 4 percent of any amounts appropriated for a fiscal year pursuant to this subsection for the reasonable and necessary costs of administering this section.

(d) REPORT TO CONGRESS.—Not later than 5 years after the date of enactment of this section, the Administrator shall transmit to Congress a report on the results of the pilot projects conducted under this section and their possible application nationwide.

(33 U.S.C. 1274)

[1] The second section 121 was added by section 112(b) of the Miscellaneous Appropriations Act, 2001 (114 Stat. 2763A–225), as enacted into law by section 1(a)(6) of Public Law 106–554 (114 Stat. 2763).

TITLE II—GRANTS FOR CONSTRUCTION OF TREATMENT WORKS

PURPOSE

SEC. 201. (a) It is the purpose of this title to require and to assist the development and implementation of waste treatment management plans and practices which will achieve the goals of this Act.

(b) Waste treatment management plans and practices shall provide for the application of the best practicable waste treatment technology before any discharge into receiving waters, including reclaiming and recycling of water, and confined disposal of pollutants so they will not migrate to cause water or other environmental pollution and shall provide for consideration of advanced waste treatment techniques.

(c) To the extent practicable, waste treatment management shall be on an areawide basis and provide control or treatment of all point and nonpoint sources of pollution, including in place or accumulated pollution sources.

(d) The Administrator shall encourage waste treatment management which results in the construction of revenue producing facilities providing for—

(1) the recycling of potential sewage pollutants through the production of agriculture, silviculture, or aquaculture products, or any combination thereof;

(2) the confined and contained disposal of pollutants not recycled;

(3) the reclamation of wastewater; and

(4) the ultimate disposal of sludge in a manner that will not result in environmental hazards.

(e) The Administrator shall encourage waste treatment management which results in integrating facilities for sewage treatment and recycling with facilities to treat, dispose of, or utilize other industrial and municipal wastes, including but not limited to solid waste and waste heat and thermal discharges. Such integrated facilities shall be designed and operated to produce revenues in excess of capital and operation and maintenance costs and such revenues shall be used by the designated regional management agency to aid in financing other environmental improvement programs.

(f) The Administrator shall encourage waste treatment management which combines "open space" and recreational considerations with such management.

(g)(1) The Administrator is authorized to make grants to any State, municipality, or intermunicipal or interstate agency for the construction of publicly owned treatment works. On and after October 1, 1984, grants under this title shall be made only for projects for secondary treatment or more stringent treatment, or any cost effective alternative thereto, new interceptors and appurtenances, and infiltration-in-flow correction. Notwithstanding the preceding sentences, the Administrator may make grants on and after October 1, 1984, for (A) any project within the definition set forth in section 212(2) of this Act, other than for a project referred to in the preceding sentence, and (B) any purpose for which a grant may be

made under sections [1] 319 (h) and (i) of this Act (including any innovative and alternative approaches for the control of nonpoint sources of pollution), except that not more than 20 per centum (as determined by the Governor of the State) of the amount allotted to a State under section 205 of this Act for any fiscal year shall be obligated in such State under authority of this sentence.

(2) The Administrator shall not make grants from funds authorized for any fiscal year beginning after June 30, 1974, to any State, municipality, or intermunicipal or interstate agency for the erection, building, acquisition, alteration, remodeling, improvement, or extension of treatment works unless the grant applicant has satisfactorily demonstrated to the Administrator that—

(A) alternative waste management techniques have been studied and evaluated and the works proposed for grant assistance will provide for the application of the best practicable waste treatment technology over the life of the works consistent with the purposes of this title; and

(B) as appropriate, the works proposed for grant assistance will take into account and allow to the extent practicable the application of technology at a later date which will provide for the reclaiming or recycling of water or otherwise eliminate the discharge of pollutants.

(3) The Administrator shall not approve any grant after July 1, 1973, for treatment works under this section unless the applicant shows to the satisfaction of the Administrator that each sewer collection system discharging into such treatment works is not subject to excessive infiltration.

(4) The Administrator is authorized to make grants to applicants for treatment works grants under this section for such sewer system evaluation studies as may be necessary to carry out the requirements of paragraph (3) of this subsection. Such grants shall be made in accordance with rules and regulations promulgated by the Administrator. Initial rules and regulations shall be promulgated under this paragraph not later than 120 days after the date of enactment of the Federal Water Pollution Control Act Amendments of 1972.

(5) The Administrator shall not make grants from funds authorized for any fiscal year beginning after September 30, 1978, to any State, municipality, or intermunicipal or interstate agency for the erection, building, acquisition, alteration, remodeling, improvement, or extension of treatment works unless the grant applicant has satisfactorily demonstrated to the Administrator that innovative and alternative wastewater treatment processes and techniques which provide for the reclaiming and reuse of water, otherwise eliminate the discharge of pollutants, and utilize recycling techniques, land treatment, new or improved methods of waste treatment management for municipal and industrial waste (discharged into municipal systems) and the confined disposal of pollutants, so that pollutants will not migrate to cause water or other environmental pollution, have been fully studied and evaluated by the applicant taking into account section 201(d) of this Act and taking into account and allowing to the extent practicable the more efficient use of energy and resources.

[1] So in original. Probably should be "section".

(6) The Administrator shall not make grants from funds authorized for any fiscal year beginning after September 30, 1978, to any State, municipality, or intermunicipal or interstate agency for the erection, building, acquisition, alteration, remodeling, improvement, or extension of treatment works unless the grant applicant has satisfactorily demonstrated to the Administrator that the applicant has analyzed the potential recreation and open space opportunities in the planning of the proposed treatment works.

(h) A grant may be made under this section to construct a privately owned treatment works serving one or more principal residences or small commercial establishments constructed prior to, and inhabited on the date of enactment of this subsection where the Administrator finds that—

(1) a public body otherwise eligible for a grant under subsection (g) of this section has applied on behalf of a number of such units and certified that public ownership of such works is not feasible;

(2) such public body has entered into an agreement with the Administrator which guarantees that such treatment works will be properly operated and maintained and will comply with all other requirements of section 204 of this Act and includes a system of charges to assure that each recipient of waste treatment services under such a grant will pay its proportionate share of the cost of operation and maintenance (including replacement); and

(3) the total cost and environmental impact of providing waste treatment services to such residences or commercial establishments will be less than the cost of providing a system of collection and central treatment of such wastes.

(i) The Administrator shall encourage waste treatment management methods, processes, and techniques which will reduce total energy requirements.

(j) The Administrator is authorized to make a grant for any treatment works utilizing processes and techniques meeting the guidelines promulgated under section 304(d)(3) of this Act, if the Administrator determines it is in the public interest and if in the cost effectiveness study made of the construction grant application for the purpose of evaluating alternative treatment works, the life cycle cost of the treatment works for which the grant is to be made does not exceed the life cycle cost of the most effective alternative by more than 15 per centum.

(k) No grant made after November 15, 1981, for a publicly owned treatment works, other than for facility planning and the preparation of construction plans and specifications, shall be used to treat, store, or convey the flow of any industrial user into such treatment works in excess of a flow per day equivalent to fifty thousand gallons per day of sanitary waste. This subsection shall not apply to any project proposed by a grantee which is carrying out an approved project to prepare construction plans and specifications for a facility to treat wastewater, which received its grant approval before May 15, 1980. This subsection shall not be in effect after November 15, 1981.

(l)(1) After the date of enactment of this subsection, Federal grants shall not be made for the purpose of providing assistance solely for facility plans, or plans, specifications, and estimates for

any proposed project for the construction of treatment works. In the event that the proposed project receives a grant under this section for construction, the Administrator shall make an allowance in such grant for non-Federal funds expended during the facility planning and advanced engineering and design phase at the prevailing Federal share under section 202(a) of this Act, based on the percentage of total project costs which the Administrator determines is the general experience for such projects.

(2)(A) Each State shall use a portion of the funds allotted to such State each fiscal year, but not to exceed 10 per centum of such funds, to advance to potential grant applicants under this title the costs of facility planning or the preparation of plans, specifications, and estimates.

(B) Such an advance shall be limited to the allowance for such costs which the Administrator establishes under paragraph (1) of this subsection, and shall be provided only to a potential grant applicant which is a small community and which in the judgment of the State would otherwise be unable to prepare a request for a grant for construction costs under this section.

(C) In the event a grant for construction costs is made under this section for a project for which an advance has been made under this paragraph, the Administrator shall reduce the amount of such grant by the allowance established under paragraph (1) of this subsection. In the event no such grant is made, the State is authorized to seek repayment of such advance on such terms and conditions as it may determine.

(m)(1) Notwithstanding any other provisions of this title, the Administrator is authorized to make a grant from any funds otherwise allotted to the State of California under section 205 of this Act to the project (and in the amount) specified in Order WQG 81–1 of the California State Water Resources Control Board.

(2) Notwithstanding any other provision of this Act, the Administrator shall make a grant from any funds otherwise allotted to the State of California to the city of Eureka, California, in connection with project numbered C–06–2772, for the purchase of one hundred and thirty-nine acres of property as environmental mitigation for siting of the proposed treatment plant.

(3) Notwithstanding any other provision of this Act, the Administrator shall make a grant from any funds otherwise allotted to the State of California to the city of San Diego, California, in connection with that city's aquaculture sewage process (total resources recovery system) as an innovative and alternative waste treatment process.

(n)(1) On and after October 1, 1984, upon the request of the Governor of an affected State, the Administrator is authorized to use funds available to such State under section 205 to address water quality problems due to the impacts of discharges from combined storm water and sanitary sewer overflows, which are not otherwise eligible under this subsection, where correction of such discharges is a major priority for such State.

(2) Beginning fiscal year 1983, the Administrator shall have available $200,000,000 per fiscal year in addition to those funds authorized in section 207 of this Act to be utilized to address water quality problems of marine bays and estuaries subject to lower levels of water quality due to the impacts of discharges from combined

storm water and sanitary sewer overflows from adjacent urban complexes, not otherwise eligible under this subsection. Such sums may be used as deemed appropriate by the Administrator as provided in paragraphs (1) and (2) of this subsection, upon the request of and demonstration of water quality benefits by the Governor of an affected State.

(o) The Administrator shall encourage and assist applicants for grant assistance under this title to develop and file with the Administrator a capital financing plan which, at a minimum—

(1) projects the future requirements for waste treatment services within the applicant's jurisdiction for a period of no less than ten years;

(2) projects the nature, extent, timing, and costs of future expansion and reconstruction of treatment works which will be necessary to satisfy the applicant's projected future requirements for waste treatment services; and

(3) sets forth with specificity the manner in which the applicant intends to finance such future expansion and reconstruction.

(p) TIME LIMIT ON RESOLVING CERTAIN DISPUTES.—In any case in which a dispute arises with respect to the awarding of a contract for construction of treatment works by a grantee of funds under this title and a party to such dispute files an appeal with the Administrator under this title for resolution of such dispute, the Administrator shall make a final decision on such appeal within 90 days of the filing of such appeal.

(33 U.S.C. 1281)

FEDERAL SHARE

SEC. 202. (a)(1) The amount of any grant for treatment works made under this Act from funds authorized for any fiscal year beginning after June 30, 1971, and ending before October 1, 1984, shall be 75 per centum of the cost of construction thereof (as approved by the Administrator), and for any fiscal year beginning on or after October 1, 1984, shall be 55 per centum of the cost of construction thereof (as approved by the Administrator), unless modified to a lower percentage rate uniform throughout a State by the Governor of that State with the concurrence of the Administrator. Within ninety days after the enactment of this sentence the Administrator, shall issue guidelines for concurrence in any such modification, which shall provide for the consideration of the unobligated balance of sums allocated to the State under section 205 of this Act, the need for assistance under this title in such State, and the availability of State grant assistance to replace the Federal share reduced by such modification. The payment of any such reduced Federal share shall not constitute an obligation on the part of the United States or a claim on the part of any State or grantee to reimbursement for the portion of the Federal share reduced in any such State. Any grant (other than for reimbursement) made prior to the date of enactment of the Federal Water Pollution Control Act Amendments of 1972 from any funds authorized for any fiscal year beginning after June 30, 1971, shall, upon the request of the applicant, be increased to the applicable percentage under this section. Notwithstanding the first sentence of this paragraph,

in any case where a primary, secondary, or advanced waste treatment facility or its related interceptors or a project for infiltration-in-flow correction has received a grant for erection, building, acquisition, alteration, remodeling, improvement, extension, or correction before October 1, 1984, all segments and phases of such facility, interceptors, and project for infiltration-in-flow correction shall be eligible for grants at 75 per centum of the cost of construction thereof for any grant made pursuant to a State obligation which obligation occurred before October 1, 1990. Notwithstanding the first sentence of this paragraph, in the case of a project for which an application for a grant under this title has been made to the Administrator before October 1, 1984, and which project is under judicial injunction on such date prohibiting its construction, such project shall be eligible for grants at 75 percent of the cost of construction thereof. Notwithstanding the first sentence of this paragraph, in the case of the Wyoming Valley Sanitary Authority project mandated by judicial order under a proceeding begun prior to October 1, 1984, and a project for wastewater treatment for Altoona, Pennsylvania, such projects shall be eligible for grants at 75 percent of the cost of construction thereof.

(2) The amount of any grant made after September 30, 1978, and before October 1, 1981, for any eligible treatment works or significant portion thereof utilizing innovative or alternative wastewater treatment processes and techniques referred to in section 201(g)(5) shall be 85 per centum of the cost of construction thereof, unless modified by the Governor of the State with the concurrence of the Administrator to a percentage rate no less than 15 per centum greater than the modified uniform percentage rate in which the Administrator has concurred pursuant to paragraph (1) of this subsection. The amount of any grant made after September 30, 1981, for any eligible treatment works or unit processes and techinques thereof utilizing innovative or alternative wastewater treatment processes and techniques referred to in section 201(g)(5) shall be a percentage of the cost of construction thereof equal to 20 per centum greater than the percentage in effect under paragraph (1) of this subsection for such works or unit processes and techniques, but in no event greater than 85 per centum of the cost of construction thereof. No grant shall be made under this paragraph for construction of a treatment works in any State unless the proportion of the State contribution to the non-Federal share of construction costs for all treatment works in such State receiving a grant under this paragraph is the same as or greater than the proportion of the State contribution (if any) to the non-Federal share of construction costs for all treatment works receiving grants in such State under paragraph (1) of this subsection.

(3) In addition to any grant made pursuant to paragraph (2) of this subsection, the Administrator is authorized to make a grant to fund all of the costs of the modification or replacement of any facilities constructed with a grant made pursuant to paragraph (2) if the Administrator finds that such facilities have not met design performance specifications unless such failure is attributable to negligence on the part of any person and if such failure has significantly increased capital or operating and maintenance expenditures. In addition, the Administrator is authorized to make a grant to fund all of the costs of the modification or replacement of biodisc

equipment (rotating biological contractors) in any publicly owned treatment works if the Administrator finds that such equipment has failed to meet design performance specifications, unless such failure is attributable to negligence on the part of any person, and if such failure has significantly increased capital or operating and maintenance expenditures.

(4) For the purposes of this section, the term "eligible treatment works" means those treatment works in each State which meet the requirements of section 201(g)(5) of this Act and which can be fully funded from funds available for such purpose in such State.

(b) The amount of the grant for any project approved by the Administrator after January 1, 1971, and before July 1, 1971, for the construction of treatment works, the actual erection, building or acquisition of which was not commenced prior to July 1, 1971, shall, upon the request of the applicant, be increased to the applicable percentage under subsection (a) of this section for grants for treatment works from funds for fiscal years beginning after June 30, 1971, with respect to the cost of such actual erection, building, or acquisition. Such increased amount shall be paid from any funds allocated to the State in which the treatment works is located without regard to the fiscal year for which such funds were authorized. Such increased amount shall be paid for such project only if—

(1) a sewage collection system that is a part of the same total waste treatment system as the treatment works for which such grant was approved is under construction or is to be constructed for use in conjunction with such treatment works, and if the cost of such sewage collection system exceeds the cost of such treatment works, and

(2) the State water pollution control agency or other appropriate State authority certifies that the quantity of available ground water will be insufficient, inadequate, or unsuitable for public use, including the ecological preservation and recreational use of surface water bodies, unless effluents from publicly-owned treatment works after adequate treatment are returned to the ground water consistent with acceptable technological standards.

(c) Notwithstanding any other provision of law, sums allotted to the Commonwealth of Puerto Rico under section 205 of this Act for fiscal year 1981 shall remain available for obligation for the fiscal year for which authorized and for the period of the next succeeding twenty-four months. Such sums and any unobligated funds available to Puerto Rico from allotments for fiscal years ending prior to October 1, 1981, shall be available for obligation by the Administrator of the Environmental Protection Agency only to fund the following systems: Aguadilla, Arecibo, Mayaguez, Carolina, and Camuy Hatillo. These funds may be used by the Commonwealth of Puerto Rico to fund the non-Federal share of the costs of such projects. To the extent that these funds are used to pay the non-Federal share, the Commonwealth of Puerto Rico shall repay to the Environmental Protection Agency such amounts on terms and conditions developed and approved by the Administrator in consultation with the Governor of the Commonwealth of Puerto Rico. Agreement on such terms and conditions including the payment of interest to be determined by the Secretary of the Treasury, shall

be reached prior to the use of these funds for the Commonwealth's non-Federal share. No Federal funds awarded under this provision shall be used to replace local governments funds previously expended on these projects.

(33 U.S.C. 1282)

PLANS, SPECIFICATIONS, ESTIMATES, AND PAYMENTS

SEC. 203. (a)(1) Each applicant for a grant shall submit to the Administrator for his approval, plans, specifications, and estimates for each proposed project for the construction of treatment works for which a grant is applied for under section 201(g)(1) from funds allotted to the State under section 205 and which otherwise meets the requirements of this Act. The Administrator shall act upon such plans, specifications, and estimates as soon as practicable after the same have been submitted, and his approval of any such plans, specifications, and estimates shall be deemed a contractual obligation of the United States for the payment of its proportional contribution to such project.

(2) AGREEMENT ON ELIGIBLE COSTS.—

(A) LIMITATION ON MODIFICATIONS.—Before taking final action on any plans, specifications, and estimates submitted under this subsection after the 60th day following the date of the enactment of the Water Quality Act of 1987, the Administrator shall enter into a written agreement with the applicant which establishes and specifies which items of the proposed project are eligible for Federal payments under this section. The Administrator may not later modify such eligibility determinations unless they are found to have been made in violation of applicable Federal statutes and regulations.

(B) LIMITATION ON EFFECT.—Eligibility determinations under this paragraph shall not preclude the Administrator from auditing a project pursuant to section 501 of this Act, or other authority, or from withholding or recovering Federal funds for costs which are found to be unreasonable, unsupported by adequate documentation, or otherwise unallowable under applicable Federal costs principles, or which are incurred on a project which fails to meet the design specifications or effluent limitations contained in the grant agreement and permit pursuant to section 402 of this Act for such project.

(3) In the case of a treatment works that has an estimated total cost of $8,000,000 of less (as determined by the Administrator), and the population of the applicant municipality is twenty-five thousand or less (according to the most recent United States census), upon completion of an approved facility plan, a single grant may be awarded for the combined Federal share of the cost of preparing construction plans and specifications, and the building and erection of the treatment works.

(b) The Administrator shall, from time to time as the work progresses, make payments to the recipient of a grant for costs of construction incurred on a project. These payments shall at no time exceed the Federal share of the cost of construction incurred to the date of the voucher covering such payment plus the Federal share

of the value of the materials which have been stockpiled in the vicinity of such construction in conformity to plans and specifications for the project.

(c) After completion of a project and approval of the final voucher by the Administrator, he shall pay out of the appropriate sums the unpaid balance of the Federal share payable on account of such project.

(d) Nothing in this Act shall be construed to require, or to authorize the Administrator to require, that grants under this Act for construction of treatment works be made only for projects which are operable units usable for sewage collection, transportation, storage, waste treatment, or for similar purposes without additional construction.

(e) At the request of a grantee under this title, the Administrator is authorized to provide technical and legal assistance in the administration and enforcement of any contract in connection with treatment works assisted under this title, and to intervene any civil action involving the enforcement of such a contract.

(f) DESIGN/BUILD PROJECTS.—

(1) AGREEMENT.—Consistent with State law, an applicant who proposes to construct waste water treatment works may enter into an agreement with the Administrator under this subsection providing for the preparation of construction plans and specifications and the erection of such treatment works, in lieu of proceeding under the other provisions of this section.

(2) LIMITATION ON PROJECTS.—Agreements under this subsection shall be limited to projects under an approved facility plan which projects are—

(A) treatment works that have an estimated total cost of $8,000,000 or less; and

(B) any of the following types of waste water treatment systems: aerated lagoons, trickling filters, stabilization ponds, land application systems, sand filters, and subsurface disposal systems.

(3) REQUIRED TERMS.—An agreement entered into under this subsection shall—

(A) set forth an amount agreed to as the maximum Federal contribution to the project, based upon a competitively bid document of basic design data and applicable standard construction specifications and a determination of the federally eligible costs of the project at the applicable Federal share under section 202 of this Act;

(B) set forth dates for the start and completion of construction of the treatment works by the applicant and a schedule of payments of the Federal contribution to the project;

(C) contain assurances by the applicant that (i) engineering and management assistance will be provided to manage the project; (ii) the proposed treatment works will be an operable unit and will meet all the requirements of this title; and (iii) not later than 1 year after the date specified as the date of completion of construction of the treatment works, the treatment works will be operating so as to meet the requirements of any applicable permit for such treatment works under section 402 of this Act;

(D) require the applicant to obtain a bond from the contractor in an amount determined necessary by the Administrator to protect the Federal interest in the project; and

(E) contain such other terms and conditions as are necessary to assure compliance with this title (except as provided in paragraph (4) of this subsection).

(4) LIMITATION ON APPLICATION.—Subsections (a), (b), and (c) of this section shall not apply to grants made pursuant to this subsection.

(5) RESERVATION TO ASSURE COMPLIANCE.—The Administrator shall reserve a portion of the grant to assure contract compliance until final project approval as defined by the Administrator. If the amount agreed to under paragraph (3)(A) exceeds the cost of designing and constructing the treatment works, the Administrator shall reallot the amount of the excess to the State in which such treatment works are located for the fiscal year in which such audit is completed.

(6) LIMITATION ON OBLIGATIONS.—The Administrator shall not obligate more than 20 percent of the amount allotted to a State for a fiscal year under section 205 of this Act for grants pursuant to this subsection.

(7) ALLOWANCE.—The Administrator shall determine an allowance for facilities planning for projects constructed under this subsection in accordance with section 201(l).

(8) LIMITATION ON FEDERAL CONTRIBUTIONS.—In no event shall the Federal contribution for the cost of preparing construction plans and specifications and the building and erection of treatment works pursuant to this subsection exceed the amount agreed upon under paragraph (3).

(9) RECOVERY ACTION.—In any case in which the recipient of a grant made pursuant to this subsection does not comply with the terms of the agreement entered into under paragraph (3), the Administrator is authorized to take such action as may be necessary to recover the amount of the Federal contribution to the project.

(10) PREVENTION OF DOUBLE BENEFITS.—A recipient of a grant made pursuant to this subsection shall not be eligible for any other grants under this title for the same project.

(33 U.S.C. 1283)

LIMITATIONS AND CONDITIONS

SEC. 204. (a) Before approving grants for any project for any treatment works under section 201(g)(1) the Administrator shall determine—

(1) that any required areawide waste treatment management plan under section 208 of this Act (A) is being implemented for such area and the proposed treatment works are included in such plan, or (B) is being developed for such area and reasonable progress is being made toward its implementation and the proposed treatment works will be included in such plan;

(2) that (A) the State in which the project is to be located (i) is implementing any required plan under section 303(e) of

this Act and the proposed treatment works are in conformity with such plan, or (ii) is developing such a plan and the proposed treatment works will be in conformity with such plan, and (B) such State is in compliance with section 305(b) of this Act;

(3) that such works have been certified by the appropriate State water pollution control agency as entitled to priority over such other works in the State in accordance with any applicable State plan under section 303(e) of this Act, except that any priority list developed pursuant to section 303(e)(3)(H) may be modified by such State in accordance with regulations promulgated by the Administrator to give higher priority for grants for the Federal share of the cost of preparing construction drawings and specifications for any treatment works utilizing processes and techniques meeting the guidelines promulgated under section 304(d)(3) of this Act for grants for the combined Federal share of the cost of preparing construction drawings and specifications and the building and erection of any treatment works meeting the requirements of the next to the last sentence of section 203(a) of this Act which utilizes processes and techniques meeting the guidelines promulgated under section 304(d)(3) of this Act.[1]

(4) that the applicant proposing to construct such works agrees to pay the non-Federal costs of such works and has made adequate provisions satisfactory to the Administrator for assuring proper and efficient operation, including the employment of trained management and operations personnel, and the maintenance of such works in accordance with a plan of operation approved by the state water pollution control agency or, as appropriate, the interstate agency, after construction thereof;

(5) that the size and capacity of such works relate directly to the needs to be served by such works, including sufficient reserve capacity. The amount of reserve capacity provided shall be approved by the Administrator on the basis of a comparison of the cost of constructing such reserves as a part of the works to be funded and the anticipated cost of providing expanded capacity at a date when such capacity will be required, after taking into account, in accordance with regulations promulgated by the Administrator, efforts to reduce total flow of sewage and unnecessary water consumption. The amount of reserve capacity eligible for a grant under this title shall be determined by the Administrator taking into account the projected population and associated commercial and industrial establishments within the jurisdiction of the applicant to be served by such treatment works as identified in an approved facilities plan, an areawide plan under section 208, or an applicable municipal master plan of development. For the purpose of this paragraph, section 208, and any such plan, projected population shall be determined on the basis of the latest information available from the United States Department of Commerce or from the States as the Administrator, by regulation, determines appropriate. Beginning October 1, 1984, no grants shall be made

[1] So in law. The period should be a semicolon.

under this title to construct that portion of any treatment works providing reserve capacity in excess of existing needs (including existing needs of residential, commercial, industrial, and other users) on the date of approval of a grant for the erection, building, acquisition, alteration, remodeling, improvement, or extension of a project for secondary treatment or more stringent treatment or new interceptors and appurtenances, except that in no event shall reserve capacity of a facility and its related interceptors to which this subsection applies be in excess of existing needs on October 1, 1990. In any case in which an applicant proposes to provide reserve capacity greater than that eligible for Federal financial assistance under this title, the incremental costs of the additional reserve capacity shall be paid by the applicant;

(6) that no specification for bids in connection with such works shall be written in such a manner as to contain proprietary, exclusionary, or discriminatory requirements other than those based upon performance, unless such requirements are necessary to test or demonstrate a specific thing or to provide for necessary interchangeability of parts and equipment. When in the judgment of the grantee, it is impractical or uneconomical to make a clear and accurate description of the technical requirements, a "brand name or equal" description may be used as a means to define the performance or other salient requirements of a procurement, and in doing so the grantee need not establish the existence of any source other than the brand or source so named.

(b)(1) Notwithstanding any other provision of this title, the Administrator shall not approve any grant for any treatment works under section 201(g)(1) after March 1, 1973, unless he shall first have determined that the applicant (A) has adopted or will adopt a system of charges to assure that each recipient of waste treatment services within the applicant's jurisdiction, as determined by the Administrator, will pay its proportionate share (except as otherwise provided in this paragraph) of the costs of operation and maintenance (including replacement) of any waste treatment services provided by the applicant; and (B) has legal, institutional, managerial, and financial capability to insure adequate construction, operation, and maintenance of treatment works throughout the applicant's jurisdiction, as determined by the Administrator. In any case where an applicant which, as of the date of enactment of this sentence, uses a system of dedication ad valorem taxes and the Administrator determines that the applicant has a system of charges which results in the distribution of operation and maintenance costs for treatment works within the applicant's jurisdiction, to each user class, in proportion to the contribution to the total cost of operation and maintenance of such works by each user class (taking into account total waste water loading of such works, the constituent elements of the waste, and other appropriate factors), and such applicant is otherwise in compliance with clause (A) of this paragraph with respect to each industrial user, then such dedication ad valorem tax system shall be deemed to be the user charge system meeting the requirements of clause (A) of this paragraph for the residential user class and such small non-residential user classes as defined by the Administrator. In defining small non-resi-

dential users, the Administrator shall consider the volume of wastes discharged into the treatment works by such users and the constituent elements of such wastes as well as such other factors as he deems appropriate. A system of user charges which imposes a lower charge for low-income residential users (as defined by the Administrator) shall be deemed to be a user charge system meeting the requirements of clause (A) of this paragraph if the Administrator determines that such system was adopted after public notice and hearing.

(2) The Administrator shall, within one hundred and eighty days after the date of enactment of the Federal Water Pollution Control Act Amendments of 1972, and after consultation with appropriate State, interstate, municipal and intermunicipal agencies, issue guidelines applicable to payment of waste treatment costs by industrial and nonindustrial receipts of waste treatment services which shall establish (A) classes of users of such services, including categories of industrial users; (B) criteria against which to determine the adequacy of charges imposed on classes and categories of users reflecting all factors that influence the cost of waste treatment, including strength, volume, and delivery flow rate characteristics of waste; and (C) model systems and rates of user charges typical of various treatment works serving municipal-industrial communities.

(3) Approval by the Administrator of a grant to an interstate agency established by interstate compact for any treatment works shall satisfy any other requirement that such works be authorized by Act of Congress.

(4) A system of charges which meets the requirement of clause (A) of paragraph (1) of this subsection may be based on something other than metering the sewage or water supply flow of residential recipients of waste treatment services, including ad valorem taxes. If the system of charges is based on something other than metering the Administrator shall require (A) the applicant to establish a system by which the necessary funds will be available for the proper operation and maintenance of the treatment works; and (B) the applicant to establish a procedure under which the residential user will be notified as to that portion of his total payment which will be allocated to the costs of the waste treatment services.

(c) The next to the last sentence of paragraph (5) of subsection (a) of this section shall not apply in any case where a primary, secondary, or advanced waste treatment facility or its related interceptors has received a grant for erection, building, acquisition, alteration, remodeling, improvement, or extension before October 1, 1984, and all segments and phases of such facility and interceptors shall be funded based on a 20-year reserve capacity in the case of such facility and a 20-year reserve capacity in the case of such interceptors, except that, if a grant for such interceptors has been approved prior to the date of enactment of the Municipal Wastewater Treatment Construction Grant Amendments of 1981, such interceptors shall be funded based on the approved reserve capacity not to exceed 40 years.

(d)(1) A grant for the construction of treatment works under this title shall provide that the engineer or engineering firm supervising construction or providing architect engineering services during construction shall continue its relationship to the grant appli-

cant for a period of one year after the completion of construction and initial operation of such treatment works. During such period such engineer or engineering firm shall supervise operation of the treatment works, train operating personnel, and prepare curricula and training material for operating personnel. Costs associated with the implementation of this paragraph shall be eligible for Federal assistance in accordance with this title.

(2) On the date one year after the completion of construction and initial operation of such treatment works, the owner and operator of such treatment works shall certify to the Administrator whether or not such treatment works meet the design specifications and effluent limitations contained in the grant agreement and permit pursuant to section 402 of the Act for such works. If the owner and operator of such treatment works cannot certify that such treatment works meet such design specifications and effluent limitations, any failure to meet such design specifications and effluent limitations shall be corrected in a timely manner, to allow such affirmative certification, at other than Federal expense.

(3) Nothing in this section shall be construed to prohibit a grantee under this title from requiring more assurances, guarantees, or indemnity or other contractual requirements from any party to a contract pertaining to a project assisted under this title, than those provided under this subsection.

(33 U.S.C. 1284)

ALLOTMENT

SEC. 205. (a) Sums authorized to be appropriated pursuant to section 207 for each fiscal year beginning after June 30, 1972, before September 30, 1977, shall be allotted by the Administrator not later than the January 1st immediately preceding the beginning of the fiscal year for which authorized, except that the allotment for fiscal year 1973 shall be made not later than 30 days after the date of enactment of the Federal Water Pollution Control Act Amendments of 1972. Such sums shall be allotted among the States by the Administrator in accordance with regulations promulgated by him, in the ratio that the estimated cost of constructing all needed publicly owned treatment works in each State bears to the estimated cost of construction of all needed publicly owned treatment works in all of the States. For the fiscal years ending June 30, 1973, and June 30, 1974, such ratio shall be determined on the basis of table III of House Public Works Committee Print No. 92–50. For the fiscal year ending June 30, 1975, such ratio shall be determined one-half on the basis of table I of House Public Works Committee Print Numbered 93–28 and one-half on the basis of table II of such print, except that no State shall receive an allotment less than that which it received for the fiscal year ending June 30, 1972, as set forth in table III of such print. Allotments for fiscal years which begin after the fiscal year ending June 30, 1975 shall be made only in accordance with a revised cost estimate made and submitted to Congress in accordance with section 516 of this Act and only after such revised cost estimate shall have been approved by law specifically enacted hereafter.

(b)(1) Any sums allotted to a State under subsection (a) shall be available for obligation under section 203 on and after the date

of such allotment. Such sums shall continue available for obligation in such State for a period of one year after the close of the fiscal year for which such sums are authorized. Any amounts so allotted which are not obligated by the end of such one-year period shall be immediately reallotted by the Administrator, in accordance with regulations promulgated by him, generally on the basis of the ratio used in making the last allotment of sums under this section. Such reallotted sums shall be added to the last allotments made to the States. Any sum made available to a State by reallotment under this subsection shall be in addition to any funds otherwise allotted to such State for grants under this title during any fiscal year.

(2) Any sums which have been obligated under section 203 and which are released by the payment of the final voucher for the project shall be immediately credited to the State to which such sums were last allotted. Such released sums shall be added to the amounts last allotted to such State and shall be immediately available for obligation in the same manner and to the same extent as such last allotment.

(c)(1) Sums authorized to be appropriated pursuant to section 207 for the fiscal years during the period beginning October 1, 1977, and ending September 30, 1981, shall be allotted for each such year by the Administrator not later than the tenth day which begins after the date of enactment of the Clean Water Act of 1977. Not-withstanding any other provision of law, sums authorized for the fiscal years ending September 30, 1978, September 30, 1979, September 30, 1980, and September 30, 1981, shall be allotted in accordance with table 3 of Committee Print Numbered 95–30 of the Committee on Public Works and Transportation of the House of Representatives.

(2) Sums authorized to be appropriated pursuant to section 207 for the fiscal years 1982, 1983, 1984, and 1985 shall be allotted for each such year by the Administrator not later than the tenth day which begins after the date of enactment of the Municipal Wastewater Treatment Construction Grant Amendments of 1981. Notwithstanding any other provision of law, sums authorized for the fiscal year ending September 30, 1982, shall be allotted in accordance with table 3 of Committee Print Numbered 95–30 of the Committee on Public Works and Transportation of the House of Representatives. Sums authorized for the fiscal years ending September 30, 1983, September 30, 1984, September 30, 1985, and September 30, 1986, shall be allotted in accordance with the following table:

	Fiscal years 1983 through 1985 [1]
States:	
Alabama	.011398
Alaska	.006101
Arizona	.006885
Arkansas	.006668
California	.072901
Colorado	.008154
Connecticut	.012487
Delaware	.004965
District of Columbia	.004965
Florida	.034407
Georgia	.017234
Hawaii	.007895
Idaho	.004965
Illinois	.046101
Indiana	.024566
Iowa	.013796
Kansas	.009201
Kentucky	.012973
Louisiana	.011205
Maine	.007788
Maryland	.024653
Massachusetts	.034608
Michigan	.043829
Minnesota	.018735
Mississippi	.009184
Missouri	.028257
Montana	.004965
Nebraska	.005214
Nevada	.004965
New Hampshire	.010186
New Jersey	.041654
New Mexico	.004965
New York	.113097
North Carolina	.018396
North Dakota	.004965
Ohio	.057383
Oklahoma	.008235
Oregon	.011515
Pennsylvania	.040377
Rhode Island	.006750
South Carolina	.010442
South Dakota	.004965
Tennessee	.014807
Texas	.038726
Utah	.005371
Vermont	.004965
Virginia	.020861
Washington	.017726
West Virginia	.015890
Wisconsin	.027557
Wyoming	.004965
Samoa	.000915
Guam	.000662
Northern Marianas	.000425
Puerto Rico	.013295
Pacific Trust Territories	.001305
Virgin Islands	.000531
United States totals	.999996

[1] So in original. Probably should be "1986".

(3) FISCAL YEARS 1987–1990.—Sums authorized to be appropriated pursuant to section 207 for the fiscal years 1987, 1988, 1989, and 1990 shall be allotted for each such year by the Administrator not later than the 10th day which begins after the date of the enactment of this paragraph. Sums authorized for

such fiscal years shall be allotted in accordance with the following table:

States:	
Alabama	.011309
Alaska	.006053
Arizona	.006831
Arkansas	.006616
California	.072333
Colorado	.008090
Connecticut	.012390
Delaware	.004965
District of Columbia	.004965
Florida	.034139
Georgia	.017100
Hawaii	.007833
Idaho	.004965
Illinois	.045741
Indiana	.024374
Iowa	.013688
Kansas	.009129
Kentucky	.012872
Louisiana	.011118
Maine	.007829
Maryland	.024461
Massachusetts	.034338
Michigan	.043487
Minnesota	.018589
Mississippi	.009112
Missouri	.028037
Montana	.004965
Nebraska	.005173
Nevada	.004965
New Hampshire	.010107
New Jersey	.041329
New Mexico	.004965
New York	.111632
North Carolina	.018253
North Dakota	.004965
Ohio	.056936
Oklahoma	.008171
Oregon	.011425
Pennsylvania	.040062
Rhode Island	.006791
South Carolina	.010361
South Dakota	.004965
Tennessee	.014692
Texas	.046226
Utah	.005329
Vermont	.004965
Virginia	.020698
Washington	.017588
West Virginia	.015766
Wisconsin	.027342
Wyoming	.004965
American Samoa	.000908
Guam	.000657
Northern Marianas	.000422
Puerto Rico	.013191
Pacific Trust Territories	.001295
Virgin Islands	.000527

(d) Sums allotted to the States for a fiscal year shall remain available for obligation for the fiscal year for which authorized and for the period of the next succeeding twelve months. The amount of any allotment not obligated by the end of such twenty-four-month period shall be immediately reallotted by the Administrator on the basis of the same ratio as applicable to sums allotted for the

then current fiscal year, except that none of the funds reallotted by the Administrator for fiscal year 1978 and for fiscal years thereafter shall be allotted to any State which failed to obligate any of the funds being reallotted. Any sum made available to a State by reallotment under this subsection shall be in addition to any funds otherwise allotted to such State for grants under this title during any fiscal year.

(e) For the fiscal years 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, and 1990, no State shall receive less than one-half of 1 per centum of the total allotment under subsection (c) of this section, except that in the case of Guam, Virgin Islands, American Samoa, and the Trust Territories not more than thirty-three one-hundredths of 1 per centum in the aggregate shall be allotted to all four for these jurisdictions. For the purpose of carrying out this subsection there are authorized to be appropriated, subject to such amounts as are provided in appropriation Acts, not to exceed $75,000,000 for each fiscal years 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, and 1990. If for any fiscal year the amount appropriated under authority of this subsection is less than the amount necessary to carry out this subsection, the amount each State receives under this subsection for such year shall be the same ratio for the amount such State would have received under this subsection in such year if the amount necessary to carry it out had been appropriated as the amount appropriated for such year bears to the amount necessary to carry out this subsection for such year.

(f) Notwithstanding any other provision of this section, sums made available between January 1, 1975, and March 1, 1975, by the Administrator for obligation shall be available for obligation until September 30, 1978.

(g)(1) The Administrator is authorized to reserve each fiscal year not to exceed 2 per centum of the amount authorized under section 207 of this title for purposes of the allotment made to each State under this section on or after October 1, 1977, except in the case of any fiscal year beginning on or after October 1, 1981, and ending before October 1, 1994, in which case the percentage authorized to be reserved shall not exceed 4 per centum.[1] or $400,000 whichever amount is the greater. Sums so reserved shall be available for making grants to such State under paragraph (2) of this subsection for the same period as sums are available from such allotment under subsection (d) of this section, and any such grant shall be available for obligation only during such period. Any grant made from sums reserved under this subsection which has not been obligated by the end of the period for which available shall be added to the amount last allotted to such State under this section and shall be immediately available for obligation in the same manner and to the same extent as such last allotment. Sums authorized to be reserved by this paragraph shall be in addition to and not in lieu of any other funds which may be authorized to carry out this subsection.

(2) The Administrator is authorized to grant to any State from amounts reserved to such State under this subsection, the reasonable costs of administering any aspects of sections 201, 203, 204,

[1] P.L. 97–117 added this phrase with a period at the end; probably should be a comma.

and 212 of this Act the responsibility for administration of which the Administrator has delegated to such State. The Administrator may increase such grant to take into account the reasonable costs of administering an approved program under section 402 or 404, administering a statewide waste treatment management planning program under section 208(b)(4), and managing waste treatment construction grants for small communities.

(h) The Administrator shall set aside from funds authorized for each fiscal year beginning on or after October 1, 1978, a total (as determined by the Governor of the State) of not less than 4 percent nor more than 7½ percent of the sums allotted to any State with a rural population of 25 per centum or more of the total population of such State, as determined by the Bureau of the Census. The Administrator may set aside no more than 7½ percent of the sums allotted to any other State for which the Governor requests such action. Such sums shall be available only for alternatives to conventional sewage treatment works for municipalities having a population of three thousand five hundred or less, or for the highly dispersed sections of larger municipalities, as defined by the Administrator.

(i) SET-ASIDE FOR INNOVATIVE AND ALTERNATIVE PROJECTS.—Not less than ½ of 1 percent of funds allotted to a State for each of the fiscal years ending September 30, 1979, through September 30, 1990, under subsection (c) of this section shall be expended only for increasing the Federal share of grants for construction of treatment works utilizing innovative processes and techniques pursuant to section 202(a)(2) of this Act. Including the expenditures authorized by the preceding sentence, a total of 2 percent of the funds allotted to a State for each of the fiscal years ending September 30, 1979, and September 30, 1980, and 3 percent of the funds allotted to a State for the fiscal year ending September 30, 1981, under subsection (c) of this section shall be expended only for increasing grants for construction of treatment works pursuant to section 202(a)(2) of this Act. Including the expenditures authorized by the first sentence of this subsection, a total (as determined by the Governor of the State) of not less than 4 percent nor more than 7½ percent of the funds allotted to such State under subsection (c) of this section for each of the fiscal years ending September 30, 1982, through September 30, 1990, shall be expended only for increasing the Federal share of grants for construction of treatment works pursuant to section 202(a)(2) of this Act.

(j)(1) The Administrator shall reserve each fiscal year not to exceed 1 per centum of the sums allotted and available for obligation to each State under this section for each fiscal year beginning on or after October 1, 1981, or $100,000, whichever amount is the greater.

(2) Such sums shall be used by the Administrator to make grants to the States to carry out water quality management planning, including, but not limited to—

(A) identifying most cost effective and locally acceptable facility and non-point measures to meet and maintain water quality standards;

(B) developing an implementation plan to obtain State and local financial and regulatory commitments to implement measures developed under subparagraph (A);

(C) determining the nature, extent, and causes of water quality problems in various areas of the State and interstate region, and reporting on these annually; and

(D) determining those publicly owned treatment works which should be constructed with assistance under this title, in which areas and in what sequence, taking into account the relative degree of effluent reduction attained, the relative contributions to water quality of other point or nonpoint sources, and the consideration of alternatives to such construction, and implementing section 303(e) of this Act.

(3) In carrying out planning with grants made under paragraph (2) of this subsection, a State shall develop jointly with local, regional, and interstate entities, a plan for carrying out the program and give funding priority to such entities and designated or undesignated public comprehensive planning organizations to carry out the purposes of this subsection. In giving such priority, the State shall allocate at least 40 percent of the amount granted to such State for a fiscal year under paragraph (2) of this subsection to regional public comprehensive planning organizations in such State and appropriate interstate organizations for the development and implementation of the plan described in this paragraph. In any fiscal year for which the Governor, in consultation with such organizations and with the approval of the Administrator, determines that allocation of at least 40 percent of such amount to such organizations will not result in significant participation by such organizations in water quality management planning and not significantly assist in development and implementation of the plan described in this paragraph and achieving the goals of this Act, the allocation to such organization may be less than 40 percent of such amount.

(4) All activities undertaken under this subsection shall be in coordination with other related provisions of this Act.

(5) NONPOINT SOURCE RESERVATION.—In addition to the sums reserved under paragraph (1), the Administrator shall reserve each fiscal year for each State 1 percent of the sums allotted and available for obligation to such State under this section for each fiscal year beginning on or after October 1, 1986, or $100,000, whichever is greater, for the purpose of carrying out section 319 of this Act. Sums so reserved in a State in any fiscal year for which such State does not request the use of such sums, to the extent such sums exceed $100,000, may be used by such State for other purposes under this title.

(k) The Administrator shall allot to the State of New York from sums authorized to be appropriated for the fiscal year ending September 30, 1982, an amount necessary to pay the entire cost of conveying sewage from the Convention Center of the City of New York to the Newtown sewage treatment plant, Brooklyn-Queens area, New York. The amount allotted under this subsection shall be in addition to and not in lieu of any other amounts authorized to be allotted to such State under this Act.

(l) MARINE ESTUARY RESERVATION.—

(1) RESERVATION OF FUNDS.—

(A) GENERAL RULE.—Prior to making allotments among the States under subsection (c) of this section, the Administrator shall reserve funds from sums appropriated

pursuant to section 207 for each fiscal year beginning after September 30, 1986.

(B) FISCAL YEARS 1987 AND 1988.—For each of fiscal years 1987 and 1988 the reservation shall be 1 percent of the sums appropriated pursuant to section 207 for such fiscal year.

(C) FISCAL YEARS 1989 AND 1990.—For each of fiscal years 1989 and 1990 the reservation shall be 1½ percent of the funds appropriated pursuant to section 207 for such fiscal year.

(2) USE OF FUNDS.—Of the sums reserved under this subsection, two-thirds shall be available to address water quality problems of marine bays and estuaries subject to lower levels of water quality due to the impacts of discharges from combined storm water and sanitary sewer overflows from adjacent urban complexes, and one-third shall be available for the implementation of section 320 of this Act, relating to the national estuary program.

(3) PERIOD OF AVAILABILITY.—Sums reserved under this subsection shall be subject to the period of availability for obligation established by subsection (d) of this section.

(4) TREATMENT OF CERTAIN BODY OF WATER.—For purposes of this section and section 201(n), Newark Bay, New Jersey, and the portion of the Passaic River up to Little Falls, in the vicinity of Beatties Dam, shall be treated as a marine bay and estuary.

(m) DISCRETIONARY DEPOSITS INTO STATE WATER POLLUTION CONTROL REVOLVING FUNDS.—

(1) FROM CONSTRUCTION GRANT ALLOTMENTS.—In addition to any amounts deposited in a water pollution control revolving fund established by a State under title VI, upon request of the Governor of such State, the Administrator shall make available to the State for deposit, as capitalization grants, in such fund in any fiscal year beginning after September 30, 1986, such portion of the amounts allotted to such State under this section for such fiscal year as the Governor considers appropriate; except that (A) in fiscal year 1987 such deposit may not exceed 50 percent of the amounts allotted to such State under this section for such fiscal year, and (B) in fiscal year 1988, such deposit may not exceed 75 percent of the amounts allotted to such State under this section for this [1] fiscal year.

(2) NOTICE REQUIREMENT.—The Governor of a State may make a request under paragraph (1) for a deposit into the water pollution control revolving fund of such State—

(A) in fiscal year 1987 only if no later than 90 days after the date of the enactment of this subsection, and

(B) in each fiscal year thereafter only if 90 days before the first day of such fiscal year,

the State provides notice of its intent to make such deposit.

(3) EXCEPTION.—Sums reserved under section 205(j) of this Act shall not be available for obligation under this subsection.

(33 U.S.C. 1285)

[1] So in original. Probably should be "such".

REIMBURSEMENT AND ADVANCED CONSTRUCTION

SEC. 206. (a) Any publicly owned treatment works in a State on which construction was initiated after June 30, 1966, but before July 1, 1973, which was approved by the appropriate State water pollution control agency and which the Administrator finds meets the requirements of section 8 of this Act in effect at the time of the initiation of construction shall be reimbursed a total amount equal to the difference between the amount of Federal financial assistance, if any, received under such section 8 for such project and 50 per centum of the cost of such project, or 55 per centum of the project cost where the Administrator also determines that such treatment works was constructed in conformity with a comprehensive metropolitan treatment plan as described in section 8(f) of the Federal Water Pollution Control Act as in effect immediately prior to the date of enactment of the Federal Water Pollution Control Act Amendments of 1972. Nothing in this subsection shall result in any such works receiving Federal grants from all sources in excess of 80 per centum of the cost of such project.

(b) Any publicly owned treatment works constructed with or eligible for Federal financial assistance under this Act in a State between June 30, 1956, and June 30, 1966, which was approved by the State water pollution control agency and which the Administrator finds meets the requirements of section 8 of this Act prior to the date of enactment of the Federal Water Pollution Control Act Amendments of 1972 but which was constructed without assistance under such section 8 or which received such assistance in an amount less than 30 per centum of the cost of such project shall qualify for payments and reimbursement of State or local funds used for such project from sums allocated to such State under this section in an amount which shall not exceed the difference between the amount of such assistance, if any, received for such project and 30 per centum of the cost of such project.

(c) No publicly owned treatment works shall receive any payment or reimbursement under subsection (a) or (b) of this section unless an application for such assistance is filed with the Administrator within the one year period which begins on the date of enactment of the Federal Water Pollution Control Act Amendments of 1972. Any application filed within such one year period may be revised from time to time, as may be necessary.

(d) The Administrator shall allocate to each qualified project under subsection (a) of this section each fiscal year for which funds are appropriated under subsection (e) of this section an amount which bears the same ratio to the unpaid balance of the reimbursement due such project as the total of such funds for such year bears to the total unpaid balance of reimbursement due all such approved projects on the date of enactment of such appropriation. The Administrator shall allocate to each qualified project under subsection (b) of this section each fiscal year for which funds are appropriated under subsection (e) of this section an amount which bears the same ratio to the unpaid balance of the reimbursement due such project as the total of such funds for such year bears to the total unpaid balance of reimbursement due all such approved projects on the date of enactment of such appropriation.

(e) There is authorized to be appropriated to carry out subsection (a) of this section not to exceed $2,600,000,000 and, to carry out subsection (b) of this section, not to exceed $750,000,000. The authorizations contained in this subsection shall be the sole source of funds for reimbursements authorized by this section.

(f)(1) In any case where a substantial portion of the funds allotted to a State for the current fiscal year under this title have been obligated under section 201(g), or will be so obligated in a timely manner (as determined by the Administrator), and there is construction of any treatment work project without the aid of Federal funds and in accordance with all procedures and all requirements applicable to treatment works projects, except those procedures and requirements which limit construction of projects to those constructed with the aid of previously allotted Federal funds, the Administrator, upon his approval of an application made under this subsection therefore, is authorized to pay the Federal share of the cost of construction of such project when additional funds are allotted to the State under this title if prior to the construction of the project the Administrator approves plans, specifications, and estimates therefor in the same manner as other treatment works projects. The Administrator may not approve an application under this subsection unless an authorization is in effect for the first fiscal year in the period for which the application requests payment and such requested payment for that fiscal year does not exceed the State's expected allotment from such authorization. The Administrator shall not be required to make such requested payment for any fiscal year—

(A) to the extent that such payment would exceed such State's allotment of the amount appropriated for such fiscal year; and

(B) unless such payment is for a project which, on the basis of an approved funding priority list of such State, is eligible to receive such payment based on the allotment and appropriation for such fiscal year.

To the extent that sufficient funds are not appropriated to pay the full Federal share with respect to a project for which obligations under the provisions of this subsection have been made, the Administrator shall reduce the Federal share to such amount less than 75 per centum as such appropriations do provide.

(2) In determining the allotment for any fiscal year under this title, any treatment works project constructed in accordance with this section and without the aid of Federal funds shall not be considered completed until an application under the provisions of this subsection with respect to such project has been approved by the Administrator, or the availability of funds from which this project is eligible for reimbursement has expired, whichever first occurs.

(33 U.S.C. 1286)

AUTHORIZATION

SEC. 207. There is authorized to be appropriated to carry out this title, other than sections 206(e), 208 and 209, for the fiscal year ending June 30, 1973, not to exceed $5,000,000,000, for the fiscal year ending June 30, 1974, not to exceed $6,000,000,000, and for the fiscal year ending June 30, 1975, not to exceed

$7,000,000,000, and, subject to such amounts as are provided in appropriation Acts for the fiscal year ending September 30, 1977, $1,000,000,000 for the fiscal year ending September 30, 1978, $4,500,000,000 and for the fiscal years ending September 30, 1979, September 30, 1980, not to exceed $5,000,000,000; for the fiscal year ending September 30, 1981, not to exceed $2,548,837,000; and for the fiscal years ending September 30, 1982, September 30, 1983, September 30, 1984, and September 30, 1985, not to exceed $2,400,000,000 per fiscal year; and for each of the fiscal years ending September 30, 1986, September 30, 1987, and September 30, 1988, not to exceed $2,400,000,000; and for each of the fiscal years ending September 30, 1989, and September 30, 1990, not to exceed $1,200,000,000.

(33 U.S.C. 1287)

AREAWIDE WASTE TREATMENT MANAGEMENT

SEC. 208. (a) For the purpose of encouraging and facilitating the development and implementation of areawide waste treatment management plans—

(1) The Administrator, within ninety days after the date of enactment of this Act and after consultation with appropriate Federal, State, and local authorities, shall by regulation publish guidelines for the identification of those areas which, as a result of urban-industrial concentrations or other factors, have substantial water quality control problems.

(2) The Governor of each State, within sixty days after publication of the guidelines issued pursuant to paragraph (1) of this subsection, shall identify each area within the State which, as a result of urban-industrial concentrations or other factors, has substantial water quality control problems. Not later than one hundred and twenty days following such identification and after consultation with appropriate elected and other officials of local governments having jurisdiction in such areas, the Governor shall designate (A) the boundaries of each such area, and (B) a single representative organization, including elected officials from local governments or their designees, capable of developing effective areawide waste treatment management plans for such an area. The Governor may in the same manner at any later time identify any additional area (or modify an existing area) for which he determines areawide waste treatment management to be appropriate, designate the boundaries of such area, and designate an organization capable of developing effective areawide waste treatment management plans for such area.

(3) With respect to any area which, pursuant to the guidelines published under paragraph (1) of this subsection, is located in two or more States, the Governors of the respective States shall consult and cooperate in carrying out the provisions of paragraph (2), with a view toward designating the boundaries of the interstate area having common water quality control problems and for which areawide waste treatment management plans would be most effective, and toward designating, within one hundred and eighty days after publication of guidelines issued pursuant to paragraph (1) of this sub-

section, of a single representative organization capable of developing effective areawide waste treatment management plans for such area.

(4) If a Governor does not act, either by designating or determining not to make a designation under paragraph (2) of this subsection, within the time required by such paragraph, or if, in the case of an interstate area, the Governors of the States involved do not designate a planning organization within the time required by paragraph (3) of this subsection, the chief elected officials of local governments within an area may by agreement designate (A) the boundaries for such an area, and (B) a single representative organization including elected officials from such local governments, or their designees, capable of developing an areawide waste treatment management plan for such area.

(5) Existing regional agencies may be designated under paragraphs (2), (3), and (4) of this subsection.

(6) The State shall act as a planning agency for all portions of such State which are not designated under paragraphs (2), (3), or (4) of this subsection.

(7) Designations under this subsection shall be subject to the approval of the Administrator.

(b)(1)(A) Not later than one year after the date of designation of any organization under subsection (a) of this section such organization shall have in operation a continuing areawide waste treatment management planning process consistent with section 201 of this Act. Plans prepared in accordance with this process shall contain alternatives for waste treatment management, and be applicable to all wastes generated within the area involved. The initial plan prepared in accordance with such process shall be certified by the Governor and submitted to the Administrator not later than two years after the planning process is in operation.

(B) For any agency designated after 1975 under subsection (a) of this section and for all portions of a State for which the State is required to act as the planning agency in accordance with subsection (a)(6), the initial plan prepared in accordance with such process shall be certified by the Governor and submitted to the Administrator not later than three years after the receipt of the initial grant award authorized under subsection (f) of this section.

(2) Any plan prepared under such process shall include, but not be limited to—

(A) the identification of treatment works necessary to meet the anticipated municipal and industrial waste treatment needs of the area over a twenty-year period, annually updated (including an analysis of alternative waste treatment systems), including any requirements for the acquisition of land for treatment purposes; the necessary waste water collection and urban storm water runoff systems; and a program to provide the necessary financial arrangements for the development of such treatment works, and an identification of open space and recreation opportunities that can be expected to result from improved water quality, including consideration of potential use of lands associated with treatment works and increased access to water-based recreation;

(B) the establishment of construction priorities for such treatment works and time schedules for the initiation and completion of all treatment works;

(C) the establishment of a regulatory program to—

(i) implement the waste treatment management requirements of section 201(c),

(ii) regulate the location, modification, and construction of any facilities within such area which may result in any discharge in such area, and

(iii) assure that any industrial or commercial waste discharged into any treatment works in such area meet applicable pretreatment requirements;

(D) the identification of those agencies necessary to construct, operate, and maintain all facilities required by the plan and otherwise to carry out the plan;

(E) the identification of the measures necessary to carry out the plan (including financing), the period of time necessary to carry out the plan, the costs of carrying out the plan within such time, and the economic, social, and environmental impact of carrying out the plan within such time;

(F) a process to (i) identify, if appropriate, agriculturally and silviculturally related nonpoint sources of pollution, including return flows from irrigated agriculture, and their cumulative effects, runoff from manure disposal areas, and from land used for livestock and crop production, and (ii) set forth procedures and methods (including land use requirements) to control to the extent feasible such sources;

(G) a process of (i) identify, if appropriate, mine-related sources of pollution including new, current, and abandoned surface and underground mine runoff, and (ii) set forth procedures and methods (including land use requirements) to control to the extent feasible such sources;

(H) a process to (i) identify construction activity related sources of pollution, and (ii) set forth procedures and methods (including land use requirements) to control to the extent feasible such sources;

(I) a process to (i) identify, if appropriate, salt water intrusion into rivers, lakes, and estuaries resulting from reduction of fresh water flow from any cause, including irrigation, obstruction, ground water extraction, and diversion, and (ii) set forth procedures and methods to control such intrusion to the extent feasible where such procedures and methods are otherwise a part of the waste treatment management plan;

(J) a process to control the disposition of all residual waste generated in such area which could affect water quality; and

(K) a process to control the disposal of pollutants on land or in subsurface excavations within such area to protect ground and surface water quality.

(3) Areawide waste treatment management plans shall be certified annually by the Governor or his designee (or Governors or their designees, where more than one State is involved) as being consistent with applicable basin plans and such areawide waste treatment management plans shall be submitted to the Administrator for his approval.

(4)(A) Whenever the Governor of any State determines (and notifies the Administrator) that consistency with a statewide regulatory program under section 303 so requires, the requirements of clauses (F) through (K) of paragraph (2) of this subsection shall be developed and submitted by the Governor to the Administrator for approval for application to a class or category of activity throughout such State.

(B) Any program submitted under subparagraph (A) of this paragraph which, in whole or in part, is to control the discharge or other placement of dredged or fill material into the navigable waters shall include the following:

(i) A consultation process which includes the State agency with primary jurisdiction over fish and wildlife resources.

(ii) A process to identify and manage the discharge or other placement of dredged or fill material which adversely affects navigable waters, which shall complement and be coordinated with a State program under section 404 conducted pursuant to this Act.

(iii) A process to assure that any activity conducted pursuant to a best management practice will comply with the guidelines established under section 404(b)(1), and sections 307 and 403 of this Act.

(iv) A process to assure that any activity conducted pursuant to a best management practice can be terminated or modified for cause including, but not limited to, the following:

(I) violation of any condition of the best management practice;

(II) change in any activity that requires either a temporary or permanent reduction or elimination of the discharge pursuant to the best management practice.

(v) A process to assure continued coordination with Federal and Federal-State water-related planning and reviewing processes, including the National Wetlands Inventory.

(C) If the Governor of a State obtains approval from the Administrator of a statewide regulatory program which meets the requirements of subparagraph (B) of this paragraph and if such State is administering a permit program under section 404 of this Act, no person shall be required to obtain an individual permit pursuant to such section, or to comply with a general permit issued pursuant to such section, with respect to any appropriate activity within such State for which a best management practice has been approved by the Administrator under the program approved by the Administrator pursuant to this paragraph.

(D)(i) Whenever the Administrator determines after public hearing that a State is not administering a program approved under this section in accordance with the requirements of this section, the Administrator shall so notify the State, and if appropriate corrective action is not taken within a reasonable time, not to exceed ninety days, the Administrator shall withdraw approval of such program. The Administrator shall not withdraw approval of any such program unless he shall first have notified the State, and made public, in writing, the reasons for such withdrawal.

(ii) In the case of a State with a program submitted and approved under this paragraph, the Administrator shall withdraw approval of such program under this subparagraph only for a sub-

stantial failure of the State to administer its program in accordance with the requirements of this paragraph.

(c)(1) The Governor of each State, in consultation with the planning agency designated under subsection (a) of this section, at the time a plan is submitted to the Administrator, shall designate one or more waste treatment management agencies (which may be an existing or newly created local, regional or State agency or potential subdivision) for each area designated under subsection (a) of this section and submit such designations to the Administrator.

(2) The Administrator shall accept any such designation, unless, within 120 days of such designation, he finds that the designated management agency (or agencies) does not have adequate authority—

(A) to carry out appropriate portions of an areawide waste treatment management plan developed under subsection (b) of this section;

(B) to manage effectively waste treatment works and related facilities serving such area in conformance with any plan required by subsection (b) of this section;

(C) directly or by contract, to design and construct new works, and to operate and maintain new and existing works as required by any plan developed pursuant to subsection (b) of this section;

(D) to accept and utilize grants, or other funds from any source, for waste treatment management purposes;

(E) to raise revenues, including the assessment of waste treatment charges;

(F) to incur short- and long-term indebtedness;

(G) to assure in implementation of an areawide waste treatment management plan that each participating community pays its proportionate share of treatment costs;

(H) to refuse to receive any wastes from any municipality or subdivision thereof, which does not comply with any provisions of an approved plan under this section applicable to such area; and

(I) to accept for treatment industrial wastes.

(d) After a waste treatment management agency having the authority required by subsection (c) has been designated under such subsection for an area and a plan for such area has been approved under subsection (b) of this section, the Administrator shall not make any grant for construction of a publicy owned treatment works under section 201(g)(1) within such area except to such designated agency and for works in conformity with such plan.

(e) No permit under section 402 of this Act shall be issued for any point source which is in conflict with a plan approved pursuant to subsection (b) of this section.

(f)(1) The Administrator shall make grants to any agency designated under subsection (a) of this section for payment of the reasonable costs of developing and operating a continuing areawide waste treatment management planning process under subsection (b) of this section.

(2) For the two-year period beginning on the date of the first grant is made under paragraph (1) of this subsection to an agency, if such first grant is made before October 1, 1977, the amount of each such grant to such agency shall be 100 per centum of the costs

of developing and operating a continuing areawide waste treatment management planning process under subsection (b) of this section, and thereafter the amount granted to such agency shall not exceed 75 per centum of such costs in each succeeding one-year period. In the case of any other grant made to an agency under such paragraph (1) of this subsection, the amount of such grant shall not exceed 75 per centum of the costs of developing and operating a continuing areawide waste treatment management planning process in any year.

(3) Each applicant for a grant under this subsection shall submit to the Administrator for his approval each proposal for which a grant is applied for under this subsection. The Administrator shall act upon such proposal as soon as practicable after it has been submitted, and his approval of that proposal shall be deemed a contractual obligation of the United States for the payment of its contribution to such proposal, subject to such amounts as are provided in appropriation Acts. There is authorized to be appropriated to carry out this subsection not to exceed $50,000,000 for the fiscal year ending June 30, 1973, not to exceed $100,000,000 for the fiscal year ending June 30, 1974, not to exceed $150,000,000 per fiscal year for the fiscal years ending June 30, 1975, September 30, 1977, September 30, 1978, September 30, 1979, and September 30, 1980, not to exceed $100,000,000 per fiscal year for the fiscal years ending September 30, 1981, and September 30, 1982, and such sums as may be necessary for fiscal years 1983 through 1990.

(g) The Administrator is authorized, upon request of the Governor or the designated planning agency, and without reimbursement, to consult with, and provide technical assistance to, any agency designated under subsection (a) of this section in the development of areawide waste treatment management plans under subsection (b) of this section.

(h)(1) The Secretary of the Army, acting through the Chief of Engineers, in cooperation with the Administrator is authorized and directed, upon request of the Governor or the designated planning organization, to consult with, and provide technical assistance to, any agency designed [1] under subsection (a) of this section in developing and operating a continuing areawide waste treatment management planning process under subsection (b) of this section.

(2) There is authorized to be appropriated to the Secretary of the Army, to carry out this subsection, not to exceed $50,000,000 per fiscal year for the fiscal years ending June 30, 1973, and June 30, 1974.

(i)(1) The Secretary of the Interior, acting through the Director of the United States Fish and Wildlife Service, shall, upon request of the Governor of a State, and without reimbursement, provide technical assistance to such State in developing a statewide program for submission to the Administrator under subsection (b)(4)(B) of this section and in implementing such program after its approval.

(2) There is authorized to be appropriated to the Secretary of the Interior $6,000,000 to complete the National Wetlands Inventory of the United States, by December 31, 1981, and to provide information from such Inventory to States as it becomes available to

[1] So in original. Probably should be "designated".

assist such States in the development and operation of programs under this Act.

(j)(1) The Secretary of Agriculture, with the concurrence of the Administrator, and acting through the Soil Conservation Service and such other agencies of the Department of Agriculture as the Secretary may designate, is authorized and directed to establish and administer a program to enter into contracts, subject to such amounts as are provided in advance by appropriation acts, of not less than five years nor more than ten years with owners and operators having control of rural land for the purpose of installing and maintaining measures incorporating best management practices to control nonpoint source pollution for improved water quality in those States or areas for which the Administrator has approved a plan under subsection (b) of this section where the practices to which the contracts apply are certified by the management agency designated under subsection (c)(1) of this section to be consistent with such plans and will result in improved water quality. Such contracts may be entered into during the period ending not later than September 31, 1988. Under such contracts the land owners or operator shall agree—

(i) to effectuate a plan approved by a soil conservation district, where one exists, under this section for his farm, ranch, or other land substantially in accordance with the schedule outlined therein unless any requirement thereof is waived or modified by the Secretary;

(ii) to forfeit all rights to further payments or grants under the contract and refund to the United States all payments and grants received thereunder, with interest, upon his violation of the contract at any stage during the time he has control of the land if the Secretary, after considering the recommendations of the soil conservation district, where one exists, and the Administrator, determines that such violation is of such a nature as to warrant termination of the contract, or to make refunds or accept such payment adjustments as the Secretary may deem appropriate if he determines that the violation by the owner or operator does not warrant termination of the contract;

(iii) upon transfer of his right and interest in the farm, ranch, or other land during the contract period to forfeit all rights to further payments or grants under the contract and refund to the United States all payments or grants received thereunder, with interest, unless the transferee of any such land agrees with the Secretary to assume all obligations of the contract;

(iv) not to adopt any practice specified by the Secretary on the advice of the Administrator in the contract as a practice which would tend to defeat the purposes of the contract;

(v) to such additional provisions as the Secretary determines are desirable and includes in the contract to effectuate the purposes of the program or to facilitate the practical administration of the program.

(2) In return for such agreement by the landowner or operator the Secretary shall agree to provide technical assistance and share the cost of carrying out those conservation practices and measures set forth in the contract for which he determines that cost sharing is appropriate and in the public interest and which are approved

for cost sharing by the agency designated to implement the plan developed under subsection (b) of this section. The portion of such cost (including labor) to be shared shall be that part which the Secretary determines is necessary and appropriate to effectuate the installation of the water quality management practices and measures under the contract, but not to exceed 50 per centum of the total cost of the measures set forth in the contract; except the Secretary may increase the matching cost share where he determines that (1) the main benefits to be derived from the measures are related to improving offsite water quality, and (2) the matching share requirement would place a burden on the landowner which would probably prevent him from participating in the program.

(3) The Secretary may terminate any contract with a landowner or operator by mutual agreement with the owner or operator if the Secretary determines that such termination would be in the public interest, and may agree to such modification of contracts previously entered into as he may determine to be desirable to carry out the purposes of the program or facilitate the practical administration thereof or to accomplish equitable treatment with respect to other conservation, land use, or water quality programs.

(4) In providing assistance under this subsection the Secretary will give priority to those areas and sources that have the most significant effect upon water quality. Additional investigations or plans may be made, where necessary, to supplement approved water quality management plans, in order to determine priorities.

(5) The Secretary shall, where practicable, enter into agreements with soil conservation districts, State soil and water conservation agencies, or State water quality agencies to administer all or part of the program established in this subsection under regulations developed by the Secretary. Such agreements shall provide for the submission of such reports as the Secretary deems necessary, and for payment by the United States of such portion of the costs incurred in the administration of the program as the Secretary may deem appropriate.

(6) The contracts under this subsection shall be entered into only in areas where the management agency designated under subsection (c)(1) of this section assures an adequate level of participation by owners and operators having control of rural land in such areas. Within such areas the local soil conservation district, where one exists, together with the Secretary of Agriculture, will determine the priority of assistance among individual land owners and operators to assure that the most critical water quality problems are addressed.

(7) The Secretary, in consultation with the Administrator and subject to section 304(k) of this Act, shall, not later than September 30, 1978, promulgate regulations for carrying out this subsection and for support and cooperation with other Federal and non-Federal agencies for implementation of this subsection.

(8) This program shall not be used to authorize or finance projects that would otherwise be eligible for assistance under the terms of Public Law 83–566.

(9) There are hereby authorized to be appropriated to the Secretary of Agriculture $200,000,000 for fiscal year 1979, $400,000,000 for fiscal year 1980, $100,000,000 for fiscal year 1981, $100,000,000 for fiscal year 1982, and such sums as may be nec-

essary for fiscal years 1983 through 1990, to carry out this subsection. The program authorized under this subsection shall be in addition to, and not in substitution of, other programs in such area authorized by this or any other public law.

(33 U.S.C. 1288)

BASIN PLANNING

SEC. 209. (a) The President, acting through the Water Resources Council, shall, as soon as practicable, prepare a Level B plan under the Water Resource Planning Act for all basins in the United States. All such plans shall be completed not later than January 1, 1980, except that priority in the preparation of such plans shall be given to those basins and portions thereof which are within those areas designated under paragraphs (2), (3), and (4) of subsection (a) of section 208 of this Act.

(b) The President, acting through the Water Resources Council, shall report annually to Congress on progress being made in carrying out this section. The first such report shall be submitted not later than January 31, 1973.

(c) There is authorized to be appropriated to carry out this section not to exceed $200,000,000.

(33 U.S.C. 1289)

ANNUAL SURVEY

SEC. 210. The Administrator shall annually make a survey to determine the efficiency of the operation and maintenance of treatment works constructed with grants made under this Act, as compared to the efficiency planned at the time the grant was made. The results of such annual survey shall be reported to Congress not later than 90 days after the date of convening of each session of Congress.

(33 U.S.C. 1290)

SEWAGE COLLECTION SYSTEMS

SEC. 211. (a) No grant shall be made for a sewage collection system under this title unless such grant (1) is for replacement or major rehabilitation of an existing collection system and is necessary to the total integrity and performance of the waste treatment works serving such community, or (2) is for a new collection system in an existing community with sufficient existing or planned capacity adequately to treat such collected sewage and is consistent with section 201 of this Act.

(b) If the Administrator uses population density as a test for determining the eligibility of a collector sewer for assistance it shall be only for the purpose of evaluating alternatives and determining the needs for such system in relation to ground or surface water quality impact.

(c) No grant shall be made under this title from funds authorized for any fiscal year during the period beginning October 1, 1977, and ending September 30, 1990, for treatment works for control of pollutant discharges from separate storm sewer systems.

(33 U.S.C. 1291)

DEFINITIONS

SEC. 212. As used in this title—

(1) The term "construction" means any one or more of the following: preliminary planning to determine the feasibility of treatment works, engineering, architectural, legal, fiscal, or economic investigations or studies, surveys, designs, plans, working drawings, specifications, procedures, field testing of innovative or alternative waste water treatment processes and techniques meeting guidelines promulgated under section 304(d)(3) of this Act, or other necessary actions, erection, building, acquisition, alteration, remodeling, improvement, or extension of treatment works, or the inspection or supervision of any of the foregoing items.

(2)(A) The term "treatment works" means any devices and systems used in the storage, treatment, recycling, and reclamation of municipal sewage or industrial wastes of a liquid nature to implement section 201 of this act, or necessary to recycle or reuse water at the most economical cost over the estimated life of the works, including intercepting sewers, outfall sewers, sewage collection systems, pumping, power, and other equipment, and their appurtenances; extensions, improvements, remodeling, additions, and alterations thereof; elements essential to provide a reliable recycled supply such as standby treatment units and clear well facilities; and any works, including site acquisition of the land that will be an integral part of the treatment process (including land use for the storage of treated wastewater in land treatment systems prior to land application) or is used for ultimate disposal of residues resulting from such treatment.

(B) In addition to the definition contained in subparagraph (A) of this paragraph, "treatment works" means any other method or system for preventing, abating, reducing, storing, treating, separating, or disposing of municipal waste, including storm water runoff, or industrial waste, including waste in combined storm water and sanitary sewer systems. Any application for construction grants which includes wholly or in part such methods or systems shall, in accordance with guidelines published by the Administrator pursuant to subparagraph (C) of this paragraph, contain adequate data and analysis demonstrating such proposal to be, over the life of such works, the most cost efficient alternative to comply with sections 301 or 302 of this Act, or the requirements of section 201 of this Act.

(C) For the purposes of subparagraph (B) of this paragraph, the Administrator shall, within one hundred and eighty days after the date of enactment of this title, publish and thereafter revise no less often than annually, guidelines for the evaluation of methods, including cost-effective analysis, described in subparagraph (B) of this paragraph.

(3) The term "replacement" as used in this title means those expenditures for obtaining and installing equipment, accessories, or appurtenances during the useful life of the treatment works necessary to maintain the capacity and performance for which such works are designed and constructed.

(33 U.S.C. 1292)

LOAN GUARANTEES FOR CONSTRUCTION OF TREATMENT WORKS

SEC. 213. (a) Subject to the conditions of this section and to such terms and conditions as the Administrator determines to be necessary to carry out the purposes of this title, the Administrator is authorized to guarantee, and to make commitments to guarantee, the principal and interest (including interest accruing between the date of default and the date of the payment in full of the guarantee) of any loan, obligation, or participation therein of any State, municipality, or intermunicipal or interstate agency issued directly and exclusively to the Federal Financing Bank to finance that part of the cost of any grant-eligible project for the construction of publicly owned treatment works not paid for with Federal financial assistance under this title (other than this section), which project the Administrator has determined to be eligible for such financial assistance under this title, including, but not limited to, projects eligible for reimbursement under section 206 of this title.

(b) No guarantee, or commitment to make a guarantee, may be made pursuant to this section—

(1) unless the Administrator certifies that the issuing body is unable to obtain on reasonable terms sufficient credit to finance its actual needs without such guarantee; and

(2) unless the Administrator determines that there is a reasonable assurance or repayment of the loan, obligation, or participation therein.

A determination of whether financing is available at reasonable rates shall be made by the Secretary of the Treasury with relationship to the current average yield on outstanding marketable obligations of municipalities of comparable maturity.

(c) The Administrator is authorized to charge reasonable fees for the investigation of an application for a guarantee and for the issuance of a commitment to make a guarantee.

(d) The Administrator, in determining whether there is a reasonable assurance of repayment, may require a commitment which would apply to such repayment. Such commitment may include, but not be limited to, any funds received by such grantee from the amounts appropriated under section 206 of this Act.

(33 U.S.C. 1293)

PUBLIC INFORMATION

SEC. 214. The Administrator shall develop and operate within one year of the date of enactment of this section, a continuing program of public information and education on recycling and reuse of wastewater (including sludge), the use of land treatment, and methods for the reduction of wastewater volume.

(33 U.S.C. 1294)

REQUIREMENTS FOR AMERICAN MATERIALS

SEC. 215. Notwithstanding any other provision of law, no grant for which application is made after February 1, 1978, shall be made under this title for any treatment works unless only such unmanufactured articles, materials, and supplies as have been mined or produced in the United States, and only such manufactured arti-

cles, materials, and supplies as have been manufactured in the United States, substantially all from articles, materials, or supplies mined, produced, or manufactured, as the case may be, in the United States will be used in such treatment works. This section shall not apply in any case where the Administrator determines, based upon those factors the Administrator deems relevant, including the available resources of the agency, it to be inconsistent with the public interest (including multilateral government procurement agreements) or the cost to be unreasonable, or if articles, materials, or supplies of the class or kind to be used or the articles, materials, or supplies from which they are manufactured are not mined, produced, or manufactured, as the case may be, in the United States in sufficient and reasonably available commercial quantities and of a satisfactory quality.

(33 U.S.C. 1295)

DETERMINATION OF PRIORITY

SEC. 216. Notwithstanding any other provision of this Act, the determination of the priority to be given each category of projects for construction of publicly owned treatment works within each State shall be made solely by that State, except that if the Administrator, after a public hearing, determines that a specific project will not result in compliance with the enforceable requirements of this Act, such project shall be removed from the State's priority list and such State shall submit a revised priority list. These categories shall include, but not be limited to (A) secondary treatment, (B) more stringent treatment, (C) infiltration-in-flow correction, (D) major sewer system rehabilitation, (E) new collector sewers and appurtenances, (F) new interceptors and appurtenances, and (G) correction of combined sewer overflows. Not less than 25 per centum of funds allocated to a State in any fiscal year under this title for construction of publicly owned treatment works in such State shall be obligated for those types of projects referred to in clauses (D), (E), (F), and (G) of this section, if such projects are on such State's priority list for that year and are otherwise eligible for funding in that fiscal year. It is the policy of Congress that projects for wastewater treatment and management undertaken with Federal financial assistance under this Act by any State, municipality, or intermunicipal or interstate agency shall be projects which, in the estimation of the State, are designed to achieve optimum water quality management, consistent with the public health and water quality goals and requirements of the Act.

(33 U.S.C. 1296)

COST-EFFECTIVENESS GUIDELINES

SEC. 217. Any guidelines for cost-effectiveness analysis published by the Administrator under this title shall provide for the identification and selection of cost effective alternatives to comply with the objective and goals of this Act and sections 201(b), 201(d), 201(g)(2)(A), and 301(b)(2)(B) of this Act.

(33 U.S.C. 1297)

COST EFFECTIVENESS

SEC. 218. (a) It is the policy of Congress that a project for waste treatment and management undertaken with Federal financial assistance under this Act by any State, municipality, or intermunicipal or interstate agency shall be considered as an overall waste treatment system for waste treatment and management, and shall be that system which constitutes the most economical and cost-effective combination of devices and systems used in the storage, treatment, recycling, and reclamation of municipal sewage or industrial wastes of a liquid nature to implement section 201 of this Act, or necessary to recycle or reuse water at the most economical cost over the estimated life of the works, including intercepting sewers, outfall sewers, sewage collection systems, pumping power, and other equipment, and their appurtenances; extension, improvements, remodeling, additions, and alterations thereof; elements essential to provide a reliable recycled supply such as standby treatment units and clear well facilities; and any works, including site acquisition of the land that will be an integral part of the treatment process (including land use for the storage of treated wastewater in land treatment systems prior to land application) or which is used for ultimate disposal of residues resulting from such treatment; water efficiency measures and devices; and any other method or system for preventing, abating, reducing, storing, treating, separating, or disposing of municipal waste, including storm water runoff, or industrial waste, including waste in combined storm water and sanitary sewer systems; to meet the requirements of this Act.

(b) In accordance with the policy set forth in subsection (a) of this section, before the Administrator approves any grant to any State, municipality, or intermunicipal or interstate agency for the erection, building, acquisition, alteration, remodeling, improvement, or extension of any treatment works the Administrator shall determine that the facilities plan of which such treatment works are a part constitutes the most economical and cost-effective combination of treatment works over the life of the project to meet the requirements of this Act, including, but not limited to, consideration of construction costs, operation, maintenance, and replacement costs.

(c) In furtherance of the policy set forth in subsection (a) of this section, the Administrator shall require value engineering review in connection with any treatment works, prior to approval of any grant for the erection, building, acquisition, alteration, remodeling, improvement, or extension of such treatment works, in any case in which the cost of such erection, building, acquisition, alteration, remodeling, improvement, or extension is projected to be in excess of $10,000,000. For purposes of this subsection, the term "value engineering review" means a specialized cost control technique which uses a systematic and creative approach to identify and to focus on unnecessarily high cost in a project in order to arrive at a cost saving without sacrificing the reliability or efficiency of the project.

(d) This section applies to projects for waste treatment and management for which no treatment works including a facilities plan for such project have received Federal financial assistance for

the preparation of construction plans and specifications under this Act before the date of enactment of this section.

(33 U.S.C. 1298)

STATE CERTIFICATION OF PROJECTS

SEC. 219. Whenever the Governor of a State which has been delegated sufficient authority to administer the construction grant program under this title in that State certifies to the Administrator that a grant application meets applicable requirements of Federal and State law for assistance under this title, the Administrator shall approve or disapprove such application within 45 days of the date of receipt of such application. If the Administrator does not approve or disapprove such application within 45 days of receipt, the application shall be deemed approved. If the Administrator disapproves such application the Administrator shall state in writing the reasons for such disapproval. Any grant approved or deemed approved under this section shall be subject to amounts provided in appropriation Acts.

(33 U.S.C. 1299)

SEC. 220. PILOT PROGRAM FOR ALTERNATIVE WATER SOURCE PROJECTS.

(a) POLICY.—Nothing in this section shall be construed to affect the application of section 101(g) of this Act and all of the provisions of this section shall be carried out in accordance with the provisions of section 101(g).

(b) IN GENERAL.—The Administrator may establish a pilot program to make grants to State, interstate, and intrastate water resource development agencies (including water management districts and water supply authorities), local government agencies, private utilities, and nonprofit entities for alternative water source projects to meet critical water supply needs.

(c) ELIGIBLE ENTITY.—The Administrator may make grants under this section to an entity only if the entity has authority under State law to develop or provide water for municipal, industrial, and agricultural uses in an area of the State that is experiencing critical water supply needs.

(d) SELECTION OF PROJECTS.—

(1) LIMITATION.—A project that has received funds under the reclamation and reuse program conducted under the Reclamation Projects Authorization and Adjustment Act of 1992 (43 U.S.C. 390h et seq.) shall not be eligible for grant assistance under this section.

(2) ADDITIONAL CONSIDERATION.—In making grants under this section, the Administrator shall consider whether the project is located within the boundaries of a State or area referred to in section 1 of the Reclamation Act of June 17, 1902 (32 Stat. 385), and within the geographic scope of the reclamation and reuse program conducted under the Reclamation Projects Authorization and Adjustment Act of 1992 (43 U.S.C. 390h et seq.).

(3) GEOGRAPHICAL DISTRIBUTION.—Alternative water source projects selected by the Administrator under this section shall reflect a variety of geographical and environmental conditions.

(e) COMMITTEE RESOLUTION PROCEDURE.—

(1) IN GENERAL.—No appropriation shall be made for any alternative water source project under this section, the total Federal cost of which exceeds $3,000,000, if such project has not been approved by a resolution adopted by the Committee on Transportation and Infrastructure of the House of Representatives or the Committee on Environment and Public Works of the Senate.

(2) REQUIREMENTS FOR SECURING CONSIDERATION.—For purposes of securing consideration of approval under paragraph (1), the Administrator shall provide to a committee referred to in paragraph (1) such information as the committee requests and the non-Federal sponsor shall provide to the committee information on the costs and relative needs for the alternative water source project.

(f) USES OF GRANTS.—Amounts from grants received under this section may be used for engineering, design, construction, and final testing of alternative water source projects designed to meet critical water supply needs. Such amounts may not be used for planning, feasibility studies or for operation, maintenance, replacement, repair, or rehabilitation.

(g) COST SHARING.—The Federal share of the eligible costs of an alternative water source project carried out using assistance made available under this section shall not exceed 50 percent.

(h) REPORTS.—On or before September 30, 2004, the Administrator shall transmit to Congress a report on the results of the pilot program established under this section, including progress made toward meeting the critical water supply needs of the participants in the pilot program.

(i) DEFINITIONS.—In this section, the following definitions apply:

(1) ALTERNATIVE WATER SOURCE PROJECT.—The term ''alternative water source project'' means a project designed to provide municipal, industrial, and agricultural water supplies in an environmentally sustainable manner by conserving, managing, reclaiming, or reusing water or wastewater or by treating wastewater. Such term does not include water treatment or distribution facilities.

(2) CRITICAL WATER SUPPLY NEEDS.—The term ''critical water supply needs'' means existing or reasonably anticipated future water supply needs that cannot be met by existing water supplies, as identified in a comprehensive statewide or regional water supply plan or assessment projected over a planning period of at least 20 years.

(j) AUTHORIZATION OF APPROPRIATIONS.—There is authorized to be appropriated to carry out this section a total of $75,000,000 for fiscal years 2002 through 2004. Such sums shall remain available until expended.

(33 U.S.C. 1300)

SEC. 221. SEWER OVERFLOW CONTROL GRANTS.

(a) IN GENERAL.—In any fiscal year in which the Administrator has available for obligation at least $1,350,000,000 for the purposes of section 601—

(1) the Administrator may make grants to States for the purpose of providing grants to a municipality or municipal entity for planning, design, and construction of treatment works to intercept, transport, control, or treat municipal combined sewer overflows and sanitary sewer overflows; and

(2) subject to subsection (g), the Administrator may make a direct grant to a municipality or municipal entity for the purposes described in paragraph (1).

(b) PRIORITIZATION.—In selecting from among municipalities applying for grants under subsection (a), a State or the Administrator shall give priority to an applicant that—

(1) is a municipality that is a financially distressed community under subsection (c);

(2) has implemented or is complying with an implementation schedule for the nine minimum controls specified in the CSO control policy referred to in section 402(q)(1) and has begun implementing a long-term municipal combined sewer overflow control plan or a separate sanitary sewer overflow control plan;

(3) is requesting a grant for a project that is on a State's intended use plan pursuant to section 606(c); or

(4) is an Alaska Native Village.

(c) FINANCIALLY DISTRESSED COMMUNITY.—

(1) DEFINITION.—In subsection (b), the term ''financially distressed community'' means a community that meets affordability criteria established by the State in which the community is located, if such criteria are developed after public review and comment.

(2) CONSIDERATION OF IMPACT ON WATER AND SEWER RATES.—In determining if a community is a distressed community for the purposes of subsection (b), the State shall consider, among other factors, the extent to which the rate of growth of a community's tax base has been historically slow such that implementing a plan described in subsection (b)(2) would result in a significant increase in any water or sewer rate charged by the community's publicly owned wastewater treatment facility.

(3) INFORMATION TO ASSIST STATES.—The Administrator may publish information to assist States in establishing affordability criteria under paragraph (1).

(d) COST-SHARING.—The Federal share of the cost of activities carried out using amounts from a grant made under subsection (a) shall be not less than 55 percent of the cost. The non-Federal share of the cost may include, in any amount, public and private funds and in-kind services, and may include, notwithstanding section 603(h), financial assistance, including loans, from a State water pollution control revolving fund.

(e) ADMINISTRATIVE REPORTING REQUIREMENTS.—If a project receives grant assistance under subsection (a) and loan assistance from a State water pollution control revolving fund and the loan assistance is for 15 percent or more of the cost of the project, the project may be administered in accordance with State water pollution control revolving fund administrative reporting requirements for the purposes of streamlining such requirements.

(f) AUTHORIZATION OF APPROPRIATIONS.—There is authorized to be appropriated to carry out this section $750,000,000 for each

of fiscal years 2002 and 2003. Such sums shall remain available until expended.

(g) ALLOCATION OF FUNDS.—

(1) FISCAL YEAR 2002.—Subject to subsection (h), the Administrator shall use the amounts appropriated to carry out this section for fiscal year 2002 for making grants to municipalities and municipal entities under subsection (a)(2), in accordance with the criteria set forth in subsection (b).

(2) FISCAL YEAR 2003.—Subject to subsection (h), the Administrator shall use the amounts appropriated to carry out this section for fiscal year 2003 as follows:

(A) Not to exceed $250,000,000 for making grants to municipalities and municipal entities under subsection (a)(2), in accordance with the criteria set forth in subsection (b).

(B) All remaining amounts for making grants to States under subsection (a)(1), in accordance with a formula to be established by the Administrator, after providing notice and an opportunity for public comment, that allocates to each State a proportional share of such amounts based on the total needs of the State for municipal combined sewer overflow controls and sanitary sewer overflow controls identified in the most recent survey conducted pursuant to section 516(b)(1).

(h) ADMINISTRATIVE EXPENSES.—Of the amounts appropriated to carry out this section for each fiscal year—

(1) the Administrator may retain an amount not to exceed 1 percent for the reasonable and necessary costs of administering this section; and

(2) the Administrator, or a State, may retain an amount not to exceed 4 percent of any grant made to a municipality or municipal entity under subsection (a), for the reasonable and necessary costs of administering the grant.

(i) REPORTS.—Not later than December 31, 2003, and periodically thereafter, the Administrator shall transmit to Congress a report containing recommended funding levels for grants under this section. The recommended funding levels shall be sufficient to ensure the continued expeditious implementation of municipal combined sewer overflow and sanitary sewer overflow controls nationwide.

(33 U.S.C. 1301)

TITLE III—STANDARDS AND ENFORCEMENT

EFFLUENT LIMITATIONS

SEC. 301. (a) Except as in compliance with this section and sections 302, 306, 307, 318, 402, and 404 of this Act, the discharge of any pollutant by any person shall be unlawful.

(b) In order to carry out the objective of this Act there shall be achieved—

(1)(A) not later than July 1, 1977, effluent limitations for point sources, other than publicly owned treatment works, (i) which shall require the application of the best practicable control technology currently available as defined by the Administrator pursuant to section 304(b) of this Act, or (ii) in the case

of a discharge into a publicly owned treatment works which meets the requirements of subparagraph (B) of this paragraph, which shall require compliance with any applicable pretreatment requirements and any requirements under section 307 of this Act; and

(B) for publicly owned treatment works in existence on July 1, 1977, or approved pursuant to section 203 of this Act prior to June 30, 1974 (for which construction must be completed within four years of approval), effluent limitations based upon secondary treatment as defined by the Administrator pursuant to section 304(d)(1) of this Act; or,

(C) not later than July 1, 1977, any more stringent limitation, including those necessary to meet water quality standards, treatment standards, or schedule of compliance, established pursuant to any State law or regulations, (under authority preserved by section 510) or any other Federal law or regulation, or required to implement any applicable water quality standard established pursuant to this Act.

(2)(A) for pollutants identified in subparagraphs (C), (D), and (F) of this paragraph, effluent limitations for categories and classes of point sources, other than publicly owned treatment works, which (i) shall require application of the best available technology economically achievable for such category or class, which will result in reasonable further progress toward the national goal of eliminating the discharge of all pollutants, as determined in accordance with regulations issued by the Administrator pursuant to section 304(b)(2) of this Act, which such effluent limitations shall require the elimination of discharges of all pollutants if the Administrator finds, on the basis of information available to him (including information developed pursuant to section 315), that such elimination is technologically and economically achievable for category or class of point sources as determined in accordance with regulations issued by the Administrator pursuant to section 304(b)(2) of this Act, or (ii) in the case of the introduction of a pollutant into a publicly owned treatment works which meets the requirements of subparagraph (B) of this paragraph, shall require compliance with any applicable pretreatment requirements and any other requirement under section 307 of this Act;

[(B) subparagraph (B) repealed by section 21(b) of P.L. 97–117.]

(C) with respect to all toxic pollutants referred to in table 1 of Committee Print Numbered 95–30 of the Committee on Public Works and Transportation of the House of Representatives compliance with effluent limitations in accordance with subparagraph (A) of this paragraph as expeditiously as practicable but in no case later than three years after the date such limitations are promulgated under section 304(b), and in no case later than March 31, 1989;

(D) for all toxic pollutants listed under paragraph (1) of subsection (a) of section 307 of this Act which are not referred to in subparagraph (C) of this paragraph compliance with effluent limitation in accordance with subparagraph (A) of this paragraph as expeditiously as practicable, but in no case later

than three years after the date such limitations are promulgated under section 304(b), and in no case later than March 31, 1989;

(E) as expeditiously as practicable but in no case later than three years after the date such limitations are promulgated under section 304(b), and in no case later than March 31, 1989, compliance with effluent limitations for categories and classes of point sources, other than publicly owned treatment works, which in the case of pollutants identified pursuant to section 304(a)(4) of this Act shall require application of the best conventional pollutant control technology as determined in accordance with regulations issued by the Administrator pursuant to section 304(b)(4) of this Act; and

(F) for all pollutants (other than those subject to subparagraphs (C), (D), or (E) of this paragraph) compliance with effluent limitations in accordance with subparagraph (A) of this paragraph as expeditiously as practicable but in no case later than 3 years after the date such limitations are established, and in no case later than March 31, 1989.

(3)(A) for effluent limitations under paragraph (1)(A)(i) of this subsection promulgated after January 1, 1982, and requiring a level of control substantially greater or based on fundamentally different control technology than under permits for an industrial category issued before such date, compliance as expeditiously as practicable but in no case later than three years after the date such limitations are promulgated under section 304(b), and in no case later than March 31, 1989; and

(B) for any effluent limitation in accordance with paragraph (1)(A)(i), (2)(A)(i), or (2)(E) of this subsection established only on the basis of section 402(a)(1) in a permit issued after enactment of the Water Quality Act of 1987, compliance as expeditiously as practicable but in no case later than three years after the date such limitations are established, and in no case later than March 31, 1989.

(c) The Administrator may modify the requirements of subsection (b)(2)(A) of this section with respect to any point source for which a permit application is filed after July 1, 1977, upon a showing by the owner or operator of such point source satisfactory to the Administrator that such modified requirements (1) will represent the maximum use of technology within the economic capability of the owner or operator; and (2) will result in reasonable further progress toward the elimination of the discharge of pollutants.

(d) Any effluent limitation required by paragraph (2) of subsection (b) of this section shall be reviewed at least every five years and, if appropriate, revised pursuant to the procedure established under such paragraph.

(e) Effluent limitations established pursuant to this section or section 302 of this Act shall be applied to all point sources of discharge of pollutants in accordance with the provisions of this Act.

(f) Notwithstanding any other provisions of this Act it shall be unlawful to discharge any radiological, chemical, or biological warfare agent, any high-level radioactive waste, or any medical waste, into the navigable waters.

(g) MODIFICATIONS FOR CERTAIN NONCONVENTIONAL POLLUTANTS.—

(1) GENERAL AUTHORITY.—The Administrator, with the concurrence of the State, may modify the requirements of subsection (b)(2)(A) of this section with respect to the discharge from any point source of ammonia, chlorine, color, iron, and total phenols (4AAP) (when determined by the Administrator to be a pollutant covered by subsection (b)(2)(F)) and any other pollutant which the Administrator lists under paragraph (4) of this subsection.

(2) REQUIREMENTS FOR GRANTING MODIFICATIONS.—A modification under this subsection shall be granted only upon a showing by the owner or operator of a point source satisfactory to the Administrator that—

(A) such modified requirements will result at a minimum in compliance with the requirements of subsection (b)(1)(A) or (C) of this section, whichever is applicable;

(B) such modified requirements will not result in any additional requirements on any other point or nonpoint source; and

(C) such modification will not interfere with the attainment or maintenance of that water quality which shall assure protection of public water supplies, and the protection and propagation of a balanced population of shellfish, fish, and wildlife, and allow recreational activities, in and on the water and such modification will not result in the discharge of pollutants in quantities which may reasonably be anticipated to pose an unacceptable risk to human health or the environment because of bioaccumulation, persistency in the environment, acute toxicity, chronic toxicity (including carcinogenicity, mutagenicity or teratogenicity), or synergistic propensities.

(3) LIMITATION ON AUTHORITY TO APPLY FOR SUBSECTION (c) MODIFICATION.—If an owner or operator of a point source applies for a modification under this subsection with respect to the discharge of any pollutant, such owner or operator shall be eligible to apply for modification under subsection (c) of this section with respect to such pollutant only during the same time-period as he is eligible to apply for a modification under this subsection.

(4) PROCEDURES FOR LISTING ADDITIONAL POLLUTANTS.—

(A) GENERAL AUTHORITY.—Upon petition of any person, the Administrator may add any pollutant to the list of pollutants for which modification under this section is authorized (except for pollutants identified pursuant to section 304(a)(4) of this Act, toxic pollutants subject to section 307(a) of this Act, and the thermal component of discharges) in accordance with the provisions of this paragraph.

(B) REQUIREMENTS FOR LISTING.—

(i) SUFFICIENT INFORMATION.—The person petitioning for listing of an additional pollutant under this subsection shall submit to the Administrator sufficient information to make the determinations required by this subparagraph.

(ii) TOXIC CRITERIA DETERMINATION.—The Administrator shall determine whether or not the pollutant

meets the criteria for listing as a toxic pollutant under section 307(a) of this Act.

(iii) LISTING AS TOXIC POLLUTANT.—If the Administrator determines that the pollutant meets the criteria for listing as a toxic pollutant under section 307(a), the Administrator shall list the pollutant as a toxic pollutant under section 307(a).

(iv) NONCONVENTIONAL CRITERIA DETERMINATION.—If the Administrator determines that the pollutant does not meet the criteria for lising as a toxic pollutant under such section and determines that adequate test methods and sufficient data are available to make the determinations required by paragraph (2) of this subsection with respect to the pollutant, the Administrator shall add the pollutant to the list of pollutants specified in paragraph (1) of this subsection for which modifications are authorized under this subsection.

(C) REQUIREMENTS FOR FILING OF PETITIONS.—A petition for lising of a pollutant under this paragraph—

(i) must be filed not later than 270 days after the date of promulgation of an applicable effluent guideline under section 304;

(ii) may be filed before promulgation of such guideline; and

(iii) may be filed with an application for a modification under paragraph (1) with respect to the discharge of such pollutant.

(D) DEADLINE FOR APPROVAL OF PETITION.—A decision to add a pollutant to the list of pollutants for which modifications under this subsection are authorized must be made within 270 days after the date of promulgation of an applicable effluent guideline under section 304.

(E) BURDEN OF PROOF.—The burden of proof for making the determinations under subparagraph (B) shall be on the petitioner.

(5) REMOVAL OF POLLUTANTS.—The Administrator may remove any pollutant from the list of pollutants for which modifications are authorized under this subsection if the Administrator determines that adequate test methods and sufficient data are no longer available for determining whether or not modifications may be granted with respect to such pollutant under paragraph (2) of this subsection.

(h) The Administrator, with the concurrence of the State, may issue a permit under section 402 which modifies the requirements of subsection (b)(1)(B) of this section with respect to the discharge of any pollutant from a publicly owned treatment works into marine waters, if the applicant demonstrates to the satisfaction of the Administrator that—

(1) there is an applicable water quality standard specific to the pollutant for which the modification is requested, which has been identified under section 304(a)(6) of this Act;

(2) the discharge of pollutants in accordance with such modified requirements will not interfere, alone or in combination with pollutants from other sources, with the attainment or

maintenance of that water quality which assures protection of public water supplies and the protection and propagation of a balanced, indigenous population of shellfish, fish and wildlife, and allows recreational activities, in and on the water;

(3) the applicant has established a system for monitoring the impact of such discharge on a representative sample of aquatic biota, to the extent practicable, and the scope of such monitoring is limited to include only those scientific investigations which are necessary to study the effects of the proposed discharge;

(4) such modified requirements will not result in any additional requirements on any other point or nonpoint source;

(5) all applicable pretreatment requirements for sources introducing waste into such treatment works will be enforced;

(6) in the case of any treatment works serving a population of 50,000 or more, with respect to any toxic pollutant introduced into such works by an industrial discharger for which pollutant there is no applicable pretreatment requirement in effect, sources introducing waste into such works are in compliance with all applicable pretreatment requirements, the applicant will enforce such requirements, and the applicant has in effect a pretreatment program which, in combination with the treatment of discharges from such works, removes the same amount of such pollutant as would be removed if such works were to apply secondary treatment to discharges and if such works had no pretreatment program with respect to such pollutant;

(7) to the extent practicable the applicant has established a schedule of activities designed to eliminate the entrance of toxic pollutants from nonindustrial sources into such treatment works;

(8) there will be no new or substantially increased discharges from the point source of the pollutant to which the modification applies above that volume of discharge specified in the permit;

(9) the applicant at the time such modification becomes effective will be discharging effluent which has received at least primary or equivalent treatment and which meets the criteria established under section 304(a)(1) of this Act after initial mixing in the waters surrounding or adjacent to the point at which such effluent is discharged.

For the purposes of this subsection the phrase "the discharge of any pollutant into marine waters" refers to a discharge into deep waters of the territorial sea or the waters of the contiguous zone, or into saline estuarine waters where there is strong tidal movement and other hydrological and geological characteristics which the Administrator determines necessary to allow compliance with paragraph (2) of this subsection, and section 101(a)(2) of this Act. For the purposes of paragraph (9), "primary or equivalent treatment" means treatment by screening, sedimentation, and skimming adequate to remove at least 30 percent of the biological oxygen demanding material and of the suspended solids in the treatment works influent, and disinfection, where appropriate. A municipality which applies secondary treatment shall be eligible to receive a permit pursuant to this subsection which modifies the re-

quirements of subsection (b)(1)(B) of this section with respect to the discharge of any pollutant from any treatment works owned by such municipality into marine waters. No permit issued under this subsection shall authorize the discharge of sewage sludge into marine waters. In order for a permit to be issued under this subsection for the discharge of a pollutant into marine waters, such marine waters must exhibit characteristics assuring that water providing dilution does not contain significant amounts of previously discharged effluent from such treatment works. No permit issued under this subsection shall authorize the discharge of any pollutant into saline estuarine waters which at the time of application do not support a balanced indigenous population of shellfish, fish and wildlife, or allow recreation in and on the waters or which exhibit ambient water quality below applicable water quality standards adopted for the protection of public water supplies, shellfish, fish and wildlife or recreational activities or such other standards necessary to assure support and protection of such uses. The prohibition contained in the preceding sentence shall apply without regard to the presence or absence of a causal relationship between such characteristics and the applicant's current or proposed discharge. Notwithstanding any other provisions of this subsection, no permit may be issued under this subsection for discharge of a pollutant into the New York Bight Apex consisting of the ocean waters of the Atlantic Ocean westward of 73 degrees 30 minutes west longitude and northward of 40 degrees 10 minutes north latitude.

(i)(1) Where construction is required in order for a planned or extisting publicly owned treatment works to achieve limitations under subsection (b)(1)(B) or (b)(1)(C) of this section, but (A) construction cannot be completed with the time required in such subsection, or (B) the United States has failed to make financial assistance under this Act available in time to achieve such limitations by the time specified in such subsection, the owner or operator of such treatment works may request the Administrator (or if appropriate the State) to issue a permit pursuant to section 402 of this Act or to modify a permit issued pursuant to that section to extend such time for compliance. Any such request shall be filed with the Administrator (or if appropriate the State) within 180 days after the date of enactment of the Water Quality Act of 1987. The Administrator (or if appropriate the State) may grant such request and issue or modify such a permit, which shall contain a schedule of compliance for the publicly owned treatment works based on the earliest date by which such financial assistance will be available from the United States and construction can be completed, but in no event later than July 1, 1988, and shall contain such other terms and conditions, including those necessary to carry out subsections (b) through (g) of section 201 of this Act, section 307 of this Act, and such interim effluent limitations applicable to that treatment works as the Administrator determines are necessary to carry out the provisions of this Act.

(2)(A) Where a point source (other than a publicly owned treatment works) will not achieve the requirements of subsections (b)(1)(A) and (b)(1)(C) of this section and—

(i) if a permit issued prior to July 1, 1977, to such point source is based upon a discharge into a publicly owned treatment works; or

(ii) if such point source (other than a publicly owned treatment works) had before July 1, 1977, a contract (enforceable against such point source) to discharge into a publicly owned treatment works; or

(iii) if either an application made before July 1, 1977, for a construction grant under this Act for a publicly owned treatment works, or engineering or architectural plans or working drawings made before July 1, 1977, for a publicly owned treatment works, show that such point source was to discharge into such publicly owned treatment works,

and such publicly owned treatment works is presently unable to accept such discharge without construction, and in the case of a discharge to an existing publicly owned treatment works, such treatment works has an extension pursuant to paragraph (1) of this subsection, the owner or operator of such point source may request the Administrator (or if appropriate the State) to issue or modify such a permit pursuant to such section 402 to extend such time for compliance. Any such request shall be filed with the Administrator (or if appropriate the State) within 180 days after the date of enactment of this subsection or the filing of a request by the appropriate publicly owned treatment works under paragraph (1) of this subsection, whichever is later. If the Administrator (or if appropriate the State) finds that the owner or operator of such point source has acted in good faith, he may grant such request and issue or modify such a permit, which shall contain a schedule of compliance for the point source to achieve the requirements of subsections (b)(1)(A) and (C) of this section and shall contain such other terms and conditions, including pretreatment and interim effluent limitations and water conservation requirements applicable to that point source, as the Administrator determines are necessary to carry out the provisions of this Act.

(B) No time modification granted by the Administrator (or if appropriate the State) pursuant to paragraph (2)(A) of this subsection shall extend beyond the earliest date practicable for compliance or beyond the date of any extension granted to the appropriate publicly owned treatment works pursuant to paragraph (1) of this subsection, but in no event shall it extend beyond July 1, 1988, and no such time modification shall be granted unless (i) the publicly owned treatment works will be in operation and available to the point source before July 1, 1988, and will meet the requirements to subsections (b)(1) (B) and (C) of this section after receiving the discharge from that point source; and (ii) the point source and the publicly owned treatment works have entered into an enforceable contract requiring the point source to discharge into the publicly owned treatment works, the owner or operator of such point source to pay the costs required under section 204 of this Act, and the publicly owned treatment works to accept the discharge from the point source; and (iii) the permit for such point source requires point source to meet all requirements under section 307 (a) and (b) during the period of such time modification.

(j)(1) Any application filed under this section for a modification of the provisions of—

(A) subsection (b)(1)(B) under subsection (h) of this section shall be filed not later that [1] the 365th day which begins after the date of enactment of the Municipal Wastewater Treatment Construction Grant Amendments of 1981, except that a publicly owned treatment works which prior to December 31, 1982, had a contractual arrangement to use a portion of the capacity of an ocean outfall operated by another publicly owned treatment works which has applied for or received modification under subsection (h), may apply for a modification of subsection (h) in its own right not later than 30 days after the date of the enactment of the Water Quality Act of 1987, and except as provided in paragraph (5);

(B) subsection (b)(2)(A) as it applies to pollutants identified in subsection (b)(2)(F) shall be filed not later than 270 days after the date of promulgation of an applicable effluent guideline under section 304 or not later than 270 days after the date of enactment of the Clean Water Act of 1977, whichever is later.

(2) Subject to paragraph (3) of this section, any application for a modification filed under subsection (g) of this section shall not operate to stay any requirement under this Act, unless in the judgment of the Administrator such a stay or the modification sought will not result in the discharge of pollutants in quantities which may reasonably be anticipated to pose an unacceptable risk to human health or the environment because of bioaccumulation, persistency in the environment, acute toxicity, chronic toxicity (including carcinogenicity, mutagenicity or teratogenicity), or synergistic propensities, and that there is a substantial likelihood that the applicant will succeed on the merits of such application. In the case of an application filed under subsection (g) of this section, the Administrator may condition any stay granted under this paragraph on requiring the filing of a bond or other appropriate security to assure timely compliance with the requirements from which a modification is sought.

(3) COMPLIANCE REQUIREMENTS UNDER SUBSECTION (g).—

(A) EFFECT OF FILING.—An application for a modification under subsection (g) and a petition for listing of a pollutant as a pollutant for which modifications are authorized under such subsection shall not stay the requirement that the person seeking such modification or listing comply with effluent limitations under this Act for all pollutants not the subject of such application or petition.

(B) EFFECT OF DISAPPROVAL.—Disapproval of an application for a modification under subsection (g) shall not stay the requirement that the person seeking such modification comply with all applicable effluent limitations under this Act.

(4) DEADLINE FOR SUBSECTION (g) DECISION.—An application for a modification with respect to a pollutant filed under subsection (g) must be approved or disapproved not later than 365 days after the date of such filing; except that in any case in which a petition for listing such pollutant as a pollutant for which modifications are authorized under such subsection is

[1] So in law. Probably should be "than".

approved, such application must be approved or disapproved not later than 365 days after the date of approval of such petition.

(5) EXTENSION OF APPLICATION DEADLINE.—

(A) IN GENERAL.—In the 180-day period beginning on the date of the enactment of this paragraph, the city of San Diego, California, may apply for a modification pursuant to subsection (h) of the requirements of subsection (b)(1)(B) with respect to biological oxygen demand and total suspended solids in the effluent discharged into marine waters.

(B) APPLICATION.—An application under this paragraph shall include a commitment by the applicant to implement a waste water reclamation program that, at a minimum, will—

(i) achieve a system capacity of 45,000,000 gallons of reclaimed waste water per day by January 1, 2010; and

(ii) result in a reduction in the quantity of suspended solids discharged by the applicant into the marine environment during the period of the modification.

(C) ADDITIONAL CONDITIONS.—The Administrator may not grant a modification pursuant to an application submitted under this paragraph unless the Administrator determines that such modification will result in removal of not less than 58 percent of the biological oxygen demand (on an annual average) and not less than 80 percent of total suspended solids (on a monthly average) in the discharge to which the application applies.

(D) PRELIMINARY DECISION DEADLINE.—The Administrator shall announce a preliminary decision on an application submitted under this paragraph not later than 1 year after the date the application is submitted.

(k) In the case of any facility subject to a permit under section 402 which proposes to comply with the requirements of subsection (b)(2)(A) or (b)(2)(E) of this section by replacing existing production capacity with an innovative production process which will result in an effluent reduction significantly greater than that required by the limitation otherwise applicable to such facility and moves toward the national goal of eliminating the discharge of all pollutants, or with the installation of an innovative control technique that has a substantial likelihood for enabling the facility to comply with the applicable effluent limitation by achieving a significantly greater effluent reduction than that required by the applicable effluent limitation and moves toward the national goal of eliminating the discharge of all pollutants, or by achieving the required reduction with an innovative system that has the potential for significantly lower costs than the systems which have been determined by the Administrator to be economically achievable, the Administrator (or the State with an approved program under section 402, in consultation with the Administrator) may establish a date for compliance under subsection (b)(2)(A) or (b)(2)(E) of this section no later than two years after the date for compliance with such effluent limitation which would otherwise be applicable under such sub-

section, if it is also determined that such innovative system has the potential for industrywide application.

(l) Other than as provided in subsection (n) of this section, the Administrator may not modify any requirement of this section as it applies to any specific pollutant which is on the toxic pollutant list under section 307(a)(1) of this Act.

(m)(1) The Administrator, with the concurrence of the State, may issue a permit under section 402 which modifies the requirements of subsections (b)(1)(A) and (b)(2)(E) of this section, and of section 403, with respect to effluent limitations to the extent such limitations relate to biochemical oxygen demand and pH from discharges by an industrial discharger in such State into deep waters of the territorial seas, if the applicant demonstrates and the Administrator finds that—

(A) the facility for which modification is sought is covered at the time of the enactment of this subsection by National Pollutant Discharge Elimination System permit number CA0005894 or CA0005282;

(B) the energy and environmental costs of meeting such requirements of subsections (b)(1)(A) and (b)(2)(E) and section 403 exceed by an unreasonable amount the benefits to be obtained, including the objectives of this Act;

(C) the applicant has established a system for monitoring the impact of such discharges on a representative sample of aquatic biota;

(D) such modified requirements will not result in any additional requirements on any other point or nonpoint source;

(E) there will be no new or substantially increased discharges from the point source of the pollutant to which the modification applies above that volume of discharge specified in the permit;

(F) the discharge is into waters where there is strong tidal movement and other hydrological and geological characteristics which are necessary to allow compliance with this subsection and section 101(a)(2) of this Act;

(G) the applicant accepts as a condition to the permit a contractural obligation to use funds in the amount required (but not less than $250,000 per year for ten years) for research and development of water pollution control technology, including but not limited to closed cycle technology;

(H) the facts and circumstances present a unique situation which, if relief is granted, will not establish a precedent or the relaxation of the requirements of this Act applicable to similarly situated discharges; and

(I) no owner or operator of a facility comparable to that of the applicant situated in the United States has demonstrated that it would be put at a competitive disadvantage to the applicant (or the parent company or any subsidiary thereof) as a result of the issuance of a permit under this subsection.

(2) The effluent limitations established under a permit issued under paragraph (1) shall be sufficient to implement the applicable State water quality standards, to assure the protection of public water supplies and protection and propagation of a balanced, indigenous population of shellfish, fish, fauna, wildlife, and other aquatic organisms, and to allow recreational activities in and on the

water. In setting such limitations, the Administrator shall take into account any seasonal variations and the need for an adequate margin of safety, considering the lack of essential knowledge concerning the relationship between effluent limitations and water quality and the lack of essential knowledge of the effects of discharges on beneficial uses of the receiving waters.

(3) A permit under this subsection may be issued for a period not to exceed five years, and such a permit may be renewed for one additional period not to exceed five years upon a demonstration by the applicant and a finding by the Administrator at the time of application for any such renewal that the provisions of this subsection are met.

(4) The Administrator may terminate a permit issued under this subsection if the Administrator determines that there has been a decline in ambient water quality of the receiving waters during the period of the permit even if a direct cause and effect relationship cannot be shown: *Provided*, That if the effluent from a source with a permit issued under this subsection is contributing to a decline in ambient water quality of the receiving waters, the Administrator shall terminate such permit.

(n) FUNDAMENTALLY DIFFERENT FACTORS.—

(1) GENERAL RULE.—The Administrator, with the concurrance of the State, may establish an alternative requirement under subsection (b)(2) or section 307(b) for a facility that modifies the requirements of national effluent limitation guidelines or categorical pretreatment standards that would otherwise be applicable to such facility, if the owner or operator of such facility demonstrates to the satisfaction of the Administrator that—

(A) the facility is fundamentally different with respect to the factors (other than cost) specified in section 304(b) or 304(g) and considered by the Administrator in establishing such national effluent limitation guidelines or categorical pretreatment standards;

(B) the application—

(i) is based solely on information and supporting data submitted to the Administrator during the rule making for establishment of the applicable national effluent limitation guidelines or categorical pretreatment standard specifically raising the factors that are fundamentally different for such facility; or

(ii) is based on information and supporting data referred to in clause (i) and information and supporting data the applicant did not have a reasonable opportunity to submit during such rulemaking;

(C) the alternative requirement is no less stringent than justified by the fundamental difference; and

(D) the alternative requirement will not result in a non-water quality environmental impact which is markedly more adverse than the impact considered by the Administrator in establishing such national affluent limitation guideline or categorical pretreatment standard.

(2) TIME LIMIT FOR APPLICATIONS.—An application for an alternative requirement which modifies the requirements of an effluent limitation or pretreatment standard under this sub-

section must be submitted to the Administrator within 180 days after the date on which such limitation or standard is established or revised, as the case may be.

(3) TIME LIMIT FOR DECISION.—The Administrator shall approve or deny by final agency action an application submitted under this subsection within 180 days after the date such application is filed with the Administrator.

(4) SUBMISSION OF INFORMATION.—The Administrator may allow an applicant under this subsection to submit information and supporting data until the earlier of the date the application is approved or denied or the last day that the Administrator has to approve or deny such application.

(5) TREATMENT OF PENDING APPLICATIONS.—For the purposes of this subsection, an application for an alternative requirement based on fundamentally different factors which is pending on the date of the enactment of this subsection shall be treated as having been submitted to the Administrator on the 180th day following such date of enactment. The applicant may amend the application to take into account the provisions of this subsection.

(6) EFFECT OF SUBMISSION OF APPLICATION.—An application for an alternative requirement under this subsection shall not stay the applicant's obligation to comply with the effluent limitation guideline or categorical pretreatment standard which is the subject of the application.

(7) EFFECT OF DENIAL.—If an application for an alternative requirement which modifies the requirements of an effluent limitation or pretreatment standard under this subsection is denied by the Administrator, the applicant must comply with such limitation or standard as established or revised, as the case may be.

(8) REPORTS.—By January 1, 1997, and January 1 of every odd-numbered year thereafter, the Administrator shall submit to the Committee on Environment and Public Works of the Senate and the Committee on Transportation and Infrastructure of Representatives a report on the status of applications for alternative requirements which modify the requirements of effluent limitations under section 301 or 304 of this Act or any national categorical pretreatment standard under section 307(b) of this Act filed before, on, or after such date of enactment.

(o) APPLICATION FEES.—The Administrator shall prescribe and collect from each applicant fees reflecting the reasonable administrative costs incurred in reviewing and processing applications for modifications submitted to the Administrator pursuant to subsections (c), (g), (i), (k), (m), and (n) of section 301, section 304(d)(4), and section 316(a) of this Act. All amounts collected by the Administrator under this subsection shall be deposited into a special fund of the Treasury entitled "Water Permits and Related Services" which shall thereafter be available for appropriation to carry out activities of the Environmental Protection Agency for which such fees were collected.

(p) MODIFIED PERMIT FOR COAL REMINING OPERATIONS.—

(1) IN GENERAL.—Subject to paragraphs (2) through (4) of this subsection, the Administrator, or the State in any case

which the State has an approved permit program under section 402(b), may issue a permit under section 402 which modifies the requirements of subsection (b)(2)(A) of this section with respect to the pH level of any pre-existing discharge, and with respect to pre-existing discharges of iron and manganese from the remined area of any coal remining operation or with respect to the pH level or level of iron or manganese in any pre-existing discharge affected by the remining operation. Such modified requirements shall apply the best available technology economically achievable on a case-by-case basis, using best professional judgment, to set specific numerical effluent limitations in each permit.

(2) LIMITATIONS.—The Administrator or the State may only issue a permit pursuant to paragraph (1) if the applicant demonstrates to the satisfaction of the Administrator or the State, as the case may be, that the coal remining operation will result in the potential for improved water quality from the remining operation but in no event shall such a permit allow the pH level of any discharge, and in no event shall such a permit allow the discharges of iron and manganese, to exceed the levels being discharged from the remined area before the coal remining operation begins. No discharge from, or affected by, the remining operation shall exceed State water quality standards established under section 303 of this Act.

(3) DEFINITIONS.—For purposes of this subsection—

(A) COAL REMINING OPERATION.—The term "coal remining operation" means a coal mining operation which begins after the date of the enactment of this subsection at a site on which coal mining was conducted before the effective date of the Surface Mining Control and Reclamation Act of 1977.

(B) REMINED AREA.—The term "remined area" means only that area of any coal remining operation on which coal mining was conducted before the effective date of the Surface Mining Control and Reclamation Act of 1977.

(C) PRE-EXISTING DISCHARGE.—The term "pre-existing discharge" means any discharge at the time of permit application under this subsection.

(4) APPLICABILITY OF STRIP MINING LAWS.—Nothing in this subsection shall affect the application of the Surface Mining Control and Reclamation Act of 1977 to any coal remining operation, including the application of such Act to suspended solids.

(33 U.S.C. 1311)

WATER QUALITY RELATED EFFLUENT LIMITATIONS

SEC. 302. (a) Whenever, in the judgment of the Administrator or as identified under section 304(l), discharges of pollutants from a point source or group of point sources, with the application of effluent limitations required under section 301(b)(2) of this Act, would interfere with the attainment or maintenance of that water quality in a specific portion of the navigable waters which shall assure protection of public health, public water supplies, agricultural and industrial uses, and the protection and propagation of a bal-

anced population of shellfish, fish and wildlife, and allow recreational activities in and on the water, effluent limitations (including alternative effluent control strategies) for such point source or sources shall be established which can reasonably be expected to contribute to the attainment or maintenance of such water quality.

(b) MODIFICATIONS OF EFFLUENT LIMITATIONS.—

(1) NOTICE AND HEARING.—Prior to establishment of any effluent limitation pursuant to subsection (a) of this section, the Administrator shall publish such proposed limitation and within 90 days of such publication hold a public hearing.

(2) PERMITS.—

(A) NO REASONABLE RELATIONSHIP.—The Administrator, with the concurrence of the State, may issue a permit which modifies the effluent limitations required by subsection (a) of this section for pollutants other than toxic pollutants if the applicant demonstrates at such hearing that (whether or not technology or other alternative control strategies are available) there is no reasonable relationship between the economic and social costs and the benefits to be obtained (including attainment of the objective of this Act) from achieving such limitation.

(B) REASONABLE PROGRESS.—The Administrator, with the concurrence of the State, may issue a permit which modifies the effluent limitations required by subsection (a) of this section for toxic pollutants for a single period not to exceed 5 years if the applicant demonstrates to the satisfaction of the Administrator that such modified requirements (i) will represent the maximum degree of control within the economic capability of the owner and operator of the source, and (ii) will result in reasonable further progress beyond the requirements of section 301(b)(2) toward the requirements of subsection (a) of this section.

(c) The establishment of effluent limitations under this section shall not operate to delay the application of any effluent limitation established under section 301 of this Act.

(33 U.S.C. 1312)

WATER QUALITY STANDARDS AND IMPLEMENTATION PLANS

SEC. 303. (a)(1) In order to carry out the purpose of this Act, any water quality standard applicable to interstate waters which was adopted by any State and submitted to, and approved by, or is awaiting approval by, the Administrator pursuant to this Act as in effect immediately prior to the date of enactment of the Federal Water Pollution Control Act Amendments of 1972, shall remain in effect unless the Administrator determined that such standard is not consistent with the applicable requirements of this Act as in effect immediately prior to the date of enactment of the Federal Water Pollution Control Act Amendments of 1972. If the Administrator makes such a determination he shall, within three months after the date of enactment of the Federal Water Pollution Control Act Amendments of 1972, notify the State and specify the changes needed to meet such requirements. If such changes are not adopted by the State within ninety days after the date of such notification,

the Administrator shall promulgate such changes in accordance with subsection (b) of this section.

(2) Any State which, before the date of enactment of the Federal Water Pollution Control Act Amendments of 1972, has adopted, pursuant to its own law, water quality standards applicable to intrastate waters shall submit such standards to the Administrator within thirty days after the date of enactment of the Federal Water Pollution Control Act Amendments of 1972. Each such standard shall remain in effect, in the same manner and to the same extent as any other water quality standard established under this Act unless the Administrator determines that such standard is inconsistent with the applicable requirements of this Act as in effect immediately prior to the date of enactment of the Federal Water Pollution Control Act Amendments of 1972. If the Administrator makes such a determination he shall not later than the one hundred and twentieth day after the date of submission of such standards, notify the State and specify the changes needed to meet such requirements. If such changes are not adopted by the State within ninety days after such notification, the Administrator shall promulgate such changes in accordance with subsection (b) of this section.

(3)(A) Any State which prior to the date of enactment of the Federal Water Pollution Control Act Amendments of 1972 has not adopted pursuant to its own laws water quality standards applicable to intrastate waters shall, not later than one hundred and eighty days after the date of enactment of the Federal Water Pollution Control Act Amendments of 1972, adopt and submit such standards to the Administrator.

(B) If the Administrator determines that any such standards are consistent with the applicable requirements of this Act as in effect immediately prior to the date of enactment of the Federal Water Pollution Control Act Amendments of 1972, he shall approve such standards.

(C) If the Administrator determines that any such standards are not consistent with the applicable requirements of this Act as in effect immediately prior to the date of enactment of the Federal Water Pollution Control Act Amendments of 1972, he shall, not later than the ninetieth day after the date of submission of such standards, notify the State and specify the changes to meet such requirements. If such changes are not adopted by the State within ninety days after the date of notification, the Administrator shall promulgate such standards pursuant to subsection (b) of this section.

(b)(1) The Administrator shall promptly prepare and publish proposed regulations setting forth water quality standards for a State in accordance with the applicable requirements of this Act as in effect immediately prior to the date of enactment of the Federal Water Pollution Control Act Amendments of 1972, if—

(A) the State fails to submit water quality standards within the times prescribed in subsection (a) of this section,

(B) a water quality standard submitted by such State under subsection (a) of this section is determined by the Administrator not to be consistent with the applicable requirements of subsection (a) of this section.

(2) The Administrator shall promulgate any water quality standard published in a proposed regulation not later than one

hundred and ninety days after the date he publishes any such proposed standard, unless prior to such promulgation, such State has adopted a water quality standard which the Administrator determines to be in accordance with subsection (a) of this section.

(c)(1) The Governor of a State or the State water pollution control agency of such State shall from time to time (but at least once each three year period beginning with the date of enactment of the Federal Water Pollution Control Act Amendments of 1972) hold public hearings for the purpose of reviewing applicable water quality standards and, as appropriate, modifying and adopting standards. Results of such review shall be made available to the Administrator.

(2)(A) Whenever the State revises or adopts a new standard, such revised or new standard shall be submitted to the Administrator. Such revised or new water quality standard shall consist of the designated uses of the navigable waters involved and the water quality criteria for such waters based upon such uses. Such standards shall be such as to protect the public health or welfare, enhance the quality of water and serve the purposes of this Act. Such standards shall be established taking into consideration their use and value for public water supplies, propagation of fish and wildlife, recreational purposes, and agricultural, industrial, and other purposes, and also taking into consideration their use and value for navigation.

(B) Whenever a State reviews water quality standards pursuant to paragraph (1) of this subsection, or revises or adopts new standards pursuant to this paragraph, such State shall adopt criteria for all toxic pollutants listed pursuant to section 307(a)(1) of this Act for which criteria have been published under section 304(a), the discharge or presence of which in the affected waters could reasonably be expected to interfere with those designated uses adopted by the State, as necessary to support such designated uses. Such criteria shall be specific numerical criteria for such toxic pollutants. Where such numerical criteria are not available, whenever a State reviews water quality standards pursuant to paragraph (1), or revises or adopts new standards pursuant to this paragraph, such State shall adopt criteria based on biological monitoring or assessment methods consistent with information published pursuant to section 304(a)(8). Nothing in this section shall be construed to limit or delay the use of effluent limitations or other permit conditions based on or involving biological monitoring or assessment methods or previously adopted numerical criteria.

(3) If the Administrator, within sixty days after the date of submission of the revised or new standard, determines that such standard meets the requirements of this Act, such standard shall thereafter be the water quality standard for the applicable waters of that State. If the Administrator determines that any such revised or new standard is not consistent with the applicable requirements of this Act, he shall not later than the ninetieth day after the date of submission of such standard notify the State and specify the changes to meet such requirements. If such changes are not adopted by the State within ninety days after the date of notification, the Administrator shall promulgate such standard pursuant to paragraph (4) of this subsection.

(4) The Administrator shall promptly prepare and publish proposed regulations setting forth a revised or new water quality standard for the navigable waters involved—

(A) if a revised or new water quality standard submitted by such State under paragraph (3) of this subsection for such waters is determined by the Administrator not to be consistent with the applicable requirements of this Act, or

(B) in any case where the Administrator determines that a revised or new standard is necessary to meet the requirements of this Act.

The Administrator shall promulgate any revised or new standard under this paragraph not later than ninety days after he publishes such proposed standards, unless prior to such promulgation, such State has adopted a revised or new water quality standard which the Administrator determines to be in accordance with this Act.

(d)(1)(A) Each State shall identify those waters within its boundaries for which the effluent limitations required by section 301(b)(1)(A) and section 301(b)(1)(B) are not stringent enough to implement any water quality standard applicable to such waters. The State shall establish a priority ranking for such waters, taking into account the severity of the pollution and the uses to be made of such waters.

(B) Each State shall identify those waters or parts thereof within its boundaries for which controls on thermal discharges under section 301 are not stringent enough to assure protection and propagation of a balanced indigenous population of shellfish, fish, and wildlife.

(C) Each State shall establish for the waters identified in paragraph (1)(A) of this subsection, and in accordance with the priority ranking, the total maximum daily load, for those pollutants which the Administrator identifies under section 304(a)(2) as suitable for such calculation. Such load shall be established at a level necessary to implement the applicable water quality standards with seasonal variations and a margin of safety which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality.

(D) Each State shall estimate for the waters identified in paragraph (1)(D) of this subsection the total maximum daily thermal load required to assure protection and propagation of a balanced, indigenous population of shellfish, fish and wildlife. Such estimates shall take into account the normal water temperatures, flow rates, seasonal variations, existing sources of heat input, and the dissipative capacity of the identified waters or parts thereof. Such estimates shall include a calculation of the maximum heat input that can be made into each such part and shall include a margin of safety which takes into account any lack of knowledge concerning the development of thermal water quality criteria for such protection and propagation in the identified waters or parts thereof.

(2) Each State shall submit to the Administrator from time to time, with the first such submission not later than one hundred and eighty days after the date of publication of the first identification of pollutants under section 304(a)(2)(D), for his approval the waters identified and the loads established under paragraphs (1)(A), (1)(B), (1)(C), and (1)(D) of this subsection. The Administrator shall either approve or disapprove such identification and

load not later than thirty days after the date of submission. If the Administrator approves such identification and load, such State shall incorporate them into its current plan under subsection (e) of this section. If the Administrator disapproves such identification and load, he shall not later than thirty days after the date of such disapproval identify such waters in such State and establish such loads for such waters as he determines necessary to implement the water quality standards applicable to such waters and upon such identification and establishment the State shall incorporate them into its current plan under subsection (e) of this section.

(3) For the specific purpose of developing information, each State shall identify all waters within its boundaries which it has not identified under paragraph (1)(A) and (1)(B) of this subsection and estimate for such waters the total maximum daily load with seasonal variations and margins of safety, for those pollutants which the Administrator identifies under section 304(a)(2) as suitable for such calculation and for thermal discharges, at a level that would assure protection and propagation of a balanced indigenous population of fish, shellfish and wildlife.

(4) LIMITATIONS ON REVISION OF CERTAIN EFFLUENT LIMITATIONS.—

(A) STANDARD NOT ATTAINED.—For waters identified under paragraph (1)(A) where the applicable water quality standard has not yet been attained, any effluent limitation based on a total maximum daily load or other waste load allocation established under this section may be revised only if (i) the cumulative effect of all such revised effluent limitations based on such total maximum daily load or waste load allocation will assure the attainment of such water quality standard, or (ii) the designated use which is not being attained is removed in accordance with regulations established under this section.

(B) STANDARD ATTAINED.—For waters identified under paragraph (1)(A) where the quality of such waters equals or exceeds levels necessary to protect the designated use for such waters or otherwise required by applicable water quality standard, any effluent limitation based on a total maximum daily load or other waste load allocation established under this section, or any water quality standard established under this section, or any other permitting standard may be revised only if such revision is subject to and consistent with the antidegradation policy established under this section.

(e)(1) Each State shall have a continuing planning process approved under paragraph (2) of this subsection which is consistent with this Act.

(2) Each State shall submit not later than 120 days after the date of the enactment of the Water Pollution Control Amendments of 1972 to the Administrator for his approval a proposed continuing planning process which is consistent with this Act. Not later than thirty days after the date of submission of such a process the Administrator shall either approve or disapprove such process. The Administrator shall from time to time review each State's approved planning process for the purpose of insuring that such planning process is at all times consistent with this Act. The Administrator

shall not approve any State permit program under title IV of this Act for any State which does not have an approved continuing planning process under this section.

(3) The Administrator shall approve any continuing planning process submitted to him under this section which will result in plans for all navigable waters within such State, which include, but are not limited to, the following:

(A) effluent limitations and schedules of compliance at least as stringent as those required by section 301(b)(1), section 301(b)(2), section 306, and section 307, and at least as stringent as any requirements contained in any applicable water quality standard in effect under authority of this section;

(B) the incorporation of all elements of any applicable areawide waste management plans under section 208, and applicable basin plans under section 209 of this Act;

(C) total maximum daily load for pollutants in accordance with subsection (d) of this section;

(D) procedures for revision;

(E) adequate authority for intergovernmental cooperation;

(F) adequate implementation, including schedules of compliance, for revised or new water quality standards, under subsection (c) of this section;

(G) controls over the disposition of all residual waste from any water treatment processing;

(H) an inventory and ranking, in order of priority, of needs for construction of waste treatment works required to meet the applicable requirements of sections 301 and 302.

(f) Nothing in this section shall be construed to affect any effluent limitation, or schedule of compliance required by any State to be implemented prior to the dates set forth in sections 301(b)(1) and 301(b)(2) nor to preclude any State from requiring compliance with any effluent limitation or schedule of compliance at dates earlier than such dates.

(g) Water quality standards relating to heat shall be consistent with the requirements of section 316 of this Act.

(h) For the purposes of this Act the term ''water quality standards'' includes thermal water quality standards.

(i) COASTAL RECREATION WATER QUALITY CRITERIA.—

(1) ADOPTION BY STATES.—

(A) INITIAL CRITERIA AND STANDARDS.—Not later than 42 months after the date of the enactment of this subsection, each State having coastal recreation waters shall adopt and submit to the Administrator water quality criteria and standards for the coastal recreation waters of the State for those pathogens and pathogen indicators for which the Administrator has published criteria under section 304(a).

(B) NEW OR REVISED CRITERIA AND STANDARDS.—Not later than 36 months after the date of publication by the Administrator of new or revised water quality criteria under section 304(a)(9), each State having coastal recreation waters shall adopt and submit to the Administrator new or revised water quality standards for the coastal recreation waters of the State for all pathogens and patho-

gen indicators to which the new or revised water quality criteria are applicable.

(2) FAILURE OF STATES TO ADOPT.—

(A) IN GENERAL.—If a State fails to adopt water quality criteria and standards in accordance with paragraph (1)(A) that are as protective of human health as the criteria for pathogens and pathogen indicators for coastal recreation waters published by the Administrator, the Administrator shall promptly propose regulations for the State setting forth revised or new water quality standards for pathogens and pathogen indicators described in paragraph (1)(A) for coastal recreation waters of the State.

(B) EXCEPTION.—If the Administrator proposes regulations for a State described in subparagraph (A) under subsection (c)(4)(B), the Administrator shall publish any revised or new standard under this subsection not later than 42 months after the date of the enactment of this subsection.

(3) APPLICABILITY.—Except as expressly provided by this subsection, the requirements and procedures of subsection (c) apply to this subsection, including the requirement in subsection (c)(2)(A) that the criteria protect public health and welfare.

(33 U.S.C. 1313)

INFORMATION AND GUIDELINES

SEC. 304. (a)(1) The Administrator, after consultation with appropriate Federal and State agencies and other interested persons, shall develop and publish, within one year after the date of enactment of this title (and from time to time thereafter revise) criteria for water quality accurately reflecting the latest scientific knowledge (A) on the kind and extent of all identifiable effects on health and welfare including, but not limited to, plankton, fish, shellfish, wildlife, plant life, shorelines, beaches, esthetics, and recreation which may be expected from the presence of pollutants in any body of water, including ground water; (B) on the concentration and dispersal of pollutants, or their byproducts, through biological, physical, and chemical processes; and (C) on the effects of pollutants on biological community diversity, productivity, and stability, including information on the factors affecting rates of eutrophication and rates of organic and inorganic sedimentation for varying types of receiving waters.

(2) The Administrator, after consultation with appropriate Federal and State agencies and other interested persons, shall develop and publish, within one year after the date of enactment of this title (and from time to time thereafter revise) information (A) on the factors necessary to restore and maintain the chemical, physical, and biological integrity of all navigable waters, ground waters, waters of the contiguous zone, and the oceans; (B) on the factors necessary for the protection and propagation of shellfish, fish, and wildlife for classes and categories of receiving waters and to allow recreational activities in and on the water; and (C) on the measurement and classification of water quality; and (D) for the purpose of section 303, on and the identification of pollutants suitable for

maximum daily load measurement correlated with the achievement of water quality objectives.

(3) Such criteria and information and revisions thereof shall be issued to the States and shall be published in the Federal Register and otherwise made available to the public.

(4) The Administrator shall, within 90 days after the date of enactment of the Clean Water Act of 1977 and from time to time thereafter, publish and revise as appropriate information identifying conventional pollutants, including but not limited to, pollutants classified as biological oxygen demanding, suspended solids, fecal coliform, and pH. The thermal component of any discharge shall not be identified as a conventional pollutant under this paragraph.

(5)(A) The Administrator, to the extent practicable before consideration of any request under section 301(g) of this Act and within six months after the date of enactment of the Clean Water Act of 1977, shall develop and publish information on the factors necessary for the protection of public water supplies, and the protection and propagation of a balanced population of shellfish, fish and wildlife, and to allow recreational activities, in and on the water.

(B) The Administrator, to the extent practicable before consideration of any application under section 301(h) of this Act and within six months after the date of enactment of Clean Water Act of 1977, shall develop and publish information on the factors necessary for the protection of public water supplies, and the protection and propagation of a balanced indigenous population of shellfish, fish and wildlife, and to allow recreational activities, in and on the water.

(6) The Administrator shall, within three months after enactment of the Clean Water Act of 1977 and annually thereafter, for purposes of section 301(h) of this Act publish and revise as appropriate information identifying each water quality standard in effect under this Act of State law, the specific pollutants associated with such water quality standard, and the particular waters to which such water quality standard applies.

(7) GUIDANCE TO STATES.—The Administrator, after consultation with appropriate State agencies and on the basis of criteria and information published under paragraphs (1) and (2) of this subsection, shall develop and publish, within 9 months after the date of the enactment of the Water Quality Act of 1987, guidance to the States on performing the identification required by section 304(l)(1) of this Act.

(8) INFORMATION ON WATER QUALITY CRITERIA.—The Administrator, after consultation with appropriate State agencies and within 2 years after the date of the enactment of the Water Quality Act of 1987, shall develop and publish information on methods for establishing and measuring water quality criteria for toxic pollutants on other bases than pollutant-by-pollutant criteria, including biological monitoring and assessment methods.

(9) REVISED CRITERIA FOR COASTAL RECREATION WATERS.—

(A) IN GENERAL.—Not later than 5 years after the date of the enactment of this paragraph, after consultation and in cooperation with appropriate Federal, State, tribal, and local officials (including local health officials), the Adminis-

trator shall publish new or revised water quality criteria for pathogens and pathogen indicators (including a revised list of testing methods, as appropriate), based on the results of the studies conducted under section 104(v), for the purpose of protecting human health in coastal recreation waters.

(B) REVIEWS.—Not later than the date that is 5 years after the date of publication of water quality criteria under this paragraph, and at least once every 5 years thereafter, the Administrator shall review and, as necessary, revise the water quality criteria.

(b) For the purposes of adopting or revising effluent limitations under this Act the Administrator shall, after consultation with appropriate Federal and State agencies and other interested persons, publish within one year of enactment of this title, regulations, providing guidelines for effluent limitations, and, at least annually thereafter, revise, if appropriate, such regulations. Such regulations shall—

(1)(A) identify, in terms of amounts of constituents and chemical, physical, and biological characteristics of pullutants, the degree of effluent reduction attainable through the application of the best practicable control technology currently available for classes and categories to point sources (other than publicly owned treatment works); and

(B) specify factors to be taken into account in determining the control measures and practices to be applicable to point sources (other than publicly owned treatment works) within such categories of classes. Factors relating to the assessment of best practical control technology currently available to comply with subsection (b)(1) of section 301 of this Act shall include consideration of the total cost of application of technology in relation to the effluent reduction benefits to be achieved from such application, and shall also take into account the age of equipment and facilities involved, the process employed, the engineering aspects of the application of various types of control techniques, process changes, non-water quality environmental impact (including energy requirements), and such other factors as the Administrator deems appropriate;

(2)(A) identify, in terms of amounts of constituents and chemical, physical, and biological characteristics of pollutants, the degree of effluent reduction attainable through the application of the best control measures and practices achievable including treatment techniques, process and procedure innovations, operating methods, and other alternatives for classes and categories of point sources (other than publicly owned treatment works); and

(B) specify factors to be taken into account in determining the best measures and practices available to comply with subsection (b)(2) of section 301 of this Act to be applicable to any point source (other than publicly owned treatment works) within such categories of classes. Factors relating to the assessment of best available technology shall take into account the age of equipment and facilities involved, the process employed, the engineering aspects of the application of various types of control techniques, process changes, the cost of achieving such ef-

fluent reduction, non-water quality environmental impact (including energy requirements), and such other factors as the Administrator deems appropriate;

(3) identify control measures and practices available to eliminate the discharge of pollutants from categories and classes of point sources, taking into account the cost of achieving such elimination of the discharge of pollutants; and

(4)(A) identify, in terms of amounts of constituents and chemical, physical, and biological characteristics of pollutants, the degree of effluent reduction attainable through the application of the best conventional pollutant control technology (including measures and practices) for classes and categories of point sources (other than publicly owned treatment works); and

(B) specify factors to be taken into account in determining the best conventional pollutant control technology measures and practices to comply with section 301(b)(2)(E) of this Act to be applicable to any point source (other than publicly owned treatment works) within such categories or classes. Factors relating to the assessment of best conventional pollutant control technology (including measures and practices) shall include consideration of the reasonableness of the relationship between the costs of attaining a reduction in effluents and the effluent reduction benefits derived, and the comparison of the cost and level of reduction of such pollutants from the discharge from publicly owned treatment works to the cost and level of reduction of such pollutants from a class or category of industrial sources, and shall take into account the age of equipment and facilities involved, the process employed, the engineering aspects of the application of various types of control techniques, process changes, non-water quality environmental impact (including energy requirements), and such other factors as the Administrator deems appropriate.

(c) The Administrator, after consultation, with appropriate Federal and State agencies and other interested persons, shall issue to the States and appropriate water pollution control agencies within 270 days after enactment of this title (and from time to time thereafter) information on the processes, procedures, or operating methods which result in the elimination or reduction of the discharge of pollutants to implement standards of performance under section 306 of this Act. Such information shall include technical and other data, including costs, as are available on alternative methods of elimination or reduction of the discharge of pollutants. Such information, and revisions thereof, shall be published in the Federal Register and otherwise shall be made available to the public.

(d)(1) The Administrator, after consultation with appropriate Federal and State agencies and other interested persons, shall publish within sixty days after enactment of this title (and from time to time thereafter) information, in terms of amounts of constituents and chemical, physical, and biological characteristics of pollutants, on the degree of effluent reduction attainable through the application of secondary treatment.

(2) The Administrator, after consultation with appropriate Federal and State agencies and other interested persons, shall publish

within nine months after the date of enactment of this title (and from time to time thereafter) information on alternative waste treatment management techniques and systems available to implement section 201 of this Act.

(3) The Administrator, after consultation with appropriate Federal and State agencies and other interested persons, shall promulgate witin one hundred and eighty days after the date of enactment of this subsection guidelines for identifying and evaluating innovative and alternative wastewater treatment process and techniques referred to in section 201(g)(5) of this Act.

(4) For the purposes of this subsection, such biological treatment facilities as oxidation ponds, lagoons, and ditches and trickling filters shall be deemed the equivalent of secondary treatment. The Administrator shall provide guidance under paragraph (1) of this subsection on design criteria for such facilities, taking into account pollutant removal efficiencies and, consistent with the objective of the Act, assuring that water quality will not be adversely affected by deeming such facilities as the equivalent of secondary treatment.

(e) The Administrator, after consultation with appropriate Federal and State agencies and other interested persons, may publish regulations, supplemental to any effluent limitations specified under subsections (b) and (c) of this section for a class or category of point sources, for any specific pollutant which the Administrator is charged with a duty to regulate as a toxic or hazardous pollutant under section 307(a)(1) or 311 of this Act, to control plant site runoff, spillage or leaks, sludge or waste disposal, and drainage from raw material storage which the Administrator determines are associated with or ancillary to the industrial manufacturing or treatment process within such class or category of point sources and may contribute significant amounts of such pollutants, to navigable waters. Any applicable controls established under this subsection shall be included as a requirement for the purposes of section 301, 302, 307, or 403, as the case may be, in any permit issued to a point source pursuant to section 402 of this Act.

(f) The Administrator, after consultation with appropriate Federal and State agencies and other interested persons, shall issue to appropriate Federal agencies, the States, water pollution control agencies, and agencies designated under section 208 of this Act, within one year after the effective date of this subsection (and from time to time thereafter) information including (1) guidelines for identifying and evaluating the nature and extent of nonpoint sources of pollutants, and (2) processes, procedures, and methods to control pollution resulting from—

(A) agricultural and silvicultural activities, including runoff from fields and crop and forest lands;

(B) mining activities, including runoff and siltation from new, currently operating, and abandoned surface and underground mines;

(C) all construction activity, including runoff from the facilities resulting from such construction;

(D) the disposal of pollutants in wells or in subsurface excavations;

(E) salt water intrusion resulting from reductions of fresh water flow from any cause, including extraction of ground water, irrigation, obstruction, and diversion; and

(F) changes in the movement, flow, or circulation of any navigable waters or ground waters, including changes caused by the construction of dams, levees, channels, causeways, or flow diversion facilities.

Such information and revisions thereof shall be published in the Federal Register and otherwise made available to the public.

(g)(1) For the purpose of assisting States in carrying out programs under section 402 of this Act, the Administrator shall publish, within one hundred and twenty days after the date of enactment of this title, and review at least annually thereafter and, if appropriate, revise guidelines for pretreatment of pollutants which he determines are not susceptible to treatment by publicly owned treatment works. Guidelines under this subsection shall be established to control and prevent the discharge into the navigable waters, the contiguous zone, or the ocean (either directly or through publicly owned treatment works) of any pollutant which interferes with, passes through, or otherwise is incompatible with such works.

(2) When publishing guidelines under this subsection, the Administrator shall designate the category or categories of treatment works to which the guidelines shall apply.

(h) The Administrator shall, within one hundred and eighty days from the date of enactment of this title, promulgate guidelines establishing test procedures for the analysis of pollutants that shall include the factors which must be provided in any certification pursuant to section 401 of this Act or permit application pursuant to section 402 of this Act.

(i) The Administrator shall (1) within sixty days after the enactment of this title promulgate guidelines for the purpose of establishing uniform application forms and other minimum requirements for the acquisition of information from owners and operators of point-sources of discharge subject to any State program under section 402 of this Act, and (2) within sixty days from the date of enactment of this title promulgate guidelines establishing the minimum procedural and other elements of any State program under section 402 of this Act which shall include:

(A) monitoring requirements;

(B) reporting requirements (including procedures to make information available to the public);

(C) enforcement provisions; and

(D) funding, personnel qualifications, and manpower requirements (including a requirement that no board or body which approves permit applications or portions thereof shall include, as a member, any person who receives, or has during the previous two years received, a significant portion of his income directly or indirectly from permit holders or applicants for a permit).

(j) LAKE RESTORATION GUIDANCE MANUAL.—The Administrator shall, within 1 year after the date of the enactment of the Water Quality Act of 1987 and biennially thereafter, publish and disseminate a lake restoration guidance manual describing methods, procedures, and processes to guide State and local efforts to improve, re-

store, and enhance water quality in the Nation's publicly owned lakes.

(k)(1) The Administrator shall enter into agreements with the Secretary of Agriculture, the Secretary of the Army, and the Secretary of the Interior, and the heads of such other departments, agencies, and instrumentalities of the United States as the Administrator determines, to provide for the maximum utilization of other Federal laws and programs for the purpose of achieving and maintaining water quality through appropriate implementation of plans approved under section 208 of this Act and nonpoint source pollution management programs approved under section 319 of this Act.

(2) The Administrator is authorized to transfer to the Secretary of Agriculture, the Secretary of the Army, and the Secretary of the Interior and the heads of such other departments, agencies, and instrumentalities of the United States as the Administrator determines, any funds appropriated under paragraph (3) of this subsection to supplement funds otherwise appropriated to programs authorized pursuant to any agreement under paragraph (1).

(3) There is authorized to be appropriated to carry out the provisions of this subsection, $100,000,000 per fiscal year for the fiscal years 1979 through 1983 and such sums as may be necessary for fiscal years 1984 through 1990.

(l) INDIVIDUAL CONTROL STRATEGIES FOR TOXIC POLLUTANTS.—

(1) STATE LIST OF NAVIGABLE WATERS AND DEVELOPMENT OF STRATEGIES.—Not later than 2 years after the date of the enactment of this subsection, each State shall submit to the Administrator for review, approval, and implementation under this subsection—

(A) a list of those waters within the State which after the application of effluent limitations required under section 301(b)(2) of this Act cannot reasonably be anticipated to attain or maintain (i) water quality standards for such waters reviewed, revised, or adopted in accordance with section 303(c)(2)(B) of this Act, due to toxic pollutants, or (ii) that water quality which shall assure protection of public health, public water supplies, agricultural and industrial uses, and the protection and propagation of a balanced population of shellfish, fish and wildlife, and allow recreational activities in and on the water;

(B) a list of all navigable waters in such State for which the State does not expect the applicable standard under section 303 of this Act will be achieved after the requirements of sections 301(b), 306, and 307(b) are met, due entirely or substantially to discharges from point sources of any toxic pollutants listed pursuant to section 307(a);

(C) for each segment of the navigable waters included on such lists, a determination of the specific point sources discharging any such toxic pollutant which is believed to be preventing or impairing such water quality and the amount of each toxic pollutant discharged by each such source; and

(D) for each such segment, an individual control strategy which the State determines will produce a reduction in the discharge of toxic pollutants from point sources identified by the State under this paragraph through the estab-

lishment of effluent limitations under section 402 of this Act and water quality standards under section 303(c)(2)(B) of this Act, which reduction is sufficient, in combination with existing controls on point and nonpoint sources of pollution, to achieve the applicable water quality standard as soon as possible, but not later than 3 years after the date of the establishment of such strategy.

(2) APPROVAL OR DISAPPROVAL.—Not later than 120 days after the last day of the 2-year period referred to in paragraph (1), the Administrator shall approve or disapprove the control strategies submitted under paragraph (1) by any State.

(3) ADMINISTRATOR'S ACTION.—If a State fails to submit control strategies in accordance with paragraph (1) or the Administrator does not approve the control strategies submitted by such State in accordance with paragraph (1), then, not later than 1 year after the last day of the period referred to in paragraph (2), the Administrator, in cooperation with such State and after notice and opportunity for public comment, shall implement the requirements of paragraph (1) in such State. In the implementation of such requirements, the Administrator shall, at a minimum, consider for listing under this subsection any navigable waters for which any person submits a petition to the Administrator for listing not later than 120 days after such last day.

(m) SCHEDULE FOR REVIEW OF GUIDELINES.—

(1) PUBLICATION.—Within 12 months after the date of the enactment of the Water Quality Act of 1987, and biennially thereafter, the Administrator shall publish in the Federal Register a plan which shall—

(A) establish a schedule for the annual review and revision of promulgated effluent guidelines, in accordance with subsection (b) of this section;

(B) identify categories of sources discharging toxic or nonconventional pollutants for which guidelines under subsection (b)(2) of this section and section 306 have not previously been published; and

(C) establish a schedule for promulgation of effluent guidelines for categories identified in subparagraph (B), under which promulgation of such guidelines shall be no later than 4 years after such date of enactment for categories identified in the first published plan or 3 years after the publication of the plan for categories identified in later published plans.

(2) PUBLIC REVIEW.—The Administrator shall provide for public review and comment on the plan prior to final publication.

(33 U.S.C. 1314)

WATER QUALITY INVENTORY

SEC. 305. (a) The Administrator, in cooperation with the States and with the assistance of appropriate Federal agencies, shall prepare a report to be submitted to the Congress on or before January 1, 1974, which shall—

(1) describe the specific quality, during 1973, with appropriate supplemental descriptions as shall be required to take into account seasonal, tidal, and other variations, of all navigable waters and the waters of the contiguous zone;

(2) include an inventory of all point sources of discharge (based on a qualitative and quantitative analysis of discharges) of pollutants, into all navigable waters and the waters of the contiguous zone; and

(3) identify specifically those navigable waters, the quality of which—

(A) is adequate to provide for the protection and propagation of a balanced population of shellfish, fish, and wildlife and allow recreational activities in and on the water;

(B) can reasonably be expected to attain such level by 1977 or 1983; and

(C) can reasonably be expected to attain such level by any later date.

(b)(1) Each State shall prepare and submit to the Administrator by April 1, 1975, and shall bring up to date by April 1, 1976, and biennially thereafter, a report which shall include—

(A) a description of the water quality of all navigable waters in such State during the preceding year, with appropriate supplemental descriptions as shall be required to take into account seasonal, tidal, and other variations, correlated with the quality of water required by the objective of this Act (as identified by the Administrator pursuant to criteria published under section 304(a) of this Act) and the water quality described in subparagraph (B) of this paragraph;

(B) an analysis of the extent to which all navigable waters of such State provide for the protection and propagation of a balanced population of shellfish, fish, and wildlife, and allow recreational activities in and on the water;

(C) an analysis of the extent to which the elimination of the discharge of pollutants and a level of water quality which provides for the protection and propagation of a balanced population of shellfish, fish, and wildlife and allows recreational activities in and on the water, have been or will be achieved by the requirements of this Act, together with recommendations as to additional action necessary to achieve such objectives and for what waters such additional action is necessary;

(D) an estimate of (i) the environmental impact, (ii) the economic and social costs necessary to achieve the objective of this Act in such State, (iii) the economic and social benefits of such achievement, and (iv) an estimate of the date of such achievement; and

(E) a description of the nature and extent of nonpoint sources of pollutants, and recommendations as to the programs which must be undertaken to control each category of such sources, including an estimate of the costs of implementing such programs.

(2) The Administrator shall transmit such State reports, together with an analysis thereof, to Congress on or before October 1, 1975, and October 1, 1976, and biennially thereafter.

(33 U.S.C. 1315)

NATIONAL STANDARDS OF PERFORMANCE

SEC. 306. (a) For purposes of this section:

(1) The term "standard of performance" means a standard for the control of the discharge of pollutants which reflects the greatest degree of effluent reduction which the Administrator determines to be achievable through application of the best available demonstrated control technology, processes, operating methods, or other alternatives, including, where practicable, a standard permitting no discharge of pollutants.

(2) The term "new source" means any source, the construction of which is commenced after the publication of proposed regulations prescribing a standard of performance under this section which will be applicable to such sources, if such standard is thereafter promulgated in accordance with this section.

(3) The term "source" means any building, structure, facility, or installation from which there is or may be the discharge of pollutants.

(4) The term "owner or operator" means any person who owns, leases, operates, controls, or supervises a source.

(5) The term "construction" means any placement, assembly, or installation of facilities or equipment (including contractual obligations to purchase such facilities or equipment) at the premises where such equipment will be used, including preparation work at such premises.

(b)(1)(A) The Administrator shall, within ninety days after the date of enactment of this title publish (and from time to time thereafter shall revise) a list of categories of sources, which shall, at the minimum, include:

pulp and paper mills;
paperboard, builders paper and board mills;
meat product and rendering processing;
dairy product processing;
grain mills;
canned and preserved fruits and vegetables processing;
canned and preserved seafood processing;
sugar processing;
textile mills;
cement manufacturing;
feedlots;
electroplating;
organic chemicals manufacturing;
inorganic chemicals manufacturing;
plastic and synthetic materials manufacturing;
soap and detergent manufacturing
fertilizer manufacturing;
petroleum refining;
iron and steel manufacturing;
nonferrous metals manufacturing;
phosphate manufacturing;
steam electric powerplants;
ferroalloy manufacturing;
leather tanning and finishing;
glass and asbestos manufacturing;
rubber processing; and

timber products processing.

(B) As soon as practicable, but in no case more than one year, after a category of sources is included in a list under subparagraph (A) of this paragraph, the Administrator shall propose and publish regulations establishing Federal standards of performance for new sources within such category. The Administrator shall afford interested persons an opportunity for written comment on such proposed regulations. After considering such comments, he shall promulgate, within one hundred and twenty days after publication of such proposed regulations, such standards with such adjustments as he deems appropriate. The Administrator shall, from time to time, as technlogy and alternatives change, revise such standards following the procedure required by this subsection for promulgation of such standards. Standards of performance, or revisions thereof, shall become effective upon promulgation. In establishing or revising Federal standards of performance for new sources under this section, the Administrator shall take into consideration the cost of achieving such effluent reduction, and any non-water quality environmental impact and energy requirements.

(2) The Administrator may distinguish among classes, types, and sizes within categories of new sources for the purpose of establishing such standards and shall consider the type of process employed (including whether batch or continuous).

(3) The provisions of this section shall apply to any new source owned or operated by the United States.

(c) Each State may develop and submit to the Administrator a procedure under State law for applying and enforcing standards of performance for new sources located in such State. If the Administrator finds that the procedure and the law of any State require the application and enforcement of standards of performance to at least the same extent as required by this section, such State is authorized to apply and enforce such standards of performance (except with respect to new sources owned or operated by the United States).

(d) Notwithstanding any other provision of this Act, any point source the construction of which is commenced after the date of enactment of the Federal Water Pollution Control Act Amendments of 1972 and which is so constructed as to meet all applicable standards of performance shall not be subject to any more stringent standard of performance during a ten-year period beginning on the date of completion of such construction or during the period of depreciation or amortization of such facility for the purposes of section 167 or 169 (or both) of the Internal Revenue Code of 1954, whichever period ends first.

(e) After the effective date of standards of performance promulgated under this section, it shall be unlawful for any owner or operator of any new source to operate such source in violation of any standard of performance applicable to such source.

(33 U.S.C. 1316)

TOXIC AND PRETREATMENT EFFLUENT STANDARDS

SEC. 307. (a)(1) On and after the date of enactment of the Clean Water Act of 1977, the list of toxic pollutants or combination of pollutants subject to this Act shall consist of those toxic

polllutants listed in table 1 of Committee Print Numbered 95–30 of the Committee on Public Works and Transportation of the House of Representatives, and the Administrator shall publish, not later than the thirtieth day after the date of enactment of the Clean Water Act of 1977, that list. From time to time thereafter, the Administrator may revise such list and the Administrator is authorized to add to or remove from such list any pollutant. The Administrator in publishing any revised list, including the addition or removal of any pollutant from such list, shall take into account the toxicity of the pollutant, its persistence, degradability, the usual or potential presence of the affected organisms in any waters, the importance of the affected organisms, and the nature and extent of the effect of the toxic pollutant on such organisms. A determination of the Administrator under this paragraph shall be final except that if, on judicial review, such determination was based on arbitrary and capricious action of the Administrator, the Administrator shall make a redetermination.

(2) Each toxic pollutant listed in accordance with paragraph (1) of this subsection shall be subject to effluent limitations resulting from the application of the best available technology economically achieveable for the applicable category or class of point sources established in accordance with section 301(b)(2)(A) and 304(b)(2) of this Act. The Administrator, in his discretion, may publish in the Federal Register a proposed effluent standard (which may include a prohibition) establishing requirements for a toxic pollutant which, if an effluent limitation is applicable to a class or category of point sources, shall be applicable to such category or class only if such standard imposes more stringent requirements. Such published effluent standard (or prohibition) shall take into account the toxicity of the pollutant, its persistence, degradability, the usual or potential presence of the affected organisms in any waters, the importance of the affected organisms and the nature and extent of the effect of the toxic pollutant on such organisms, and the extent to which effective control is being or may be achieved under other regulatory authority. The Administrator shall allow a period of not less than sixty days following publication of any such proposed effluent standard (or prohibition) for written comment by interested persons on such proposed standard. In addition, if within thirty days of publication of any such proposed effluent standard (or prohibition) any interested person so requests, the Administrator shall hold a public hearing in connection therewith. Such a public hearing shall provide an opportunity for oral and written presentations, such cross-examination as the Administrator determines is appropriate on disputed issues of material fact, and the transcription of a verbatim record which shall be available to the public. After consideration of such comments and any information and material presented at any public hearing held on such proposed standard or prohibition, the Administrator shall promulgate such standards (or prohibition) with such modifications as the Administrator finds are justified. Such promulgation by the Administrator shall be made within two hundred and seventy days after publication of proposed standard (or prohibition). Such standard (or prohibition) shall be final except that if, on judicial review, such standard was not based on substantial evidence, the Administrator shall promulgate a revised standard. Effluent limitations shall be established in accord-

ance with sections 301(b)(2)(A) and 304(b)(2) for every toxic pollutant referred to in table 1 of Committee Print Numbered 95–30 of the Committee on Public Works and Transportation of the House of Representatives as soon as practicable after the date of enactment of the Clean Water Act of 1977, but no later than July 1, 1980. Such effluent limitations or effluent standards (or prohibitions) shall be established for every other toxic pollutant listed under paragraph (1) of this subsection as soon as practicable after it is so listed.

(3) Each such effluent standard (or prohibition) shall be reviewed and, if appropriate, revised at least every three years.

(4) Any effluent standard promulgated under this section shall be at that level which the Administrator determines provides an ample margin of safety.

(5) When proposing or promulgating any effluent standard (or prohibition) under this section, the Administrator shall designate the category or categories of sources to which the effluent standard (or prohibition) shall apply. Any disposal of dredged material may be included in such a category of sources after consultation with the Secretary of the Army.

(6) Any effluent standard (or prohibition) established pursuant to this section shall take effect on such date or dates as specified in the order promulgating such standard, but in no case, more than one year from the date of such promulgation. If the Administrator determines that compliance within one year from the date of promulgation is technologically infeasible for a category of sources, the Administrator may establish the effective date of the effluent standard (or prohibition) for such category at the earliest date upon which compliance can be feasibly attained by sources within such category, but in no event more than three years after the date of such promulgation.

(7) Prior to publishing any regulations pursuant to this section the Administrator shall, to the maximum extent practicable within the time provided, consult with appropriate advisory committees, States, independent experts, and Federal departments and agencies.

(b)(1) The Administrator shall, within one hundred and eighty days after the date of enactment of this title and from time to time thereafter, publish proposed regulations establishing pretreatment standards for introduction of pollutants into treatment works (as defined in section 212 of this Act) which are publicly owned for those pollutants which are determined not to be susceptible to treatment by such treatment works or which would interfere with the operation of such treatment works. Not later than ninety days after such publication, and after opportunity for public hearing, the Administrator shall promulgate such pretreatment standards. Pretreatment standards under this subsection shall specify a time for compliance not to exceed three years from the date of promulgation and shall be established to prevent the discharge of any pollutant through treatment works (as defined in section 212 of this Act) which are publicly owned, which pollutant interfers with, passes through, or otherwise is incompatible with such works. If, in the case of any toxic pollutant under subsection (a) of this section introduced by a source into a publicly owned treatment works, the treatment by such works removes all or any part of such toxic pol-

lutant and the discharge from such works does not violate that effluent limitation or standard which would be applicable to such toxic pollutant if it were discharged by such source other than through a publicly owned treatment works, and does not prevent sludge use or disposal by such works in accordance with section 405 of this Act, then the pretreatment requirements for the sources actually discharging such toxic pollutant into such publicly owned treatment works may be revised by the owner or operator of such works to reflect the removal of such toxic pollutant by such works.

(2) The Administrator shall, from time to time, as control technology, processes, operating methods, or other alternative change, revise such standards following the procedures established by this subsection for promulgation of such standards.

(3) When proposing or promulgating any pretreatment standard under this section, the Administrator shall designate the category or categories of sources to which such standard shall apply.

(4) Nothing in this subsection shall affect any pretreatment requirement established by any State or local law not in conflict with any pretreatment standard established under this subsection.

(c) In order to ensure that any source introducing pollutants into a publicly owned treatment works, which source would be a new source subject to section 306 if it were to discharge pollutants, will not cause a violation of the effluent limitations established for any such treatment works, the Administrator shall promulgate pretreatment standards for the category of such sources simultaneously with the promulgation of standards of performance under section 306 for the equivalent category of new sources. Such pretreatment standards shall prevent the discharge of any pollutant into such treatment works, which pollutant may interfere with, pass through, or otherwise be incompatible with such works.

(d) After the effective date of any effluent standard or prohibition or pretreatment standard promulgated under this section, it shall be unlawful for any owner or operator of any source to operate any source in violation of any such effluent standard or prohibition or pretreatment standard.

(e) COMPLIANCE DATE EXTENSION FOR INNOVATIVE PRETREATMENT SYSTEMS.—In the case of any existing facility that proposes to comply with the pretreatment standards of subsection (b) of this section by applying an innovative system that meets the requirements of section 301(k) of this Act, the owner or operator of the publicly owned treatment works receiving the treated effluent from such facility may extend the date for compliance with the applicable pretreatment standard established under this section for a period not to exceed 2 years—

(1) if the Administrator determines that the innovative system has the potential for industrywide application, and

(2) if the Administrator (or the State in consultation with the Administrator, in any case in which the State has a pretreatment program approved by the Administrator)—

(A) determines that the proposed extension will not cause the publicly owned treatment works to be in violation of its permit under section 402 or of section 405 or to contribute to such a violation, and

(B) concurs with the proposed extension.

(33 U.S.C. 1317)

INSPECTIONS, MONITORING, AND ENTRY

SEC. 308. (a) Whenever required to carry out the objective of this Act, including but not limited to (1) developing or assisting in the development of any effluent limitation, or other limitation, prohibition, or effluent standard, pretreatment standard, or standard of performance under this Act; (2) determining whether any person is in violation of any such effluent limitation, or other limitation, prohibition or effluent standard, pretreatment standard, or standard of performance; (3) any requirement established under this section; or (4) carrying out sections 305, 311, 402, 404 (relating to State permit programs), 405, and 504 of this Act—

(A) the Administrator shall require the owner or operator of any point source to (i) establish and maintain such records, (ii) make such reports, (iii) install, use, and maintain such monitoring equipment or methods (including where appropriate, biological monitoring methods), (iv) sample such effluents (in accordance with such methods, at such locations, at such intervals, and in such manner as the Administrator shall prescribe), and (v) provide such other information as he may reasonably require; and

(B) the Administrator or his authorized representative (including an authorized contractor acting as a representative of the Administrator), upon presentation of his credentials—

(i) shall have a right of entry to, upon, or through any premises in which an effluent source is located or in which any records required to be maintained under clause (A) of this subsection are located, and

(ii) may at reasonable times have access to and copy any records, inspect any monitoring equipment or method required under clause (A), and sample any effluents which the owner or operator of such source is required to sample under such clause.

(b) Any records, reports, or information obtained under this section (1) shall, in the case of effluent data, be related to any applicable effluent limitations, toxic, pretreatment, or new source performance standards, and (2) shall be available to the public, except that upon a showing satisfactory to the Administrator by any person that records, reports, or information, or particular part thereof (other than effluent data), to which the Administrator has access under this section, if made public would divulge methods or processes entitled to protection as trade secrets of such person, the Administrator shall consider such record, report, or information, or particular portion thereof confidential in accordance with the purposes of section 1905 of title 18 of the United States Code. Any authorized representative of the Administrator (including an authorized contractor acting as a representative of the Administrator) who knowingly or willfully publishes, divulges, discloses, or makes known in any manner or to any extent not authorized by law any information which is required to be considered confidential under this subsection shall be fined not more than $1,000 or imprisoned not more than 1 year, or both. Nothing in this subsection shall prohibit the Administrator or an authorized representative of the Administrator (including any authorized contractor acting as a representative of the Administrator) from disclosing records, reports,

or information to other officers, employees, or authorized representatives of the United States concerned with carrying out this Act or when relevant in any proceeding under this Act.

(c) Each State may develop and submit to the Administrator procedures under State law for inspection, monitoring, and entry with respect to point sources located in such State. If the Administrator finds that the procedures and the law of any State relating to inspection, monitoring, and entry are applicable to at least the same extent as those required by this section, such State is authorized to apply and enforce its procedures for inspection, monitoring, and entry with respect to point sources located in such State (except with respect to point sources owned or operated by the United States).

(d) ACCESS BY CONGRESS.—Notwithstanding any limitation contained in this section or any other provision of law, all information reported to or otherwise obtained by the Administrator (or any representative of the Administrator) under this Act shall be made available, upon written request of any duly authorized committee of Congress, to such committee.

(33 U.S.C. 1318)

FEDERAL ENFORCEMENT

SEC. 309. (a)(1) Whenever, on the basis of any information available to him, the Administrator finds that any person is in violation of any condition or limitation which implements section 301, 302, 306, 307, 308, 318, or 405 of this Act in a permit issued by a State under an approved permit program under section 402 or 404 of this Act, he shall proceed under his authority in paragraph (3) of this subsection or he shall notify the person in alleged violation and such State of such finding. If beyond the thirtieth day after the Administrator's notification the State has not commenced appropriate enforcement action, the Administrator shall issue an order requiring such person to comply with such condition or limitation or shall bring a civil action in accordance with subsection (b) of this section.

(2) Whenever, on the basis of information available to him, the Administrator finds that violations of permit conditions or limitations as set forth in paragraph (1) of this subsection are so widespread that such violations appear to result from a failure of the State to enforce such permit conditions or limitations effectively, he shall so notify the State. If the Administrator finds such failure extends beyond the thirtieth day after such notice, he shall give public notice of such finding. During the period beginning with such public notice and ending when such State satisfies the Administrator that it will enforce such conditions and limitations (hereafter referred to in this section as the period of "federally assumed enforcement"), except where an extension has been granted under paragraph (5)(B) of this subsection, the Administrator shall enforce any permit condition or limitation with respect to any person—

(A) by issuing an order to comply with such condition or limitation, or

(B) by bringing a civil action under subsection (b) of this section.

(3) Whenever on the basis of any information available to him the Administrator finds that any person is in violation of section 301, 302, 306, 307, 308, 318, or 405 of this Act, or is in violation of any permit condition or limitation implementing any of such sections in a permit issued under section 402 of this Act by him or by a State or in a permit issued under section 404 of this Act by a State, he shall issue an order requiring such person to comply with such section or requirement, or he shall bring a civil action in accordance with subsection (b) of this section.

(4) A copy of any order issued under this subsection shall be sent immediately by the Administrator to the State in which the violation occurs and other affected States. In any case in which an order under this subsection (or notice to a violator under paragraph (1) of this subsection) is issued to a corporation, a copy of such order (or notice) shall be served on any appropriate corporate officers. An order issued under this subsection relating to a violation of section 308 of this Act shall not take effect until the person to whom it is issued has had an opportunity to confer with the Administrator concerning the alleged violation.

(5)(A) Any order issued under this subsection shall be by personal service, shall state with reasonable specificity the nature of the violation, and shall specify a time for compliance not to exceed thirty days in the case of a violation of an interim compliance schedule or operation and maintenance requirement and not to exceed a time the Administrator determines to be reasonable in the case of a violation of a final deadline, taking into account the seriousness of the violation and any good faith efforts to comply with applicable requirements.

(B) The Administrator may, if he determines (i) that any person who is a violator of, or any person who is otherwise not in compliance with, the time requirements under this Act or in any permit issued under this Act, has acted in good faith, and has made a commitment (in the form of contracts or other securities) of necessary resources to achieve compliance by the earliest possible date after July 1, 1977, but not later than April 1, 1979; (ii) that any extension under this provision will not result in the imposition of any additional controls on any other point or nonpoint source; (iii) that an application for a permit under section 402 of this Act was filed for such person prior to December 31, 1974; and (iv) that the facilities necessary for compliance with such requirements are under construction, grant an extension of the date referred to in section 301(b)(1)(A) to a date which will achieve compliance at the earliest time possible but not later than April 1, 1979.

(6) Whenever, on the basis of information available to him, the Administrator finds (A) that any person is in violation of section 301(b)(1) (A) or (C) of this Act, (B) that such person cannot meet the requirements for a time extension under section 301(i)(2) of this Act, and (C) that the most expeditious and appropriate means of compliance with this Act by such person is to discharge into a publicly owned treatment works, then, upon request of such person, the Administrator may issue an order requiring such person to comply with this Act at the earliest date practicable, but not later than July 1, 1983, by discharging into a publicly owned treatment works if such works concur with such order. Such order shall include a schedule of compliance.

(b) The Administrator is authorized to commence a civil action for appropriate relief, including a permanent or temporary injunction, for any violation for which he is authorized to issue a compliance order under subsection (a) of this section. Any action under this subsection may be brought in the district court of the United States for the district in which the defendant is located or resides or is doing business, and such court shall have jurisdiction to restrain such violation and to require compliance. Notice of the commencement of such action shall be given immediately to the appropriate State.

(c) CRIMINAL PENALTIES.—

(1) NEGLIGENT VIOLATIONS.—Any person who—

(A) negligently violates section 301, 302, 306, 307, 308, 311(b)(3), 318, or 405 of this Act, or any permit condition or limitation implementing any of such sections in a permit issued under section 402 of this Act by the Administrator or by a State, or any requirement imposed in a pretreatment program approved under section 402(a)(3) or 402(b)(8) of this Act or in a permit issued under section 404 of this Act by the Secretary of the Army or by a State; or

(B) negligently introduces into a sewer system or into a publicly owned treatment works any pollutant or hazardous substance which such person knew or reasonably should have known could cause personal injury or property damage or, other than in compliance with all applicable Federal, State, or local requirements or permits, which causes such treatment works to violate any effluent limitation or condition in any permit issued to the treatment works under section 402 of this Act by the Administrator or a State;

shall be punished by a fine of not less than $2,500 nor more than $25,000 per day of violation, or by imprisonment for not more than 1 year, or by both. If a conviction of a person is for a violation committed after a first conviction of such person under this paragraph, punishment shall be by a fine of not more than $50,000 per day of violation, or by imprisonment of not more than 2 years, or by both.

(2) KNOWING VIOLATIONS.—Any person who—

(A) knowingly violates section 301, 302, 306, 307, 308, 311(b)(3), 318, or 405 of this Act, or any permit condition or limitation implementing any of such sections in a permit issued under section 402 of this Act by the Administrator or by a State, or any requirement imposed in a pretreatment program approved under section 402(a)(3) or 402(b)(8) of this Act or in a permit issued under section 404 of this Act by the Secretary of the Army or by a State; or

(B) knowingly introduces into a sewer system or into a publicly owned treatment works any pollutant or hazardous substance which such person knew or reasonably should have known could cause personal injury or property damage or, other than in compliance with all applicable Federal, State, or local requirements or permits, which causes such treatment works to violate any effluent limita-

tion or condition in a permit issued to the treatment works under section 402 of this Act by the Administrator or a State;

shall be punished by a fine of not less that $5,000 nor more than $50,000 per day of violation, or by imprisonment for not more than 3 years, or by both. If a conviction of a person is for a violation committed after a first conviction of such person under this paragraph, punishment shall be by a fine of not more than $100,000 per day of violation, or imprisonment of not more than 6 years, or by both.

(3) KNOWING ENDANGERMENT.—

(A) GENERAL RULE.—Any person who knowingly violates section 301, 302, 306, 307, 308, 311(b)(3), 318, or 405 of this Act, or any permit condition or limitation implementing any of such sections in a permit issued under section 402 of this Act by the Administrator or by a State, or in a permit issued under section 404 of this Act by the Secretary of the Army or by a State, and who knows at that time that he thereby places another person in imminent danger of death or serious bodily injury, shall, upon conviction, be subject to a fine of not more than $250,000 or imprisonment of not more than 15 years, or both. A person which is an organization shall, upon conviction of violating this subparagraph, be subject to a fine of not more than $1,000,000. If a conviction of a person is for a violation committed after a first conviction of such person under this paragraph, the maximum punishment shall be doubled with respect to both fine and imprisonment.

(B) ADDITIONAL PROVISIONS.—For the purpose of subparagraph (A) of this paragraph—

(i) in determining whether a defendant who is an individual knew that his conduct placed another person in imminent danger of death or serious bodily injury—

(I) the person is responsible only for actual awareness or actual belief that he possessed; and

(II) knowledge possessed by a person other than the defendant but not by the defendant himself may not be attributed to the defendant;

except that in proving the defendant's possession of actual knowledge, circumstantial evidence may be used, including evidence that the defendant took affirmative steps to shield himself from relevant information;

(ii) it is an affirmative defense to prosecution that the conduct charged was consented to by the person endangered and that the danger and conduct charged were reasonably foreseeable hazards of—

(I) an occupation, a business, or a profession; or

(II) medical treatment or medical or scientific experimentation conducted by professionally approved methods and such other person had been made aware of the risks involved prior to giving consent;

and such defense may be established under this subparagraph by a preponderance of the evidence;

(iii) the term "organization" means a legal entity, other than a government, established or organized for any purpose, and such term includes a corporation, company, association, firm, partnership, joint stock company, foundation, institution, trust, society, union, or any other association of persons; and

(iv) the term "serious bodily injury" means bodily injury which involves a substantial risk of death, unconsciousness, extreme physical pain, protracted and obvious disfigurement, or protracted loss or impairment of the function of a bodily member, organ, or mental faculty.

(4) FALSE STATEMENTS.—Any person who knowingly makes any false material statement, representation, or certification in any application, record, report, plan, or other document filed or required to be maintained under this Act or who knowingly falsifies, tampers with, or renders inaccurate any monitoring device or method required to be maintained under this Act, shall upon conviction, be punished by a fine of not more than $10,000, or by imprisonment for not more than 2 years, or by both. If a conviction of a person is for a violation committed after a first conviction of such person under this paragraph, punishment shall be by a fine of not more than $20,000 per day of violation, or by imprisonment of not more than 4 years, or by both.

(5) TREATMENT OF SINGLE OPERATIONAL UPSET.—For purposes of this subsection, a single operational upset which leads to simultaneous violations of more than one pollutant parameter shall be treated as a single violation.

(6) RESPONSIBLE CORPORATE OFFICER AS "PERSON".—For the purpose of this subsection, the term "person" means, in addition to the definition contained in section 502(5) of this Act, any responsible corporate officer.

(7) HAZARDOUS SUBSTANCE DEFINED.—For the purpose of this subsection, the term "hazardous substance" means (A) any substance designated pursuant to section 311(b)(2)(A) of this Act, (B) any element, compound, mixture, solution, or substance designated pursuant to section 102 of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, (C) any hazardous waste having the characteristics identified under or listed pursuant to section 3001 of the Solid Waste Disposal Act (but not including any waste the regulation of which under the Solid Waste Disposal Act has been suspended by Act of Congress), (D) any toxic pollutant listed under section 307(a) of this Act, and (E) any imminently hazardous chemical substance or mixture with respect to which the Administrator has taken action pursuant to section 7 of the Toxic Substances Control Act.

(d) Any person who violates section 301, 302, 306, 307, 308, 311(b)(3), 318 or 405 of this Act, or any permit condition or limitation implementing any of such sections in a permit issued under section 402 of this Act by the Administrator, or by a State, or in

a permit issued under section 404 of this Act by a State,,[1] or any requirement imposed in a pretreatment program approved under section 402(a)(3) or 402(b)(8) of this Act, and any person who violates any order issued by the Administrator under subsection (a) of this section, shall be subject to a civil penalty not to exceed $25,000 per day for each violation. In determining the amount of a civil penalty the court shall consider the seriousness of the violation or violations, the economic benefit (if any) resulting from the violation, any history of such violations, any good-faith efforts to comply with the applicable requirements, the economic impact of the penalty on the violator, and such other matters as justice may require. For purposes of this subsection, a single operational upset which leads to simultaneous violations of more than one pollutant parameter shall be treated as a single violation.

(e) Whenever a municipality is a party to a civil action brought by the United States under this section, the State in which such municipality is located shall be joined as a party. Such State shall be liable for payment of any judgment, or any expenses incurred as a result of complying with any judgment, entered against the municipality in such action to the extent that the laws of that State prevent the municipality from raising revenues needed to comply with such judgment.

(f) Whenever, on the basis of an information available to him, the Administrator finds that an owner or operator of any source is introducing a pollutant into a treatment works in violation of subsection (d) of section 307, the Administrator may notify the owner or operator of such treatment works and the State of such violation. If the owner or operator of the treatment works does not commence appropriate enforcement action within 30 days of the date of such notification, the Administrator may commence a civil action for appropriate relief, including but not limited to, a permanent or temporary injunction, against the owner or operator of such treatment works. In any such civil action the Administrator shall join the owner or operator of such source as a party to the action. Such action shall be brought in the district court of the United States in the district in which the treatment works is located. Such court shall have jurisdiction to restrain such violation and to require the owner or operator of the treatment works and the owner or operator of the source to take such action as may be necessary to come into compliance with this Act. Notice of commencement of any such action shall be given to the State. Nothing in this subsection shall be construed to limit or prohibit any other authority the Administrator may have under this Act.

(g) ADMINISTRATIVE PENALTIES.—

(1) VIOLATIONS.—Whenever on the basis of any information available—

(A) the Administrator finds that any person has violated section 301, 302, 306, 307, 308, 318, or 405 of this Act, or has violated any permit condition or limitation implementing any of such sections in a permit issued under section 402 of this Act by the Administrator or by a State, or in a permit issued under section 404 by a State, or

[1] So in law. See P.L. 100–4, sec. 313(a)(1), 101 Stat. 45.

(B) the Secretary of the Army (hereinafter in this subsection referred to as the "Secretary") finds that any person has violated any permit condition or limitation in a permit issued under section 404 of this Act by the Secretary,

the Administrator or Secretary, as the case may be, may, after consultation with the State in which the violation occurs, assess a class I civil penalty or a class II civil penalty under this subsection.

(2) CLASSES OF PENALTIES.—

(A) CLASS I.—The amount of a class I civil penalty under paragraph (1) may not exceed $10,000 per violation, except that the maximum amount of any class I civil penalty under this subparagraph shall not exceed $25,000. Before issuing an order assessing a civil penalty under this subparagraph, the Administrator or the Secretary, as the case may be, shall give to the person to be assessed such penalty written notice of the Administrator's or Secretary's proposal to issue such order and the opportunity to request, within 30 days of the date the notice is received by such person, a hearing on the proposed order. Such hearing shall not be subject to section 554 or 556 of title 5, United States Code, but shall provide a reasonable opportunity to be heard and to represent evidence.

(B) CLASS II.—The amount of a class II civil penalty under paragraph (1) may not exceed $10,000 per day for each day during which the violation continues; except that the maximum amount of any class II civil penalty under this subparagraph shall not exceed $125,000. Except as otherwise provided in this subsection, a class II civil penalty shall be assessed and collected in the same manner, and subject to the same provisions, as in the case of civil penalties assessed and collected after notice and opportunity for a hearing on the record in accordance with section 554 of title 5, United States Code. The Administrator and the Secretary may issue rules for discovery procedures for hearings under this subparagraph.

(3) DETERMINING AMOUNT.—In determining the amount of any penalty assessed under this subsection, the Administrator or the Secretary, as the case may be, shall take into account the nature, circumstances, extent and gravity of the violation, or violations, and, with respect to the violator, ability to pay, any prior history of such violations, the degree of culpability, economic benefit or savings (if any) resulting from the violation, and such other matters as justice may require. For purposes of this subsection, a single operational upset which leads to simultaneous violations of more than one pollutant parameter shall be treated as a single violation.

(4) RIGHTS OF INTERESTED PERSONS.—

(A) PUBLIC NOTICE.—Before issuing an order assessing a civil penalty under this subsection the Administrator or Secretary, as the case may be, shall provide public notice of and reasonable opportunity to comment on the proposed issuance of such order.

(B) PRESENTATION OF EVIDENCE.—Any person who comments on a proposed assessment of a penalty under this subsection shall be given notice of any hearing held under this subsection and of the order assessing such penalty. In any hearing held under this subsection, such person shall have a reasonable opportunity to be heard and to present evidence.

(C) RIGHTS OF INTERESTED PERSONS TO A HEARING.—If no hearing is held under paragraph (2) before issuance of an order assessing a penalty under this subsection, any person who commented on the proposed assessment may petition, within 30 days after the issuance of such order, the Administrator or Secretary, as the case may be, to set aside such order and to provide a hearing on the penalty. If the evidence presented by the petitioner in support of the petition is material and was not considered in the issuance of the order, the Administrator or Secretary shall immediately set aside such order and provide a hearing in accordance with paragraph (2)(A) in the case of a class I civil penalty and paragraph (2)(B) in the case of a class II civil penalty. If the Administrator or Secretary denies a hearing under this subparagraph, the Administrator or Secretary shall provide to the petitioner, and publish in the Federal Register, notice of and the reasons for such denial.

(5) FINALITY OF ORDER.—An order issued under this subsection shall become final 30 days after its issuance unless a petition for judicial review is filed under paragraph (8) or a hearing is requested under paragraph (4)(C). If such a hearing is denied, such order shall become final 30 days after such denial.

(6) EFFECT OF ORDER.—

(A) LIMITATION ON ACTIONS UNDER OTHER SECTIONS.—Action taken by the Administrator or the Secretary, as the case may be, under this subsection shall not affect or limit the Administrator's or Secretary's authority to enforce any provision of this Act; except that any violation—

(i) with respect to which the Administrator or the Secretary has commenced and is diligently prosecuting an action under this subsection,

(ii) with respect to which a State has commenced and is diligently prosecuting an action under a State law comparable to this subsection, or

(iii) for which the Administrator, the Secretary, or the State has issued a final order not subject to further judicial review and the violator has paid a penalty assessed under this subsection, or such comparable State law, as the case may be,

shall not be the subject of a civil penalty action under subsection (d) of this section or section 311(b) or section 505 of this Act.

(B) APPLICABILITY OF LIMITATION WITH RESPECT TO CITIZEN SUITS.—The limitations contained in subparagraph (A) on civil penalty actions under section 505 of this Act shall not apply with respect to any violation for which—

(i) a civil action under section 505(a)(1) of this Act has been filed prior to commencement of an action under this subsection, or

(ii) notice of an alleged violation of section 505(a)(1) of this Act has been given in accordance with section 505(b)(1)(A) prior to commencement of an action under this subsection and an action under section 505(a)(1) with respect to such alleged violation is filed before the 120th day after the date on which such notice is given.

(7) EFFECT OF ACTION ON COMPLIANCE.—No action by the Administrator or the Secretary under this subsection shall affect any person's obligation to comply with any section of this Act or with the terms and conditions of any permit issued pursuant to section 402 or 404 of this Act.

(8) JUDICIAL REVIEW.—Any person against whom a civil penalty is assessed under this subsection or who commented on the proposed assessment of such penalty in accordance with paragraph (4) may obtain review of such assessment—

(A) in the case of assessment of a class I civil penalty, in the United States District Court for the District of Columbia or in the district in which the violation is alleged to have occurred, or

(B) in the case of assessment of a class II civil penalty, in United States Court of Appeals for the District of Columbia Circuit or for any other circuit in which such person resides or transacts business,

by filing a notice of appeal in such court within the 30-day period beginning on the date the civil penalty order is issued and by simultaneously sending a copy of such notice by certified mail to the Administrator or the Secretary, as the case may be, and the Attorney General. The Administrator or the Secretary shall promptly file in such court a certified copy of the record on which the order was issued. Such court shall not set aside or remand such order unless there is not substantial evidence in the record, taken as a whole, to support the finding of a violation or unless the Administrator's or Secretary's assessment of the penalty constitutes an abuse of discretion and shall not impose additional civil penalties for the same violation unless the Administrator's or Secretary's assessment of the penalty constitutes an abuse of discretion.

(9) COLLECTION.—If any person fails to pay an assessment of a civil penalty—

(A) after the order making the assessment has become final, or

(B) after a court in an action brought under paragraph (8) has entered a final judgment in favor of the Administrator or the Secretary, as the case may be,

the Administrator or the Secretary shall request the Attorney General to bring a civil action in an appropriate district court to recover the amount assessed (plus interest at currently prevailing rates from the date of the final order or the date of the final judgment, as the case may be). In such an action, the validity, amount, and appropriateness of such penalty shall not be subject to review. Any person who fails to pay on a timely

basis the amount of an assessment of a civil penalty as described in the first sentence of this paragraph shall be required to pay, in addition to such amount and interest, attorneys fees and costs for collection proceedings and a quarterly nonpayment penalty for each quarter during which such failure to pay persists. Such nonpayment penalty shall be in an amount equal to 20 percent of the aggregate amount of such person's penalties and nonpayment penalties which are unpaid as of the beginning of such quarter.

(10) SUBPOENAS.—The Administrator or Secretary, as the case may be, may issue subpoenas for the attendance and testimony of witnesses and the production of relevant papers, books, or documents in connection with hearings under this subsection. In case of contumacy or refusal to obey a subpoena issued pursuant to this paragraph and served upon any person, the district court of the United States for any district in which such person is found, resides, or transacts business, upon application by the United States and after notice to such person, shall have jurisdiction to issue an order requiring such person to appear and give testimony before the administrative law judge or to appear and produce documents before the administrative law judge, or both, and any failure to obey such order of the court may be punished by such court as a contempt thereof.

(11) PROTECTION OF EXISTING PROCEDURES.—Nothing in this subsection shall change the procedures existing on the day before the date of the enactment of the Water Quality Act of 1987 under other subsections of this section for issuance and enforcement of orders by the Administrator.

(33 U.S.C. 1319)

INTERNATIONAL POLLUTION ABATEMENT

SEC. 310. (a) Whenever the Administrator, upon receipts of reports, surveys, or studies from any duly constituted international agency, has reason to believe that pollution is occurring which endangers the health or welfare of persons in a foreign country, and the Secretary of State requests him to abate such pollution, he shall give formal notification thereof to the State water pollution control agency of the State or States in which such discharge or discharges originate and to the appropriate interstate agency, if any. He shall also promptly call such a hearing, if he believes that such pollution is occurring in sufficient quantity to warrant such action, and if such foreign country has given the United States essentially the same rights with respect to the prevention and control of pollution occurring in that country as is given that country by this subsection. The Administrator, through the Secretary of State, shall invite the foreign country which may be adversely affected by the pollution to attend and participate in the hearing, and the representative of such country shall, for the purpose of the hearing and any further proceeding resulting from such hearing, have all the rights of a State water pollution control agency. Nothing in this subsection shall be construed to modify, amend, repeal, or otherwise affect the provisions of the 1909 Boundary Waters Treaty between Canada and the United States or the Water Utilization

Treaty of 1944 between Mexico and the United States (59 Stat. 1219), relative to the control and abatement of pollution in waters covered by those treaties.

(b) The calling of a hearing under this section shall not be construed by the courts, the Administrator, or any person as limiting, modifying, or otherwise affecting the functions and responsibilities of the Administrator under this section to establish and enforce water quality requirements under this Act.

(c) The Administrator shall publish in the Federal Register a notice of a public hearing before a hearing board of five or more persons appointed by the Administrator. A majority of the members of the board and the chairman who shall be designated by the Administrator shall not be officers or employees of Federal, State, or local governments. On the basis of the evidence presented at such hearing, the board shall within sixty days after completion of the hearing make findings of fact as to whether or not such pollution is occurring and shall thereupon by decision, incorporating its findings therein, make such recommendations to abate the pollution as may be appropriate and shall transmit such decision and the record of the hearings to the Administrator. All such decisions shall be public. Upon receipt of such decision, the Administrator shall promptly implement the board's decision in accordance with the provisions of this Act.

(d) In connection with any hearing called under this subsection, the board is authorized to require any persons whose alleged activities result in discharges causing or contributing to pollution to file with it in such forms as it may prescribe, a report based on existing data, furnishing such information as may reasonably be required as to the character, kind, and quantity of such discharges and the use of facilities or other means to prevent or reduce such discharges by the person filing such a report. Such report shall be made under oath or otherwise, as the board may prescribe, and shall be filed with the board within such reasonable period as it may prescribe, unless additional time is granted by it. Upon a showing satisfactory to the board by the person filing such report that such report or portion thereof (other than effluent data), to which the Adminsitrator has access under this section, if made public would divulge trade secrets or secret processes of such person, the board shall consider such report or portion thereof confidential for the purposes of section 1905 of title 18 of the United States Code. If any person required to file any report under this paragraph shall fail to do so within the time fixed by the board for filing the same, and such failure shall continue for thirty days after notice of such default, such person shall forfeit to the United States the sum of $1,000 for each and every day of the continuance of such failure, which forfeiture shall be payable into the Treasury of the United States, and shall be recoverable in a civil suit in the name of the United States in the district court of the United States where such person has his principal office or in any district in which he does business. The Administrator may upon application therefor remit or mitigate any forfeiture provided for under this subsection.

(e) Board members, other than officers or employees of Federal, State, or local governments, shall be for each day (including traveltime) during which they are performing board business, entitled to

receive compensation at a rate fixed by the Administrator but not in excess of the maximum rate of pay for grade GS–18, as provided in the General Schedule under section 5332 of title 5 of the United States Code, and shall, notwithstanding the limitations of sections 5703 and 5704 of title 5 of the United States Code, be fully reimbursed for travel, subsistence, and related expenses.

(f) When any such recommendation adopted by the Administrator involves the institution of enforcement proceedings against any person to obtain the abatement of pollution subject to such recommendation, the Administrator shall institute such proceedings if he believes that the evidence warrants such proceedings. The district court of the United States shall consider and determine de novo all relevant issues, but shall receive in evidence the record of the proceedings before the conference or hearing board. The court shall have jurisdiction to enter such judgment and orders enforcing such judgment as it deems appropriate or to remand such proceedings to the Administrator for such further action as it may direct.

(33 U.S.C. 1320)

OIL AND HAZARDOUS SUBSTANCE LIABILITY

SEC. 311. (a) For the purpose of this section, the term—

(1) "oil" means oil of any kind or in any form, including, but not limited to, petroleum, fuel oil, sludge, oil refuse, and oil mixed with wastes other than dredged spoil;

(2) "discharge" includes, but is not limited to, any spilling, leaking, pumping, pouring, emitting, emptying or dumping, but excludes (A) discharges in compliance with a permit under section 402 of this Act, (B) discharges resulting from circumstances identified and reviewed and made a part of the public record with respect to a permit issued or modified under section 402 of this Act, and subject to a condition in such permit, ,(C)[1] continuous or anticipated intermittent discharges from a point source, identified in a permit or permit application under section 402 of this Act, which are caused by events occurring within the scope of relevant operating or treatment systems, and (D) discharges incidental to mechanical removal authorized by the President under subsection (c) of this section;

(3) "vessel" means every description of watercraft or other artificial contrivance used, or capable of being used, as a means of transportation on water other than a public vessel;

(4) "public vessel" means a vessel owned or bareboat-chartered and operated by the United States, or by a State or political subdivision thereof, or by a foreign nation, except when such vessel is engaged in commerce;

(5) "United States" means the States, the District of Columbia, the Commonwealth of Puerto Rico, the Commonwealth of the Northern Mariana Islands, Guam, American Samoa, the Virgin Islands, and the Trust Territory of the Pacific Islands;

(6) "owner or operator" means (A) in the case of a vessel, any person owning, operating, or chartering by demise, such vessel, and (B) in the case of an onshore facility, and an off-

[1] So in law.

shore facility, any person owning or operating such onshore facility or offshore facility, and (C) in the case of any abandoned offshore facility, the person who owned or operated such facility immediately prior to such abandonment;

(7) "person" includes an individual, firm, corporation, association, and a partnership;

(8) "remove" or "removal" refers to containment and removal of the oil or hazardous substances from the water and shorelines or the taking of such other actions as may be necessary to prevent, minimize, or mitigate damage to the public health or welfare, including, but not limited to, fish, shellfish, wildlife, and public and private property, shorelines, and beaches;

(9) "contiguous zone" means the entire zone established or to be established by the United States under article 24 of the Convention on the Territorial Sea and the Contiguous Zone;

(10) "onshore facility" means any facility (including, but not limited to, motor vehicles and rolling stock) of any kind located in, on, or under, any land within the United States other than submerged land;

(11) "offshore facility" means any facility of any kind located in, on, or under, any of the navigable waters of the United States, and any facility of any kind which is subject to the jurisdiction of the United States and is located in, on, or under any other waters, other than a vessel or a public vessel;

(12) "act of God" means an act occasioned by an unanticipated grave natural disaster;

(13) "barrel" means 42 United States gallons at 60 degrees Fahrenheit;

(14) "hazardous substance" means any substance designated pursuant to subsection (b)(2) of this section;

(15) "inland oil barge" means a non-self-propelled vessel carrying oil in bulk as cargo and certificated to operate only in the inland waters of the United States, while operating in such waters;

(16) "inland waters of the United States" means those waters of the United States lying inside the baseline from which the territorial sea is measured and those water outside such baseline which are a part of the Gulf Intracoastal Waterway;

(17) "otherwise" subject to the jurisdiction of the United States" means subject to the jurisdiction of the United States by virtue of United States citizenship, United States vessel documentation or numbering, or as provided for by international agreement to which the United States is a party;

(18) "Area Committee" means an Area Committee established under subsection (j);

(19) "Area Contingency Plan" means an Area Contingency Plan prepared under subsection (j);

(20) "Coast Guard District Response Group" means a Coast Guard District Response Group established under subsection (j);

(21) "Federal On-Scene Coordinator" means a Federal On-Scene Coordinator designated in the National Contingency Plan;

(22) "National Contingency Plan" means the National Contingency Plan prepared and published under subsection (d);

(23) "National Response Unit" means the National Response Unit established under subsection (j);

(24) "worst case discharge" means—

(A) in the case of a vessel, a discharge in adverse weather conditions of its entire cargo; and

(B) in the case of an offshore facility or onshore facility, the largest foreseeable discharge in adverse weather conditions; and

(25) "removal costs" means—

(A) the costs of removal of oil or a hazardous substance that are incurred after it is discharged; and

(B) in any case in which there is a substantial threat of a discharge of oil or a hazardous substance, the costs to prevent, minimize, or mitigate that threat.

(b)(1) The Congress hereby declares that it is the policy of the United States that there should be no discharges of oil or hazardous substances into or upon the navigable waters of the United States, adjoining shorelines, or into or upon the waters of the contiguous zone, or in connection with activities under the Outer Continental Shelf Lands Act or the Deepwater Port Act of 1974, or which may affect natural resources belonging to, appertaining to, or under the exclusive management authority of the United States (including resources under the Fishery Conservation and Management Act of 1976).

(2)(A) The Administrator shall develop, promulgate, and revise as may be appropriate, regulations designating as hazardous substances, other than oil as defined in this section, such elements and compounds which, when discharged in any quantity into or upon the navigable waters of the United States or adjoining shorelines or the waters of the contiguous zone or in connection with activities under the Outer Continental Shelf Lands Act or the Deepwater Port Act of 1974, or which may affect natural resources belonging to, appertaining to, or under the exclusive management authority of the United States (including resources under the Fishery Conservation and Management Act of 1976), present an imminent and substantial danger to the public health or welfare, including, but not limited to, fish, shellfish, wildlife, shorelines, and beaches.

(B) The Administrator shall within 18 months after the date of enactment of this paragraph, conduct a study and report to the Congress on methods, mechanisms, and procedures to create incentives to achieve a higher standard of care in all aspects of the management and movement of hazardous substances on the part of owners, operators, or persons in charge of onshore facilities, offshore facilities, or vessels. The Administrator shall include in such study (1) limits of liability, (2) liability for third party damages, (3) penalties and fees, (4) spill prevention plans, (5) current practices in the insurance and banking industries, and (6) whether the penalty enacted in subclause (bb) of clause (iii) of subparagraph (B) of subsection (b)(2) of section 311 of Public Law 92–500 should be enacted.

(3) The discharge of oil or hazardous substances (i) into or upon the navigable waters of the United States, adjoining shorelines, or into or upon the waters of the contiguous zone, or (ii) in

connection with activities under the Outer Continental Shelf Lands Act or the Deepwater Port Act of 1974, or which may affect natural resources belonging to, appertaining to, or under the exclusive management authority of the United States (including resources under the Fishery Conservation and Management Act of 1976), in such quantities as may be harmful as determined by the President under paragraph (4) of this subsection, is prohibited, except (A) in the case of such discharges into the waters of the contiguous zone or which may affect natural resources belonging to, appertaining to, or under the exclusive management authority of the United States (including resources under the Fishery Conservation and Management Act of 1976), where permitted under the Protocol of 1978 Relating to the International Convention for the Prevention of Pollution from Ships, 1973, and (B) where permitted in quantities and at times and locations or under such circumstances or conditions as the President may, by regulation, determine not to be harmful. Any regulations issued under this subsection shall be consistent with maritime safety and with marine and navigation laws and regulations and applicable water quality standards.

(4) The President shall by regulation determine for the purposes of this section those quantities of oil and any hazardous substances the discharge of which may be harmful to the public health or welfare or the environment of the United States, including but not limited to fish, shellfish, wildlife, and public and private property, shorelines, and beaches.

(5) Any person in charge of a vessel or of an onshore facility or an offshore facility shall, as soon as he has knowledge of any discharge of oil or a hazardous substance from such vessel or facility in violation of paragraph (3) of this subsection, immediately notify the appropriate agency of the United States Government of such discharge. The Federal agency shall immediately notify the appropriate State agency of any State which is, or may reasonably be expected to be, affected by the discharge of oil or a hazardous substance. Any such person (A) in charge of a vessel from which oil or a hazardous substance is discharged in violation of pragraph (3)(i) of this subsection, or (B) in charge of a vessel from which oil or a hazardous substance is discharged in violation of paragraph (3)(ii) of this subsection and who is otherwise subject to the jurisdiction of the United States at the time of the discharge, or (C) in charge of an onshore facility or an offshore facility, who fails to notify immediately such agency of such discharge shall, upon conviction, be fined in accordance with title 18, United States Code, or imprisoned for not more than 5 years, or both. Notification received pursuant to this paragraph shall not be used against any such natural person in any criminal case, except a prosecution for perjury or for giving a false statement.

(6) ADMINISTRATIVE PENALTIES.—

(A) VIOLATIONS.—Any owner, operator, or person in charge of any vessel, onshore facility, or offshore facility—

(i) from which oil or a hazardous substance is discharged in violation of paragraph (3), or

(ii) who fails or refuses to comply with any regulation issued under subsection (j) to which that owner, operator, or person in charge is subject,

may be assessed a class I or class II civil penalty by the Secretary of the department in which the Coast Guard is operating or the Administrator.

(B) CLASSES OF PENALTIES.—

(i) CLASS I.—The amount of a class I civil penalty under subparagraph (A) may not exceed $10,000 per violation, except that the maximum amount of any class I civil penalty under this subparagraph shall not exceed $25,000. Before assessing a civil penalty under this clause, the Administrator or Secretary, as the case may be, shall give to the person to be assessed such penalty written notice of the Administrator's or Secretary's proposal to assess the penalty and the opportunity to request, within 30 days of the date the notice is received by such person, a hearing on the proposed penalty. Such hearing shall not be subject to section 554 or 556 of title 5, United States Code, but shall provide a reasonable opportunity to be heard and to present evidence.

(ii) CLASS II.—The amount of a class II civil penalty under subparagraph (A) may not exceed $10,000 per day for each day during which the violation continues; except that the maximum amount of any class II civil penalty under this subparagraph shall not exceed $125,000. Except as otherwise provided in this subsection, a class II civil penalty shall be assessed and collected in the same manner, and subject to the same provisions, as in the case of civil penalties assessed and collected after notice and opportunity for a hearing on the record in accordance with section 554 of title 5, United States Code. The Administrator and Secretary may issue rules for discovery procedures for hearings under this paragraph.

(C) RIGHTS OF INTERESTED PERSONS.—

(i) PUBLIC NOTICE.—Before issuing an order assessing a class II civil penalty under this paragraph the Administrator or Secretary, as the case may be, shall provide public notice of and reasonable opportunity to comment on the proposed issuance of such order.

(ii) PRESENTATION OF EVIDENCE.—Any person who comments on a proposed assessment of a class II civil penalty under this paragraph shall be given notice of any hearing held under this paragraph and of the order assessing such penalty. In any hearing held under this paragraph, such person shall have a reasonable opportunity to be heard and to present evidence.

(iii) RIGHTS OF INTERESTED PERSONS TO A HEARING.—If no hearing is held under subparagraph (B) before issuance of an order assessing a class II civil penalty under this paragraph, any person who commented on the proposed assessment may petition, within 30 days after the issuance of such order, the Administrator or Secretary, as the case may be, to set aside

such order and to provide a hearing on the penalty. If the evidence presented by the petitioner in support of the petition is material and was not considered in the issuance of the order, the Administrator or Secretary shall immediately set aside such order and provide a hearing in accordance with subparagraph (B)(ii). If the Administrator or Secretary denies a hearing under this clause, the Administrator or Secretary shall provide to the petitioner, and publish in the Federal Register, notice of and the reasons for such denial.

(D) FINALITY OF ORDER.—An order assessing a class II civil penalty under this paragraph shall become final 30 days after its issuance unless a petition for judicial review is filed under subparagraph (G) or a hearing is requested under subparagraph (C)(iii). If such a hearing is denied, such order shall become final 30 days after such denial.

(E) EFFECT OF ORDER.—Action taken by the Administrator or Secretary, as the case may be, under this paragraph shall not affect or limit the Administrator's or Secretary's authority to enforce any provision of this Act; except that any violation—

(i) with respect to which the Administrator or Secretary has commenced and is diligently prosecuting an action to assess a class II civil penalty under this paragraph, or

(ii) for which the Administrator or Secretary has issued a final order assessing a class II civil penalty not subject to further judicial review and the violator has paid a penalty assessed under this paragraph,

shall not be the subject of a civil penalty action under section 309(d), 309(g), or 505 of this Act or under paragraph (7).

(F) EFFECT OF ACTION ON COMPLIANCE.—No action by the Administrator or Secretary under this paragraph shall affect any person's obligation to comply with any section of this Act.

(G) JUDICIAL REVIEW.—Any person against whom a civil penalty is assessed under this paragraph or who commented on the proposed assessment of such penalty in accordance with subparagraph (C) may obtain review of such assessment—

(i) in the case of assessment of a class I civil penalty, in the United States District Court for the District of Columbia or in the district in which the violation is alleged to have occurred, or

(ii) in the case of assessment of a class II civil penalty, in United States Court of Appeals for the District of Columbia Circuit or for any other circuit in which such person resides or transacts business,

by filing a notice of appeal in such court within the 30-day period beginning on the date the civil penalty order is issued and by simultaneously sending a copy of such notice by certified mail to the Administrator or Secretary, as the case may be, and the Attorney General. The Administrator or Secretary shall promptly file in such court a certified

copy of the record on which the order was issued. Such court shall not set aside or remand such order unless there is not substantial evidence in the record, taken as a whole, to support the finding of a violation or unless the Administrator's or Secretary's assessment of the penalty constitutes an abuse of discretion and shall not impose additional civil penalties for the same violation unless the Administrator's or Secretary's assessment of the penalty constitutes an abuse of discretion.

(H) COLLECTION.—If any person fails to pay an assessment of a civil penalty—

(i) after the assessment has become final, or

(ii) after a court in an action brought under subparagraph (G) has entered a final judgment in favor of the Administrator or Secretary, as the case may be,

the Administrator or Secretary shall request the Attorney General to bring a civil action in an appropriate district court to recover the amount assessed (plus interest at currently prevailing rates from the date of the final order or the date of the final judgment, as the case may be). In such an action, the validity, amount, and appropriateness of such penalty shall not be subject to review. Any person who fails to pay on a timely basis the amount of an assessment of a civil penalty as described in the first sentence of this subparagraph shall be required to pay, in addition to such amount and interest, attorneys fees and costs for collection proceedings and a quarterly nonpayment penalty for each quarter during which such failure to pay persists. Such nonpayment penalty shall be in an amount equal to 20 percent of the aggregate amount of such person's penalties and nonpayment penalties which are unpaid as of the beginning of such quarter.

(I) SUBPOENAS.—The Administrator or Secretary, as the case may be, may issue subpoenas for the attendance and testimony of witnesses and the production of relevant papers, books, or documents in connection with hearings under this paragraph. In case of contumacy or refusal to obey a subpoena issued pursuant to this subparagraph and served upon any person, the district court of the United States for any district in which such person is found, resides, or transacts business, upon application by the United States and after notice to such person, shall have jurisdiction to issue an order requiring such person to appear and give testimony before the administrative law judge or to appear and produce documents before the administrative law judge, or both, and any failure to obey such order of the court may be punished by such court as a contempt thereof.

(7) CIVIL PENALTY ACTION.—

(A) DISCHARGE, GENERALLY.—Any person who is the owner, operator, or person in charge of any vessel, onshore facility, or offshore facility from which oil or a hazardous substance is discharged in violation of paragraph (3), shall be subject to a civil penalty in an amount up to $25,000 per day of violation or an amount up to $1,000 per barrel

of oil or unit of reportable quantity of hazardous substances discharged.

(B) FAILURE TO REMOVE OR COMPLY.—Any person described in subparagraph (A) who, without sufficient cause—

(i) fails to properly carry out removal of the discharge under an order of the President pursuant to subsection (c); or

(ii) fails to comply with an order pursuant to subsection (e)(1)(B);

shall be subject to a civil penalty in an amount up to $25,000 per day of violation or an amount up to 3 times the costs incurred by the Oil Spill Liability Trust Fund as a result of such failure.

(C) FAILURE TO COMPLY WITH REGULATION.—Any person who fails or refuses to comply with any regulation issued under subsection (j) shall be subject to a civil penalty in an amount up to $25,000 per day of violation.

(D) GROSS NEGLIGENCE.—In any case in which a violation of paragraph (3) was the result of gross negligence or willful misconduct of a person described in subparagraph (A), the person shall be subject to a civil penalty of not less than $100,000, and not more than $3,000 per barrel of oil or unit of reportable quantity of hazardous substance discharged.

(E) JURISDICTION.—An action to impose a civil penalty under this paragraph may be brought in the district court of the United States for the district in which the defendant is located, resides, or is doing business, and such court shall have jurisdiction to assess such penalty.

(F) LIMITATION.—A person is not liable for a civil penalty under this paragraph for a discharge if the person has been assessed a civil penalty under paragraph (6) for the discharge.

(8) DETERMINATION OF AMOUNT.—In determining the amount of a civil penalty under paragraphs (6) and (7), the Administrator, Secretary, or the court, as the case may be, shall consider the seriousness of the violation or violations, the economic benefit to the violator, if any, resulting from the violation, the degree of culpability involved, any other penalty for the same incident, any history of prior violations, the nature, extent, and degree of success of any efforts of the violator to minimize or mitigate the effects of the discharge, the economic impact of the penalty on the violator, and any other matters as justice may require.

(9) MITIGATION OF DAMAGE.—In addition to establishing a penalty for the discharge of oil or a hazardous substance, the Administrator or the Secretary of the department in which the Coast Guard is operating may act to mitigate the damage to the public health or welfare caused by such discharge. The cost of such mitigation shall be deemed a cost incurred under subsection (c) of this section for the removal of such substance by the United States Government.

(10) RECOVERY OF REMOVAL COSTS.—Any costs of removal incurred in connection with a discharge excluded by subsection

(a)(2)(C) of this section shall be recoverable from the owner or operator of the source of the discharge in an action brought under section 309(b) of this Act.

(11) LIMITATION.—Civil penalties shall not be assessed under both this section and section 309 for the same discharge.

(12)[1] WITHHOLDING CLEARANCE.—If any owner, operator, or person in charge of a vessel is liable for a civil penalty under this subsection, or if reasonable cause exists to believe that the owner, operator, or person in charge may be subject to a civil penalty under this subsection, the Secretary of the Treasury, upon the request of the Secretary of the department in which the Coast Guard is operating or the Administrator, shall with respect to such vessel refuse or revoke—

(A) the clearance required by section 4197 of the Revised Statutes of the United States (46 U.S.C. App. 91);

(B) a permit to proceed under section 4367 of the Revised Statutes of the United States (46 U.S.C. App. 313); and

(C) a permit to depart required under section 443 of the Tariff Act of 1930 (19 U.S.C. 1443);

as applicable. Clearance or a permit refused or revoked under this paragraph may be granted upon the filing of a bond or other surety satisfactory to the Secretary of the department in which the Coast Guard is operating or the Administrator.

(c) FEDERAL REMOVAL AUTHORITY.—

(1) GENERAL REMOVAL REQUIREMENT.—(A) The President shall, in accordance with the National Contingency Plan and any appropriate Area Contingency Plan, ensure effective and immediate removal of a discharge, and mitigation or prevention of a substantial threat of a discharge, of oil or a hazardous substance—

(i) into or on the navigable waters;

(ii) on the adjoining shorelines to the navigable waters;

(iii) into or on the waters of the exclusive economic zone; or

(iv) that may affect natural resources belonging to, appertaining to, or under the exclusive management authority of the United States.

(B) In carrying out this paragraph, the President may—

(i) remove or arrange for the removal of a discharge, and mitigate or prevent a substantial threat of a discharge, at any time;

(ii) direct or monitor all Federal, State, and private actions to remove a discharge; and

(iii) remove and, if necessary, destroy a vessel discharging, or threatening to discharge, by whatever means are available.

(2) DISCHARGE POSING SUBSTANTIAL THREAT TO PUBLIC HEALTH OR WELFARE.—(A) If a discharge, or a substantial threat of a discharge, of oil or a hazardous substance from a vessel, offshore facility, or onshore facility is of such a size or character as to be a substantial threat to the public health or welfare of the United States (including but not limited to fish,

[1] Indentation so in law.

shellfish, wildlife, other natural resources, and the public and private beaches and shorelines of the United States), the President shall direct all Federal, State, and private actions to remove the discharge or to mitigate or prevent the threat of the discharge.

(B) In carrying out this paragraph, the President may, without regard to any other provision of law governing contracting procedures or employment of personnel by the Federal Government—

(i) remove or arrange for the removal of the discharge, or mitigate or prevent the substantial threat of the discharge; and

(ii) remove and, if necessary, destroy a vessel discharging, or threatening to discharge, by whatever means are available.

(3) ACTIONS IN ACCORDANCE WITH NATIONAL CONTINGENCY PLAN.—(A) Each Federal agency, State, owner or operator, or other person participating in efforts under this subsection shall act in accordance with the National Contingency Plan or as directed by the President.

(B) An owner or operator participating in efforts under this subsection shall act in accordance with the National Contingency Plan and the applicable response plan required under subsection (j), or as directed by the President, except that the owner or operator may deviate from the applicable response plan if the President or the Federal On-Scene Coordinator determines that deviation from the response plan would provide for a more expeditious or effective response to the spill or mitigation of its environmental effects.

(4) EXEMPTION FROM LIABILITY.—(A) A person is not liable for removal costs or damages which result from actions taken or omitted to be taken in the course of rendering care, assistance, or advice consistent with the National Contingency Plan or as otherwise directed by the President relating to a discharge or a substantial threat of a discharge of oil or a hazardous substance.

(B) Subparagraph (A) does not apply—

(i) to a responsible party;

(ii) to a response under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (42 U.S.C. 9601 et seq.);

(iii) with respect to personal injury or wrongful death; or

(iv) if the person is grossly negligent or engages in willful misconduct.

(C) A responsible party is liable for any removal costs and damages that another person is relieved of under subparagraph (A).

(5) OBLIGATION AND LIABILITY OF OWNER OR OPERATOR NOT AFFECTED.—Nothing in this subsection affects—

(A) the obligation of an owner or operator to respond immediately to a discharge, or the threat of a discharge, of oil; or

(B) the liability of a responsible party under the Oil Pollution Act of 1990.

(6) RESPONSIBLE PARTY DEFINED.—For purposes of this subsection, the term "responsible party" has the meaning given that term under section 1001 of the Oil Pollution Act of 1990.

(d) NATIONAL CONTINGENCY PLAN.—

(1) PREPARATION BY PRESIDENT.—The President shall prepare and publish a National Contingency Plan for removal of oil and hazardous substances pursuant to this section.

(2) CONTENTS.—The National Contingency Plan shall provide for efficient, coordinated, and effective action to minimize damage from oil and hazardous substance discharges, including containment, dispersal, and removal of oil and hazardous substances, and shall include, but not be limited to, the following:

(A) Assignment of duties and responsibilities among Federal departments and agencies in coordination with State and local agencies and port authorities including, but not limited to, water pollution control and conservation and trusteeship of natural resources (including conservation of fish and wildlife).

(B) Identification, procurement, maintenance, and storage of equipment and supplies.

(C) Establishment or designation of Coast Guard strike teams, consisting of—

(i) personnel who shall be trained, prepared, and available to provide necessary services to carry out the National Contingency Plan;

(ii) adequate oil and hazardous substance pollution control equipment and material; and

(iii) a detailed oil and hazardous substance pollution and prevention plan, including measures to protect fisheries and wildlife.

(D) A system of surveillance and notice designed to safeguard against as well as ensure earliest possible notice of discharges of oil and hazardous substances and imminent threats of such discharges to the appropriate State and Federal agencies.

(E) Establishment of a national center to provide coordination and direction for operations in carrying out the Plan.

(F) Procedures and techniques to be employed in identifying, containing, dispersing, and removing oil and hazardous substances.

(G) A schedule, prepared in cooperation with the States, identifying—

(i) dispersants, other chemicals, and other spill mitigating devices and substances, if any, that may be used in carrying out the Plan,

(ii) the waters in which such dispersants, other chemicals, and other spill mitigating devices and substances may be used, and

(iii) the quantities of such dispersant, other chemicals, or other spill mitigating device or substance which can be used safely in such waters,

which schedule shall provide in the case of any dispersant, chemical, spill mitigating device or substance, or waters

not specifically identified in such schedule that the President, or his delegate, may, on a case-by-case basis, identify the dispersants, other chemicals, and other spill mitigating devices and substances which may be used, the waters in which they may be used, and the quantities which can be used safely in such waters.

(H) A system whereby the State or States affected by a discharge of oil or hazardous substance may act where necessary to remove such discharge and such State or States may be reimbursed in accordance with the Oil Pollution Act of 1990, in the case of any discharge of oil from a vessel or facility, for the reasonable costs incurred for that removal, from the Oil Spill Liability Trust Fund.

(I) Establishment of criteria and procedures to ensure immediate and effective Federal identification of, and response to, a discharge, or the threat of a discharge, that results in a substantial threat to the public health or welfare of the United States, as required under subsection (c)(2).

(J) Establishment of procedures and standards for removing a worst case discharge of oil, and for mitigating or preventing a substantial threat of such a discharge.

(K) Designation of the Federal official who shall be the Federal On-Scene Coordinator for each area for which an Area Contingency Plan is required to be prepared under subsection (j).

(L) Establishment of procedures for the coordination of activities of—

(i) Coast Guard strike teams established under subparagraph (C);

(ii) Federal On-Scene Coordinators designated under subparagraph (K);

(iii) District Response Groups established under subsection (j); and

(iv) Area Committees established under subsection (j).

(M) A fish and wildlife response plan, developed in consultation with the United States Fish and Wildlife Service, the National Oceanic and Atmospheric Administration, and other interested parties (including State fish and wildlife conservation officials), for the immediate and effective protection, rescue, and rehabilitation of, and the minimization of risk of damage to, fish and wildlife resources and their habitat that are harmed or that may be jeopardized by a discharge.

(3) REVISIONS AND AMENDMENTS.—The President may, from time to time, as the President deems advisable, revise or otherwise amend the National Contingency Plan.

(4) ACTIONS IN ACCORDANCE WITH NATIONAL CONTINGENCY PLAN.—After publication of the National Contingency Plan, the removal of oil and hazardous substances and actions to minimize damage from oil and hazardous substance discharges shall, to the greatest extent possible, be in accordance with the National Contingency Plan.

(e) CIVIL ENFORCEMENT.—

(1) ORDERS PROTECTING PUBLIC HEALTH.—In addition to any action taken by a State or local government, when the President determines that there may be an imminent and substantial threat to the public health or welfare of the United States, including fish, shellfish, and wildlife, public and private property, shorelines, beaches, habitat, and other living and nonliving natural resources under the jurisdiction or control of the United States, because of an actual or threatened discharge of oil or a hazardous substance from a vessel or facility in violation of subsection (b), the President may—

(A) require the Attorney General to secure any relief from any person, including the owner or operator of the vessel or facility, as may be necessary to abate such endangerment; or

(B) after notice to the affected State, take any other action under this section, including issuing administrative orders, that may be necessary to protect the public health and welfare.

(2) JURISDICTION OF DISTRICT COURTS.—The district courts of the United States shall have jurisdiction to grant any relief under this subsection that the public interest and the equities of the case may require.

(f)(1) Except where an owner or operator can prove that a discharge was caused solely by (A) an act of God, (B) an act of war, (C) negligence on the part of the United States Government, or (D) an act or omission of a third party without regard to whether any such act or omission was or was not negligent, or any combination of the foregoing clauses, such owner or operator of any vessel from which oil or a hazardous substance is discharged in violation of subsection (b)(3) of this section shall, notwithstanding any other provision of law, be liable to the United States Government for the actual costs incurred under subsection (c) for the removal of such oil or substance by the United States Government in an amount not to exceed, in the case of an inland oil barge $125 per gross ton of such barge, or $125,000, whichever is greater, and in the case of any other vessel, $150 per gross ton of such vessel (or, for a vessel carrying oil or hazardous substances as cargo, $250,000), whichever is greater, except that where the United States can show that such discharge was the result of willful negligence or willful misconduct within the privity and knowledge of the owner, such owner or operator shall be liable to the United States Government for the full amount of such costs. Such costs shall constitute a maritime lien on such vessel which may be recovered in an action in rem in the district court of the United States for any district within which any vessel may be found. The United States may also bring an action against the owner or operator of such vessel in any court of competent jurisdiction to recover such costs.

(2) Except where an owner or operator of an onshore facility can prove that a discharge was caused solely by (A) an act of God, (B) an act of war, (C) negligence on the part of the United States Government, or (D) an act or omission of a third party without regard to whether any such act or omission was or was not negligent, or any combination of the foregoing clauses, such owner or operator of any such facility from which oil or a hazardous substance is discharged in violation of subsection (b)(3) of this section shall be lia-

ble to the United States Government for the actual costs incurred under subsection (c) for the removal of such oil or substance by the United States Government in an amount not to exceed $50,000,000, except that where the United States can show that such discharge was the result of willful negligence or willful misconduct within the privity and knowledge of the owner, such owner or operator shall be liable to the United States Government for the full amount of such costs. The United States may bring an action against the owner or operator of such facility in any court of competent jurisdiction to recover such costs. The Administrator is authorized, by regulation, after consultation with the Secretary of Commerce and the Small Business Administration, to establish reasonable and equitable classifications, of those onshore facilities having a total fixed storage capacity of 1,000 barrels or less which he determines because of size, type, and location do not present a substantial risk of the discharge of oil or hazardous substance in violation of subsection (b)(3) of this section, and apply with respect to such classifications differing limits of liability which may be less than the amount contained in this paragraph.

(3) Except where an owner or operator of an onshore facility can prove that a discharge was caused solely by (A) an act of God, (B) an act of war, (C) negligence on the part of the United States Government, or (D) an act or omission of a third party without regard to whether any such act or omission was or was not negligent, or any combination of the foregoing clauses, such owner or operator of any such facility from which oil or a hazardous substance is discharged in violation of subsection (b)(3) of this section shall, notwithstanding any other provision of law, be liable to the United States Government for the actual costs incurred under subsection (c) for the removal of such oil or substance by the United States Government in an amount not to exceed $50,000,000, except that where the United States can show that such discharge was the result of willful negligence or willful misconduct within the privity and knowledge of the owner, such owner or operator shall be liable to the United States Government for the full amount of such costs. The United States may bring an action against the owner or operator of such facility in any court of competent jurisdiction to recover such costs.

(4) The costs of removal of oil or a hazardous substance for which the owner or operator of a vessel or onshore or offshore facility is liable under subsection (f) of this section shall include any costs or expenses incurred by the Federal Government or any State government in the restoration or replacement of natural resources damaged or destroyed as a result of a discharge of oil or a hazardous substance in violation of subsection (b) of this section.

(5) The President, or the authorized representative of any State, shall act on behalf of the public as trustee of the natural resources to recover for the costs of replacing or restoring such resources. Sums recovered shall be used to restore, rehabilitate, or acquire the equivalent of such natural resources by the appropriate agencies of the Federal Government, or the State government.

(g) Where the owner or operator of a vessel (other than an inland oil barge) carrying oil or hazardous substances as cargo or an onshore or offshore facility which handles or stores oil or hazardous substances in bulk, from which oil or a hazardous substance is dis-

charged in violation of subsection (b) of this section, alleges that such discharge was caused solely by an act or omission of a third party, such owner or operator shall pay to the United States Government the actual costs incurred under subsection (c) for removal of such oil or substance and shall be entitled by subrogation to all rights of the United States Government to recover such costs from such third party under this subsection. In any case where an owner or operator of a vessel, of an onshore facility, or of an offshore facility, from which oil or a hazardous substance is discharged in violation of subsection (b)(3) of this section, proves that such discharge of oil or hazardous substance was caused solely by an act or omission of a third party, or was caused solely by such an act or omission in combination with an act of God, an act of war, or negligence on the part of the United States Government, such third party shall, not withstanding any other provision of law, be liable to the United States Government for the actual costs incurred under subsection (c) for removal of such oil or substance by the United States Government, except where such third party can prove that such discharge was caused solely by (A) an act of God, (B) an act of war, (C) negligence on the part of the United States Government, or (D) an act or omission of another party without regard to whether such an act or omission was or was not negligent, or any combination of the foregoing clauses. If such third party was the owner or operator of a vessel which caused the discharge of oil or a hazardous substance in violation of subsection (b)(3) of this section, the liability of such third party under this subsection shall not exceed, in the case of an inland oil barge $125 per gross ton of such barge, $125,000, whichever is greater, and in the case of any other vessel, $150 per gross ton of such vessel (or, for a vessel carrying oil or hazardous substances as cargo, $250,000), whichever is greater. In any other case the liability of such third party shall not exceed the limitation which would have been applicable to the owner or operator of the vessel or the onshore or offshore facility from which the discharge actually occurred if such owner or operator were liable. If the United States can show that the discharge of oil or a hazardous substance in violation of subsection (b)(3) of this section was the result of willful negligence or willful misconduct within the privity and knowledge of such third party, such third party shall be liable to the United States Government for the full amount of such removal costs. The United States may bring an action against the third party in any court of competent jurisdiction to recover such removal costs.

(h) The liabilities established by this section shall in no way affect any rights which (1) the owner or operator of a vessel or of an onshore facility or an offshore facility may have against any third party whose acts may in any way have caused or contributed to such discharge, or (2) The [1] United States Government may have against any third party whose actions may in any way have caused or contributed to the discharge of oil or hazardous substance.

(i) In any case where an owner or operator of a vessel or an onshore facility or an offshore facility from which oil or a hazardous substance is discharged in violation of subsection (b)(3) of this section acts to remove such oil or substance in accordance with

[1] So in law. Should not be capitalized.

regulations promulgated pursuant to this section, such owner or operator shall be entitled to recover the reasonable costs incurred in such removal upon establishing, in a suit which may be brought against the United States Government in the United States Claims Court, that such discharge was caused solely by (A) an act of God, (B) an act of war, (C) negligence on the part of the United States Government, or (D) an act or omission of a third party without regard to whether such act or omission was or was not negligent, or of any combination of the foregoing clauses.

(j) NATIONAL RESPONSE SYSTEM.—

(1) IN GENERAL.—Consistent with the National Contingency Plan required by subsection (c)(2) of this section, as soon as practicable after the effective date of this section, and from time to time thereafter, the President shall issue regulations consistent with maritime safety and with marine and navigation laws (A) establishing methods and procedures for removal of discharged oil and hazardous substances, (B) establishing criteria for the development and implementation of local and regional oil and hazardous substance removal contingency plans, (C) establishing procedures, methods, and equipment and other requirements for equipment to prevent discharges of oil and hazardous substances from vessels and from onshore facilities and offshore facilities, and to contain such discharges, and (D) governing the inspection of vessels carrying cargoes of oil and hazardous substances and the inspection of such cargoes in order to reduce the likelihood of discharges of oil from vessels in violation of this section.

(2) NATIONAL RESPONSE UNIT.—The Secretary of the department in which the Coast Guard is operating shall establish a National Response Unit at Elizabeth City, North Carolina. The Secretary, acting through the National Response Unit—

(A) shall compile and maintain a comprehensive computer list of spill removal resources, personnel, and equipment that is available worldwide and within the areas designated by the President pursuant to paragraph (4), and of information regarding previous spills, including data from universities, research institutions, State governments, and other nations, as appropriate, which shall be disseminated as appropriate to response groups and area committees, and which shall be available to Federal and State agencies and the public;

(B) shall provide technical assistance, equipment, and other resources requested by a Federal On-Scene Coordinator;

(C) shall coordinate use of private and public personnel and equipment to remove a worst case discharge, and to mitigate or prevent a substantial threat of such a discharge, from a vessel, offshore facility, or onshore facility operating in or near an area designated by the President pursuant to paragraph (4);

(D) may provide technical assistance in the preparation of Area Contingency Plans required under paragraph (4);

(E) shall administer Coast Guard strike teams established under the National Contingency Plan;

(F) shall maintain on file all Area Contingency Plans approved by the President under this subsection; and

(G) shall review each of those plans that affects its responsibilities under this subsection.

(3) COAST GUARD DISTRICT RESPONSE GROUPS.—(A) The Secretary of the department in which the Coast Guard is operating shall establish in each Coast Guard district a Coast Guard District Response Group.

(B) Each Coast Guard District Response Group shall consist of—

(i) the Coast Guard personnel and equipment, including firefighting equipment, of each port within the district;

(ii) additional prepositioned equipment; and

(iii) a district response advisory staff.

(C) Coast Guard district response groups—

(i) shall provide technical assistance, equipment, and other resources when required by a Federal On-Scene Coordinator;

(ii) shall maintain all Coast Guard response equipment within its district;

(iii) may provide technical assistance in the preparation of Area Contingency Plans required under paragraph (4); and

(iv) shall review each of those plans that affect its area of geographic responsibility.

(4) AREA COMMITTEES AND AREA CONTINGENCY PLANS.—(A) There is established for each area designated by the President an Area Committee comprised of members appointed by the President from qualified personnel of Federal, State, and local agencies.

(B) Each Area Committee, under the direction of the Federal On-Scene Coordinator for its area, shall—

(i) prepare for its area the Area Contingency Plan required under subparagraph (C);

(ii) work with State and local officials to enhance the contingency planning of those officials and to assure preplanning of joint response efforts, including appropriate procedures for mechanical recovery, dispersal, shoreline cleanup, protection of sensitive environmental areas, and protection, rescue, and rehabilitation of fisheries and wildlife; and

(iii) work with State and local officials to expedite decisions for the use of dispersants and other mitigating substances and devices.

(C) Each Area Committee shall prepare and submit to the President for approval an Area Contingency Plan for its area. The Area Contingency Plan shall—

(i) when implemented in conjunction with the National Contingency Plan, be adequate to remove a worst case discharge, and to mitigate or prevent a substantial threat of such a discharge, from a vessel, offshore facility, or onshore facility operating in or near the area;

(ii) describe the area covered by the plan, including the areas of special economic or environmental importance that might be damaged by a discharge;

(iii) describe in detail the responsibilities of an owner or operator and of Federal, State, and local agencies in removing a discharge, and in mitigating or preventing a substantial threat of a discharge;

(iv) list the equipment (including firefighting equipment), dispersants or other mitigating substances and devices, and personnel available to an owner or operator and Federal, State, and local agencies, to ensure an effective and immediate removal of a discharge, and to ensure mitigation or prevention of a substantial threat of a discharge;

(v) compile a list of local scientists, both inside and outside Federal Government service, with expertise in the environmental effects of spills of the types of oil typically transported in the area, who may be contacted to provide information or, where appropriate, participate in meetings of the scientific support team convened in response to a spill, and describe the procedures to be followed for obtaining an expedited decision regarding the use of dispersants;

(vi) describe in detail how the plan is integrated into other Area Contingency Plans and vessel, offshore facility, and onshore facility response plans approved under this subsection, and into operating procedures of the National Response Unit;

(vii) include any other information the President requires; and

(viii) be updated periodically by the Area Committee.

(D) The President shall—

(i) review and approve Area Contingency Plans under this paragraph; and

(ii) periodically review Area Contingency Plans so approved.

(5) TANK VESSEL AND FACILITY RESPONSE PLANS.—(A) The President shall issue regulations which require an owner or operator of a tank vessel or facility described in subparagraph (B) to prepare and submit to the President a plan for responding, to the maximum extent practicable, to a worst case discharge, and to a substantial threat of such a discharge, of oil or a hazardous substance.

(B) The tank vessels and facilities referred to in subparagraph (A) are the following:

(i) A tank vessel, as defined under section 2101 of title 46, United States Code.

(ii) An offshore facility.

(iii) An onshore facility that, because of its location, could reasonably be expected to cause substantial harm to the environment by discharging into or on the navigable waters, adjoining shorelines, or the exclusive economic zone.

(C) A response plan required under this paragraph shall—

(i) be consistent with the requirements of the National Contingency Plan and Area Contingency Plans;

(ii) identify the qualified individual having full authority to implement removal actions, and require immediate communications between that individual and the appro-

priate Federal official and the persons providing personnel and equipment pursuant to clause (iii);

(iii) identify, and ensure by contract or other means approved by the President the availability of, private personnel and equipment necessary to remove to the maximum extent practicable a worst case discharge (including a discharge resulting from fire or explosion), and to mitigate or prevent a substantial threat of such a discharge;

(iv) describe the training, equipment testing, periodic unannounced drills, and response actions of persons on the vessel or at the facility, to be carried out under the plan to ensure the safety of the vessel or facility and to mitigate or prevent the discharge, or the substantial threat of a discharge;

(v) be updated periodically; and

(vi) be resubmitted for approval of each significant change.

(D) With respect to any response plan submitted under this paragraph for an onshore facility that, because of its location, could reasonably be expected to cause significant and substantial harm to the environment by discharging into or on the navigable waters or adjoining shorelines or the exclusive economic zone, and with respect to each response plan submitted under this paragraph for a tank vessel or offshore facility, the President shall—

(i) promptly review such response plan;

(ii) require amendments to any plan that does not meet the requirements of this paragraph;

(iii) approve any plan that meets the requirements of this paragraph; and

(iv) review each plan periodically thereafter.

(E)[1] A tank vessel, offshore facility, or onshore facility required to prepare a response plan under this subsection may not handle, store, or transport oil unless—

(i) in the case of a tank vessel, offshore facility, or onshore facility for which a response plan is reviewed by the President under subparagraph (D), the plan has been approved by the President; and

(ii) the vessel or facility is operating in compliance with the plan.

(F) Notwithstanding subparagraph (E), the President may authorize a tank vessel, offshore facility, or onshore facility to operate without a response plan approved under this paragraph, until not later than 2 years after the date of the submission to the President of a plan for the tank vessel or facility, if the owner or operator certifies that the owner or operator has ensured by contract or other means approved by the President the availability of private personnel and equipment necessary to respond, to the maximum extent practicable, to a worst case discharge or a substantial threat of such a discharge.

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[1] Subparagraph (E) of section 311(j)(5) shall take effect 36 months (August 18, 1993) after the date of the enactment of Public Law 101-380. See P.L. 101-380, sec. 4202(b)(4)(C), 104 Stat. 532.

(G) The owner or operator of a tank vessel, offshore facility, or onshore facility may not claim as a defense to liability under title I of the Oil Pollution Act of 1990 that the owner or operator was acting in accordance with an approved response plan.

(H) The Secretary shall maintain, in the Vessel Identification System established under chapter 125 of title 46, United States Code, the dates of approval and review of a response plan under this paragraph for each tank vessel that is a vessel of the United States.

(6) EQUIPMENT REQUIREMENTS AND INSPECTION.—Not later than 2 years after the date of enactment of this section, the President shall require—

(A) periodic inspection of containment booms, skimmers, vessels, and other major equipment used to remove discharges; and

(B) vessels operating on navigable waters and carrying oil or a hazardous substance in bulk as cargo to carry appropriate removal equipment that employs the best technology economically feasible and that is compatible with the safe operation of the vessel.

(7) AREA DRILLS.—The President shall periodically conduct drills of removal capability, without prior notice, in areas for which Area Contingency Plans are required under this subsection and under relevant tank vessel and facility response plans. The drills may include participation by Federal, State, and local agencies, the owners and operators of vessels and facilities in the area, and private industry. The President may publish annual reports on these drills, including assessments of the effectiveness of the plans and a list of amendments made to improve plans.

(8) UNITED STATES GOVERNMENT NOT LIABLE.—The United States Government is not liable for any damages arising from its actions or omissions relating to any response plan required by this section.

[Subsection (k) was repealed by sec. 2002(b)(2) of P.L. 101-380.]

(l) The President is authorized to delegate the administration of this section to the heads of those Federal departments, agencies, and instrumentalities which he determines to be appropriate. Each such department, agency, and instrumentality, in order to avoid duplication of effort, shall, whenever appropriate, utilize the personnel, services, and facilities of other Federal departments, agencies, and instrumentalities.

(m) ADMINISTRATIVE PROVISIONS.—

(1) FOR VESSELS.—Anyone authorized by the President to enforce the provisions of this section with respect to any vessel may, except as to public vessels—

(A) board and inspect any vessel upon the navigable waters of the United States or the waters of the contiguous zone,

(B) with or without a warrant, arrest any person who in the presence or view of the authorized person violates the provisions of this section or any regulation issued thereunder, and

(C) execute any warrant or other process issued by an officer or court of competent jurisdiction.

(2) FOR FACILITIES.—

(A) RECORDKEEPING.—Whenever required to carry out the purposes of this section, the Administrator or the Secretary of the Department in which the Coast Guard is operating shall require the owner or operator of a facility to which this section applies to establish and maintain such records, make such reports, install, use, and maintain such monitoring equipment and methods, and provide such other information as the Administrator or Secretary, as the case may be, may require to carry out the objectives of this section.

(B) ENTRY AND INSPECTION.—Whenever required to carry out the purposes of this section, the Administrator or the Secretary of the Department in which the Coast Guard is operating or an authorized representative of the Administrator or Secretary, upon presentation of appropriate credentials, may—

(i) enter and inspect any facility to which this section applies, including any facility at which any records are required to be maintained under subparagraph (A); and

(ii) at reasonable times, have access to and copy any records, take samples, and inspect any monitoring equipment or methods required under subparagraph (A).

(C) ARRESTS AND EXECUTION OF WARRANTS.—Anyone authorized by the Administrator or the Secretary of the department in which the Coast Guard is operating to enforce the provisions of this section with respect to any facility may—

(i) with or without a warrant, arrest any person who violates the provisions of this section or any regulation issued thereunder in the presence or view of the person so authorized; and

(ii) execute any warrant or process issued by an officer or court of competent jurisdiction.

(D) PUBLIC ACCESS.—Any records, reports, or information obtained under this paragraph shall be subject to the same public access and disclosure requirements which are applicable to records, reports, and information obtained pursuant to section 308.

(n) The several district courts of the United States are invested with jurisdiction for any actions, other than actions pursuant to subsection (i)(1), arising under this section. In the case of Guam and the Trust Territory of the Pacific Islands, such actions may be brought in the district court of Guam, and in the case of the Virgin Islands such actions may be brought in the district court of the Virgin Islands. In the case of American Samoa and the Trust Territory of the Pacific Islands, such actions may be brought in the District Court of the United States for the District of Hawaii and such court shall have jurisdiction of such actions. In the case of the Canal Zone, such actions may be brought in the United States District Court for the District of the Canal Zone.

(o)(1) Nothing in this section shall affect or modify in any way the obligations of any owner or operator of any vessel, or of any owner or operator of any onshore facility or offshore facility to any person or agency under any provision of law for damages to any publicly owned or privately owned property resulting from a discharge of any oil or hazardous substance or from the removal of any such oil or hazardous substance.

(2) Nothing in this section shall be construed as preempting any State or political subdivision thereof from imposing any requirement or liability with respect to the discharge of oil or hazardous substance into any waters within such State, or with respect to any removal activites related to such discharge.

(3) Nothing in this section shall be construed as affecting or modifying any other existing authority of any Federal department, agency, or instrumentality, relative to onshore or offshore facilities under this Act or any other provision of law, or to affect any State or local law not in conflict with this section.

[Subsection (p) was repealed by sec. 2002(b)(4) of Public Law 101-380, 104 Stat. 507.]

(q) The President is authorized to establish, with repect to any class or category of onshore or offshore facilities, a maximum limit of liability under subsections (f)(2) and (3) of this section of less than $50,000,0000, but not less than, $8,000,000.

(r) Nothing in this section shall be construed to impose, or authorize the imposition of any limitation on liability under the Outer Continental Shelf Lands Act or the Deepwater Port Act of 1974.

(s) The Oil Spill Liability Trust Fund established under section 9509 of the Internal Revenue Code of 1986 (26 U.S.C. 9509) shall be available to carry out subsections (b), (c), (d), (j), and (l) as those subsections apply to discharges, and substantial threats of discharges, of oil. Any amounts received by the United States under this section shall be deposited in the Oil Spill Liability Trust Fund.

(33 U.S.C. 1321)

MARINE SANITATION DEVICES

SEC. 312. (a) For the purpose of this section, the term—

(1) "new vessel" includes every description of watercraft or other artificial contrivance used, or capable of being used, as a means of transportation on the navigable waters, the construction of which is initiated after promulgation of standards and regulations under this section;

(2) "existing vessel" includes every description of watercraft or other artificial contrivance used, or capable of being used, as a means of transportation on the navigable waters, the construction of which is initiated before promulgation of standards and regulations under this section;

(3) "public vessel" means a vessel owned or bareboat chartered and operated by the United States, by a State or political subdivision thereof, or by a foreign nation, except when such vessel is engaged in commerce;

(4) "United States" includes the States, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, the Canal Zone, and the Trust Territory of the Pacific Islands;

(5) "marine sanitation device" includes any equipment for installation on board a vessel which is designed to receive, retain, treat, or discharge sewage, and any process to treat such sewage;

(6) "sewage" means human body wastes and the wastes from toilets and other receptacles intended to receive or retain body wastes except that, with respect to commercial vessels on the Great Lakes, such term shall include graywater;

(7) "manufacture" means any person engaged in the manufacturing, assembling, or importation of marine sanitation devices or of vessels subject to standards and regulations promulgated under this section;

(8) "person" means an individual, partnership, firm, corporation, association, or agency of the United States, but does not include an individual on board a public vessel;

(9) "discharge" includes, but is not limited to, any spilling, leaking, pumping, pouring, emitting, emptying or dumping;

(10) "commercial vessels" means those vessels used in the business of transporting property for compensation or hire, or in transporting property in the business of the owner, lessee, or operator of the vessel;

(11) "graywater" means galley, bath, and shower water;

(12) "discharge incidental to the normal operation of a vessel"—

(A) means a discharge, including—

(i) graywater, bilge water, cooling water, weather deck runoff, ballast water, oil water separator effluent, and any other pollutant discharge from the operation of a marine propulsion system, shipboard maneuvering system, crew habitability system, or installed major equipment, such as an aircraft carrier elevator or a catapult, or from a protective, preservative, or absorptive application to the hull of the vessel; and

(ii) a discharge in connection with the testing, maintenance, and repair of a system described in clause (i) whenever the vessel is waterborne; and

(B) does not include—

(i) a discharge of rubbish, trash, garbage, or other such material discharged overboard;

(ii) an air emission resulting from the operation of a vessel propulsion system, motor driven equipment, or incinerator; or

(iii) a discharge that is not covered by part 122.3 of title 40, Code of Federal Regulations (as in effect on the date of the enactment of subsection (n));

(13) "marine pollution control device" means any equipment or management practice, for installation or use on board a vessel of the Armed Forces, that is—

(A) designed to receive, retain, treat, control, or discharge a discharge incidental to the normal operation of a vessel; and

(B) determined by the Administrator and the Secretary of Defense to be the most effective equipment or management practice to reduce the environmental impacts

of the discharge consistent with the considerations set forth in subsection (n)(2)(B); and

(14) "vessel of the Armed Forces" means—

(A) any vessel owned or operated by the Department of Defense, other than a time or voyage chartered vessel; and

(B) any vessel owned or operated by the Department of Transportation that is designated by the Secretary of the department in which the Coast Guard is operating as a vessel equivalent to a vessel described in subparagraph (A).

(b)(1) As soon as possible, after the enactment of this section and subject to the provisions of section 104(j) of this Act, the Administrator, after consultation with the Secretary of the department in which the Coast Guard is operating, after giving appropriate consideration to the economic costs involved, and within the limits of available technology, shall promulgate Federal standards of performance for marine sanitation devices (hereinafter in this section referred to as "standards") which shall be designed to prevent the discharge of untreated or inadequately treated sewage into or upon the navigable waters from new vessels and existing vessels, except vessels not equipped with installed toilet facilities. Such standards and standards established under subsection (c)(1)(B) of this section shall be consistent with maritime safety and the marine and navigation laws and regulations and shall be coordinated with the regulations issued under this subsection by the Secretary of the department in which the Coast Guard is operating. The Secretary of the department in which the Coast Guard is operating shall promulgate regulations, which are consistent with standards promulgated under this subsection and subsection (c) of this section and with maritime safety and the marine and navigation laws and regulations governing the design, construction, installation, and operation of any marine sanitation device on board such vessels.

(2) Any existing vessel equipped with a marine sanitation device on the date of promulgation of initial standards and regulations under this section, which device is in compliance with such initial standards and regulations, shall be deemed in compliance with this section until such time as the device is replaced or is found not to be in compliance with such initial standards and regulations.

(c)(1)(A) Initial standards and regulations under this section shall become effective for new vessels two years after promulgation; and for existing vessels five years after promulgation. Revisions of standards and regulations shall be effective upon promulgation, unless another effective date is specified, except that no revision shall take effect before the effective date of the standard or regulation being revised.

(B) The Administrator shall, with respect to commercial vessels on the Great Lakes, establish standards which require at a minimum the equivalent of secondary treatment as defined under section 304(d) of this Act. Such standards and regulations shall take effect for existing vessels after such time as the Administrator determines to be reasonable for the upgrading of marine sanitation devices to attain such standard.

(2) The Secretary of the department in which the Coast Guard is operating with regard to his regulatory authority established by this section, after consultation with the Administrator, may distinguish among classes, types, and sizes of vessels as well as between new and existing vessels, and may waive applicability of standards and regulations as necessary or appropriate for such classes, types, and sizes of vessels (including existing vessels equipped with marine sanitation devices on the date of promulgation of the initial standards required by this section), and, upon application, for individual vessels.

(d) The provisions of this section and the standards and regulations promulgated hereunder apply to vessels owned and operated by the United States unless the Secretary of Defense finds that compliance would not be in the interest of national security. With respect to vessels owned and operated by the Department of Defense, regulations under the last sentence of subsection (b)(1) of this section and certifications under subsection (g)(2) of this section shall be promulgated and issued by the Secretary of Defense.

(e) Before the standards and regulations under this section are promulgated, the Administrator and the Secretary of the department in which the Coast Guard is operating shall consult with the Secretary of State; the Secretary of Health, Education, and Welfare; the Secretary of Defense; the Secretary of the Treasury; the Secretary of Commerce; other interested Federal agencies; and the States and industries interested; and otherwise comply with the requirements of section 553 of title 5 of the United States Code.

(f)(1)(A) Except as provided in subparagraph (B), after the effective date of the initial standards and regulations promulgated under this section, no State or political subdivision thereof shall adopt or enforce any statute or regulation of such State or political subdivision with respect to the design, manufacture, or installation or use of any marine sanitation device on any vessel subject to the provisions of this section.

(B) A State may adopt and enforce a statute or regulation with respect to the design, manufacture, or installation or use of any marine sanitation device on a houseboat, if such statute or regulation is more stringent than the standards and regulations promulgated under this section. For purposes of this paragraph, the term "houseboat" means a vessel which, for a period of time determined by the State in which the vessel is located, is used primarily as a residence and is not used primarily as a means of transportation.

(2) If, after promulgation of the initial standards and regulations and prior to their effective date, a vessel is equipped with a marine sanitation device in compliance with such standards and regulations and the installation and operation of such device is in accordance with such standards and regulations, such standards and regulations shall, for the purposes of paragraph (1) of this subsection, become effective with respect to such vessel on the date of such compliance.

(3) After the effective date of the initial standards and regulations promulgated under this section, if any State determines that the protection and enhancement of the quality of some or all of the waters within such State require greater environmental protection, such State may completely prohibit the discharge from all vessels of any sewage, whether treated or not, into such waters, except

that no such prohibition shall apply until the Administrator determines that adequate facilities for the safe and sanitary removal and treatment of sewage from all vessels are reasonably available for such water to which such prohibition would apply. Upon application of the State, the Administrator shall make such determination within 90 days of the date of such application.

(4)(A) If the Administrator determines upon application by a State that the protection and enhancement of the quality of specified waters within such State requires such a prohibition, he shall by regulation completely prohibit the discharge from a vessel of any sewage (whether treated or not) into such waters.

(B) Upon application by a State, the Administrator shall, by regulation, establish a drinking water intake zone in any waters within such State and prohibit the discharge of sewage from vessels within that zone.

(g)(1) No manufacturer of a marine sanitation device shall sell, offer for sale, or introduce or deliver for introduction in interstate commerce, or import into the United States for sale or resale any marine sanitation device manufactured after the effective date of the standards and regulations promulgated under this section unless such device is in all material respects substantially the same as a test device certified under this subsection.

(2) Upon application of the manufacturer, the Secretary of the department in which the Coast Guard is operating shall so certify a marine sanitation device if he determines, in accordance with the provisions of this paragraph, that it meets the appropriate standards and regulations promulgated under this section. The Secretary of the department in which the Coast Guard is operating shall test or require such testing of the device in accordance with procedures set forth by the Administrator as to standards of performance and for such other purposes as may be appropriate. If the Secretary of the department in which the Coast Guard is operating determines that the device is satisfactory from the standpoint of safety and any other requirements of maritime law or regulation, and after consideration of the design, installation, operation, material, or other appropriate factors, he shall certify the device. Any device manufactured by such manufacturer which is in all material respects substantially the same as the certified test device shall be deemed to be in conformity with the appropriate standards and regulations established under this section.

(3) Every manufacturer shall establish and maintain such records, make such reports, and provide such information as the Administrator or the Secretary of the department in which the Coast Guard is operating may reasonably require to enable him to determine whether such manufacturer has acted or is acting in compliance with this section and regulations issued thereunder and shall, upon request of an officer or employee duly designated by the Administrator or the Secretary of the department in which the Coast Guard is operating, permit such officer or employee at reasonable times to have access to and copy such records. All information reported to or otherwise obtained by the Administrator or the Secretary of the department in which the Coast Guard is operating or their representatives pursuant to this subsection which contains or relates to a trade secret or other matter referred in section 1905 of title 18 of the United States Code shall be considered confiden-

tial for the purpose of that section, except that such information may be disclosed to other officers or employees concerned with carrying out this section. This paragraph shall not apply in the case of the construction of a vessel by an individual for his own use.

(h) After the effective date of standards and regulations promulgated under this section, it shall be unlawful—

(1) for the manufacturer of any vessel subject to such standards and regulations to manufacture for sale, to sell or offer for sale, or to distribute for sale or resale any such vessel unless it is equipped with a marine sanitation device which is in all material respects substantially the same as the appropriate test device certified pursuant to this section;

(2) for any person, prior to the sale or delivery of a vessel subject to such standards and regulations to the ultimate purchaser, wrongfully to remove or render inoperative any certified marine sanitation device or element of design of such device installed in such vessel;

(3) for any person to fail or refuse to permit access to or copying of records or to fail to make reports or provide information required under this section; and

(4) for a vessel subject to such standards and regulations to operate on the navigable waters of the United States, if such vessel is not equipped with an operable marine sanitation device certified pursuant to this section.

(i) The district courts of the United States shall have jurisdictions to restrain violations of subsection (g)(1) of this section and subsections (h)(1) through (3) of this section. Actions to restrain such violations shall be brought by, and in, the name of the United States. In case of contumacy or refusal to obey a subpena served upon any person under this subsection, the district court of the United States for any district in which such person is found or resides or transacts business, upon application by the United States and after notice to such person, shall have jurisdiction to issue an order requiring such person to appear and give testimony or to appear and produce documents, and any failure to obey such order of the court may be punished by such court as a contempt thereof.

(j) Any person who violates subsection (g)(1), clause (1) or (2) of subsection (h), or subsection (n)(8) shall be liable to a civil penalty of not more than $5,000 for each violation. Any person who violates clause (4) of subsection (h) of this section or any regulation issued pursuant to this section shall be liable to a civil penalty of not more than $2,000 for each violation. Each violation shall be a separate offense. The Secretary of the department in which the Coast Guard is operating may assess and compromise any such penalty. No penalty shall be assessed until the person charged shall have been given notice and an opportunity for a hearing on such charge. In determining the amount of the penalty, or the amount agreed upon in compromise, the gravity of the violation, and the demonstrated good faith of the person charged in attempting to achieve rapid compliance, after notification of a violation, shall be considered by said Secretary.

(k) The provisions of this section shall be enforced by the Secretary of the department in which the Coast Guard is operating and he may utilize by agreement, with or without reimbursement, law enforcement officers or other personnel and facilities of the Ad-

ministrator, other Federal agencies, or the States to carry out the provisions of this section. The provisions of this section may also be enforced by a State.

(l) Anyone authorized by the Secretary of the department in which the Coast Guard is operating to enforce the provisions of this section may, except as to public vessels, (1) board and inspect any vessel upon the navigable waters of the United States and (2) execute any warrant or other process issued by an officer or court of competent jurisdiction.

(m) In the case of Guam and the Trust Territory of the Pacific Islands, actions arising under this section may be brought in the district court of Guam, and in the case of the Virgin Islands such actions may be brought in the district court of the Virgin Islands. In the case of American Samoa and the Trust Territory of the Pacific Islands, such actions may be brought in the District Court of the United States for the District of Hawaii and such court shall have jurisdiction of such actions. In the case of the Canal Zone, such actions may be brought in the District Court for the District of the Canal Zone.

(n) UNIFORM NATIONAL DISCHARGE STANDARDS FOR VESSELS OF THE ARMED FORCES.—

(1) APPLICABILITY.—This subsection shall apply to vessels of the Armed Forces and discharges, other than sewage, incidental to the normal operation of a vessel of the Armed Forces, unless the Secretary of Defense finds that compliance with this subsection would not be in the national security interests of the United States.

(2) DETERMINATION OF DISCHARGES REQUIRED TO BE CONTROLLED BY MARINE POLLUTION CONTROL DEVICES.—

(A) IN GENERAL.—The Administrator and the Secretary of Defense, after consultation with the Secretary of the department in which the Coast Guard is operating, the Secretary of Commerce, and interested States, shall jointly determine the discharges incidental to the normal operation of a vessel of the Armed Forces for which it is reasonable and practicable to require use of a marine pollution control device to mitigate adverse impacts on the marine environment. Notwithstanding subsection (a)(1) of section 553 of title 5, United States Code, the Administrator and the Secretary of Defense shall promulgate the determinations in accordance with such section. The Secretary of Defense shall require the use of a marine pollution control device on board a vessel of the Armed Forces in any case in which it is determined that the use of such a device is reasonable and practicable.

(B) CONSIDERATIONS.—In making a determination under subparagraph (A), the Administrator and the Secretary of Defense shall take into consideration—

(i) the nature of the discharge;

(ii) the environmental effects of the discharge;

(iii) the practicability of using the marine pollution control device;

(iv) the effect that installation or use of the marine pollution control device would have on the operation or operational capability of the vessel;

(v) applicable United States law;

(vi) applicable international standards; and

(vii) the economic costs of the installation and use of the marine pollution control device.

(3) PERFORMANCE STANDARDS FOR MARINE POLLUTION CONTROL DEVICES.—

(A) IN GENERAL.—For each discharge for which a marine pollution control device is determined to be required under paragraph (2), the Administrator and the Secretary of Defense, in consultation with the Secretary of the department in which the Coast Guard is operating, the Secretary of State, the Secretary of Commerce, other interested Federal agencies, and interested States, shall jointly promulgate Federal standards of performance for each marine pollution control device required with respect to the discharge. Notwithstanding subsection (a)(1) of section 553 of title 5, United States Code, the Administrator and the Secretary of Defense shall promulgate the standards in accordance with such section.

(B) CONSIDERATIONS.—In promulgating standards under this paragraph, the Administrator and the Secretary of Defense shall take into consideration the matters set forth in paragraph (2)(B).

(C) CLASSES, TYPES, AND SIZES OF VESSELS.—The standards promulgated under this paragraph may—

(i) distinguish among classes, types, and sizes of vessels;

(ii) distinguish between new and existing vessels; and

(iii) provide for a waiver of the applicability of the standards as necessary or appropriate to a particular class, type, age, or size of vessel.

(4) REGULATIONS FOR USE OF MARINE POLLUTION CONTROL DEVICES.—The Secretary of Defense, after consultation with the Administrator and the Secretary of the department in which the Coast Guard is operating, shall promulgate such regulations governing the design, construction, installation, and use of marine pollution control devices on board vessels of the Armed Forces as are necessary to achieve the standards promulgated under paragraph (3).

(5) DEADLINES; EFFECTIVE DATE.—

(A) DETERMINATIONS.—The Administrator and the Secretary of Defense shall—

(i) make the initial determinations under paragraph (2) not later than 2 years after the date of the enactment of this subsection; and

(ii) every 5 years—

(I) review the determinations; and

(II) if necessary, revise the determinations based on significant new information.

(B) STANDARDS.—The Administrator and the Secretary of Defense shall—

(i) promulgate standards of performance for a marine pollution control device under paragraph (3) not later than 2 years after the date of a determination

under paragraph (2) that the marine pollution control device is required; and

(ii) every 5 years—

(I) review the standards; and

(II) if necessary, revise the standards, consistent with paragraph (3)(B) and based on significant new information.

(C) REGULATIONS.—The Secretary of Defense shall promulgate regulations with respect to a marine pollution control device under paragraph (4) as soon as practicable after the Administrator and the Secretary of Defense promulgate standards with respect to the device under paragraph (3), but not later than 1 year after the Administrator and the Secretary of Defense promulgate the standards. The regulations promulgated by the Secretary of Defense under paragraph (4) shall become effective upon promulgation unless another effective date is specified in the regulations.

(D) PETITION FOR REVIEW.—The Governor of any State may submit a petition requesting that the Secretary of Defense and the Administrator review a determination under paragraph (2) or a standard under paragraph (3), if there is significant new information, not considered previously, that could reasonably result in a change to the particular determination or standard after consideration of the matters set forth in paragraph (2)(B). The petition shall be accompanied by the scientific and technical information on which the petition is based. The Administrator and the Secretary of Defense shall grant or deny the petition not later than 2 years after the date of receipt of the petition.

(6) EFFECT ON OTHER LAWS.—

(A) PROHIBITION ON REGULATION BY STATES OR POLITICAL SUBDIVISIONS OF STATES.—Beginning on the effective date of—

(i) a determination under paragraph (2) that it is not reasonable and practicable to require use of a marine pollution control device regarding a particular discharge incidental to the normal operation of a vessel of the Armed Forces; or

(ii) regulations promulgated by the Secretary of Defense under paragraph (4);

except as provided in paragraph (7), neither a State nor a political subdivision of a State may adopt or enforce any statute or regulation of the State or political subdivision with respect to the discharge or the design, construction, installation, or use of any marine pollution control device required to control discharges from a vessel of the Armed Forces.

(B) FEDERAL LAWS.—This subsection shall not affect the application of section 311 to discharges incidental to the normal operation of a vessel.

(7) ESTABLISHMENT OF STATE NO-DISCHARGE ZONES.—

(A) STATE PROHIBITION.—

(i) IN GENERAL.—After the effective date of—

(I) a determination under paragraph (2) that it is not reasonable and practicable to require use of a marine pollution control device regarding a particular discharge incidental to the normal operation of a vessel of the Armed Forces; or

(II) regulations promulgated by the Secretary of Defense under paragraph (4);

if a State determines that the protection and enhancement of the quality of some or all of the waters within the State require greater environmental protection, the State may prohibit 1 or more discharges incidental to the normal operation of a vessel, whether treated or not treated, into the waters. No prohibition shall apply until the Administrator makes the determinations described in subclauses (II) and (III) of subparagraph (B)(i).

(ii) DOCUMENTATION.—To the extent that a prohibition under this paragraph would apply to vessels of the Armed Forces and not to other types of vessels, the State shall document the technical or environmental basis for the distinction.

(B) PROHIBITION BY THE ADMINISTRATOR.—

(i) IN GENERAL.—Upon application of a State, the Administrator shall by regulation prohibit the discharge from a vessel of 1 or more discharges incidental to the normal operation of a vessel, whether treated or not treated, into the waters covered by the application if the Administrator determines that—

(I) the protection and enhancement of the quality of the specified waters within the State require a prohibition of the discharge into the waters;

(II) adequate facilities for the safe and sanitary removal of the discharge incidental to the normal operation of a vessel are reasonably available for the waters to which the prohibition would apply; and

(III) the prohibition will not have the effect of discriminating against a vessel of the Armed Forces by reason of the ownership or operation by the Federal Government, or the military function, of the vessel.

(ii) APPROVAL OR DISAPPROVAL.—The Administrator shall approve or disapprove an application submitted under clause (i) not later than 90 days after the date on which the application is submitted to the Administrator. Notwithstanding clause (i)(II), the Administrator shall not disapprove an application for the sole reason that there are not adequate facilities to remove any discharge incidental to the normal operation of a vessel from vessels of the Armed Forces.

(C) APPLICABILITY TO FOREIGN FLAGGED VESSELS.—A prohibition under this paragraph—

(i) shall not impose any design, construction, manning, or equipment standard on a foreign flagged ves-

sel engaged in innocent passage unless the prohibition implements a generally accepted international rule or standard; and

(ii) that relates to the prevention, reduction, and control of pollution shall not apply to a foreign flagged vessel engaged in transit passage unless the prohibition implements an applicable international regulation regarding the discharge of oil, oily waste, or any other noxious substance into the waters.

(8) PROHIBITION RELATING TO VESSELS OF THE ARMED FORCES.—After the effective date of the regulations promulgated by the Secretary of Defense under paragraph (4), it shall be unlawful for any vessel of the Armed Forces subject to the regulations to—

(A) operate in the navigable waters of the United States or the waters of the contiguous zone, if the vessel is not equipped with any required marine pollution control device meeting standards established under this subsection; or

(B) discharge overboard any discharge incidental to the normal operation of a vessel in waters with respect to which a prohibition on the discharge has been established under paragraph (7).

(9) ENFORCEMENT.—This subsection shall be enforceable, as provided in subsections (j) and (k), against any agency of the United States responsible for vessels of the Armed Forces notwithstanding any immunity asserted by the agency.

(33 U.S.C. 1322)

FEDERAL FACILITIES POLLUTION CONTROL

SEC. 313. (a) Each department, agency, or instrumentality of the executive, legislative, and judicial branches of the Federal Government (1) having jurisdiction over any property or facility, or (2) engaged in any activity resulting, or which may result, in the discharge or runoff of pollutants, and each officer, agent, or employee thereof in the performance of his official duties, shall be subject to, and comply with, all Federal, State, interstate, and local requirements, administrative authority, and process and sanctions respecting the control and abatement of water pollution in the same manner, and to the same extent as any nongovernmental entity including the payment of reasonable service charges. The preceding sentence shall apply (A) to any requirement whether substantive or procedural (including any recordkeeping or reporting requirement, any requirement respecting permits and any other requirement, whatsoever), (B) to the exercise of any Federal, State, or local administrative authority, and (C) to any process and sanction, whether enforced in Federal, State, or local courts or in any other manner. This subsection shall apply notwithstanding any immunity of such agencies, officers, agents, or employees under any law or rule of law. Nothing in this section shall be construed to prevent any department, agency, or instrumentality of the Federal Government, or any officer, agent, or employee thereof in the performance of his official duties, from removing to the appropriate Federal district court any proceeding to which the department, agency, or instru-

mentality or officer, agent, or employee thereof is subject pursuant to this section, and any such proceeding may be removed in accordance with 28 U.S.C. 1441 et seq. No officer, agent, or employee of the United States shall be personally liable for any civil penalty arising from the performance of his official duties, for which he is not otherwise liable, and the United States shall be liable only for those civil penalties arising under Federal law or imposed by a State or local court to enforce an order or the process of such court. The President may exempt any effluent source of any department, agency, or instrumentality in the executive branch from compliance with any such a requirement if he determines it to be in the paramount interest of the United States to do so; except that no exemption may be granted from the requirements of section 306 or 307 of this Act. No such exemptions shall be granted due to lack of appropriation unless the President shall have specifically requested such appropriation as a part of the budgetary process and the Congress shall have failed to make available such requested appropriation. Any exemption shall be for a period not in excess of one year, but additional exemptions may be granted for periods of not to exceed one year upon the President's making a new determination. The President shall report each January to the Congress all exemptions from the requirements of this section granted during the preceding calendar year, together with his reason for granting such exemption. In addition to any such exemption of a particular effluent source, the President may, if he determines it to be in the paramount interest of the United States to do so, issue regulations exempting from compliance with the requirements of this section any weaponry, equipment, aircraft, vessels, vehicles, or other classes or categories of property, and access to such property, which are owned or operated by the Armed Forces of the United States (including the Coast Guard) or by the National Guard of any State and which are uniquely military in nature. The President shall reconsider the need for such regulations at three-year intervals.

(b)(1) The Administrator shall coordinate with the head of each department, agency, or instrumentality of the Federal Government having jurisdiction over any property or facility utilizing federally owned wastewater facilities to develop a program of cooperation for utilizing wastewater control systems utilizing those innovative treatment processes and techniques for which guidelines have been promulgated under section 304(d)(3). Such program shall include an inventory of property and facilities which could utilize such processes and techniques.

(2) Construction shall not be initiated for facilities for treatment of wastewater at any Federal property or facility after September 30, 1979, if alternative methods for wastewater treatment at such property or facility utilizing innovative treatment processes and techniques, including but not limited to methods utilizing recycle and reuse techniques and land treatment are not utilized, unless the life cycle cost of the alternative treatment works exceeds the life cycle cost of the most cost effective alternative by more than 15 per centum. The Administrator may waive the application of this paragraph in any case where the Administrator determines it to be in the public interest, or that compliance with this para-

graph would interfere with the orderly compliance with the conditions of a permit issued pursuant to section 402 of this Act.

(33 U.S.C. 1323)

CLEAN LAKES

SEC. 314. (a) ESTABLISHMENT AND SCOPE OF PROGRAM.—

(1) STATE PROGRAM REQUIREMENTS.—Each State on a biennial basis shall prepare and submit to the Administrator for his approval—

(A) an identification and classification according to eutrophic condition of all publicly owned lakes in such State;

(B) a description of procedures, processes, and methods (including land use requirements), to control sources of pollution of such lakes;

(C) a description of methods and procedures, in conjunction with appropriate Federal agencies, to restore the quality of such lakes;

(D) methods and procedures to mitigate the harmful effects of high acidity, including innovative methods of neutralizing and restoring buffering capacity of lakes and methods of removing from lakes toxic metals and other toxic substances mobilized by high acidity;

(E) a list and description of those publicily owned lakes in such State for which uses are known to be impaired, including those lakes which are known not to meet applicable water quality standards or which require implementation of control programs to maintain compliance with applicable standards and those lakes in which water quality has deteriorated as a result of high acidity that may reasonably be due to acid deposition; and

(F) an assessment of the status and trends of water quality in lakes in such State, including but not limited to, the nature and extent of pollution loading from point and nonpoint sources and the extent to which the use of lakes is impaired as a result of such pollution, particularly with respect to toxic pollution.

(2) SUBMISSION AS PART OF 305(b)(1) REPORT.—The information required under paragraph (1) shall be included in the report required under section 305(b)(1) of this Act, beginning with the report required under such section by April 1, 1988.

(3) ELIGIBILITY REQUIREMENT.—Beginning after April 1, 1988, a State must have submitted the information required under paragraph (1) in order to receive grant assistance under this section.

(b) The Administrator shall provide financial assistance to States in order to carry out methods and procedures approved by him under subsection (a) of this section. The Administrator shall provide financial assistance to States to prepare the identification and classification surveys required in subsection (a)(1) of this section.

(c)(1) The amount granted to any State for any fiscal year under subsection (b) of this section shall not exceed 70 per centum of the funds expended by such State in such year for carrying out

approved methods and procedures under subsection (a) of this section.

(2) There is authorized to be appropriated $50,000,000 for each of fiscal years 2001 through 2005 for grants to States under subsection (b) of this section which such sums shall remain available until expended. The Administrator shall provide for an equitable distribution of such sums to the States with approved methods and procedures under subsection (a) of this section.

(d) DEMONSTRATION PROGRAM.—

(1) GENERAL REQUIREMENTS.—The Administrator is authorized and directed to establish and conduct at locations throughout the Nation a lake water quality demonstration program. The program shall, at a minimum—

(A) develop cost effective technologies for the control of pollutants to preserve or enhance lake water quality while optimizing multiple lakes uses;

(B) control nonpoint sources of pollution which are contributing to the degradation of water quality in lakes;

(C) evaluate the feasibility of implementing regional consolidated pollution control strategies;

(D) demonstrate environmentally preferred techniques for the removal and disposal of contaminated lake sediments;

(E) develop improved methods for the removal of silt, stumps, aquatic growth, and other obstructions which impair the quality of lakes;

(F) construct and evaluate silt traps and other devices or equipment to prevent or abate the deposit of sediment in lakes; and

(G) demonstrate the costs and benefits of utilizing dredged material from lakes in the reclamation of despoiled land.

(2) GEOGRAPHICAL REQUIREMENTS.—Demonstration projects authorized by this subsection shall be undertaken to reflect a variety of geographical and environmental conditions. As a priority, the Administrator shall undertake demonstration projects at Lake Champlain, New York and Vermont; Lake Houston, Texas; Beaver Lake, Arkansas; Greenwood Lake and Belcher Creek, New Jersey; Deal Lake, New Jersey; Alcyon Lake, New Jersey; Gorton's Pond, Rhode Island; Lake Washington, Rhode Island; Lake Bomoseen, Vermont; Sauk Lake, Minnesota; Otsego Lake, New York; Oneida Lake, New York; Raystown Lake, Pennsylvania; Swan Lake, Itasca County, Minnesota; Walker Lake, Nevada; Lake Tahoe, California and Nevada; Ten Mile Lakes, Oregon; Woahink Lake, Oregon; Highland Lake, Connecticut; Lily Lake, New Jersey; Strawbridge Lake, New Jersey; Baboosic Lake, New Hampshire; French Pond, New Hampshire; Dillon Reservoir, Ohio; Tohopekaliga Lake, Florida; Lake Apopka, Florida; Lake George, New York; Lake Wallenpaupack, Pennsylvania; Lake Allatoona, Georgia; and Lake Worth, Texas.

(3) REPORTS.—Notwithstanding section 3003 of the Federal Reports Elimination and Sunset Act of 1995 (31 U.S.C. 1113 note; 109 Stat. 734–736), by January 1, 1997, and January 1 of every odd-numbered year thereafter, the Administrator shall

report to the Committee on Transportation and Infrastructure of the House of Representatives and the Committee on Environment and Public Works of the Senate on work undertaken pursuant to this subsection. Upon completion of the program authorized by this subsection, the Administrator shall submit to such committees a final report on the results of such program, along with recommendations for further measures to improve the water quality of the Nation's lakes.

(4) AUTHORIZATION OF APPROPRIATIONS.—

(A) IN GENERAL.—There is authorized to be appropriated to carry out this subsection not to exceed $40,000,000 for fiscal years beginning after September 30, 1986, to remain available until expended.

(B) SPECIAL AUTHORIZATIONS.—

(i) AMOUNT.—There is authorized to be appropriated to carry out subsection (b) with respect to subsection (a)(1)(D) not to exceed $25,000,000 for fiscal years beginning after September 30, 1986, to remain available until expended.

(ii) DISTRIBUTION OF FUNDS.—The Administrator shall provide for an equitable distribution of sums appropriated pursuant to this subparagraph among States carrying out approved methods and procedures. Such distribution shall be based on the relative needs of each such State for the mitigation of the harmful effects on lakes and other surface waters of high acidity that may reasonably be due to acid deposition or acid mine drainage.

(iii) GRANTS AS ADDITIONAL ASSISTANCE.—The amount of any grant to a State under this subparagraph shall be in addition to, and not in lieu of, any other Federal financial assistance.

(33 U.S.C. 1324)

NATIONAL STUDY COMMISSION

SEC. 315. (a) There is established a National Study Commission, which shall make a full and complete investigation and study of all of the technological aspects of achieving, and all aspects of the total economic, social, and environmental effects of achieving or not achieving, the effluent limitations and goals set forth for 1983 in section 301(b)(2) of this Act.

(b) Such Commission shall be composed of fifteen members, including five members of the Senate, who are members of the Public Works committee, appointed by the President of the Senate, five members of the House, who are members of the Public Works committee, appointed by the Speaker of the House, and five members of the public appointed by the President. The Chairman of such Commission shall be elected from among its members.

(c) In the conduct of such study, the Commission is authorized to contract with the National Academy of Sciences and the National Academy of Engineering (acting through the National Research Council), the National Institute of Ecology, Brookings Institution, and other nongovernmental entities, for the investigation of matters within their competence.

(d) The heads of the departments, agencies and instrumentalities of the executive branch of the Federal Government shall cooperate with the Commission in carrying out the requirements of this section, and shall furnish to the Commission such information as the Commission deems necessary to carry out this section.

(e) A report shall be submitted to the Congress of the results of such investigation and study, together with recommendations, not later than three years after the date of enactment of this title.

(f) The members of the Commission who are not officers or employees of the United States, while attending conferences or meetings of the Commission or while otherwise serving at the request of the Chairman shall be entitled to receive compensation at a rate not in excess of the maximum rate of pay for grade GS–18, as provided in the General Schedule under section 5332 of title V of the United States Code, including traveltime and while away from their homes or regular places of business they may be allowed travel expenses, including per diem in lieu of subsistence as authorized by law (5 U.S.C. 73b–2) for persons in the Government service employed intermittently.

(g) In addition to authority to appoint personnel subject to the provisions of title 5, United States Code, governing appointments in the competitive service, and to pay such personnel in accordance with the provisions of chapter 51 and subchapter III of chapter 53 of such title relating to classification and General Schedule pay rates, the Commission shall have authority to enter into contracts with private or public organizations who shall furnish the Commission with such administrative and technical personnel as may be necessary to carry out the purpose of this section. Personnel furnished by such organizations under this subsection are not, and shall not be considered to be, Federal employees for any purposes, but in the performance of their duties shall be guided by the standards which apply to employees of the legislative branches under rules 41 and 43 of the Senate and House of Representatives, respectively.

(h) There is authorized to be appropriated, for use in carrying out this section, not to exceed $17,250,000.

(33 U.S.C. 1325)

THERMAL DISCHARGES

SEC. 316. (a) With respect to any point source otherwise subject to the provisions of section 301 or section 306 of this Act, whenever the owner or operator of any such source, after opportunity for public hearing, can demonstrate to the satisfaction of the Administrator (or, if appropriate, the State) that any effluent limitation proposed for the control of the thermal component of any discharge from such source will require effluent limitations more stringent than necessary to assure the projection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on the body of water into which the discharge is to be made, the Administrator (or, if appropriate, the State) may impose an effluent limitation under such sections for such plant, with respect to the thermal component of such discharge (taking into account the interaction of such thermal component with other pollutants), that will assure the projection and propagation of a balanced, in-

digenous population of shellfish, fish, and wildlife in and on that body of water.

(b) Any standard established pursuant to section 301 or section 306 of this Act and applicable to a point source shall require that the location, design, construction, and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impact.

(c) Notwithstanding any other provision of this Act, any point source of a discharge having a thermal component, the modification of which point source is commenced after the date of enactment of the Federal Water Pollution Control Act Amendments of 1972 and which, as modified, meets effluent limitations established under section 301 or, if more stringent, effluent limitations established under section 303 and which effluent limitations will assure protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in or on the water into which the discharge is made, shall not be subject to any more stringent effluent limitation with respect to the thermal component of its discharge during a ten year period beginning on the date of completion of such modification or during the period of depreciation or amortization of such facility for the purpose of section 167 or 169 (or both) of the Internal Revenue Code of 1954, whichever period ends first.

(33 U.S.C. 1326)

FINANCING STUDY

SEC. 317. (a) The Administrator shall continue to investigate and study the feasibility of alternate methods of financing the cost of preventing, controlling and abating pollution as directed in the Water Quality Improvement Act of 1970 (Public Law 91–224), including, but not limited to, the feasibility of establishing a pollution abatement trust fund. The results of such investigation and study shall be reported to the Congress not later than two years after enactment of this title, together with recommendations of the Administrator for financing the programs for preventing, controlling and abating pollution for the fiscal years beginning after fiscal year 1976, including any necessary legislation.

(b) There is authorized to be appropriated for use in carrying out this section, not to exceed $1,000,000.

(33 U.S.C. 1327)

AQUACULTURE

SEC. 318. (a) The Administrator is authorized, after public hearings, to permit the discharge of a specific pollutant or pollutants under controlled conditions associated with an approved aquaculture project under Federal or State supervision pursuant to section 402 of this Act.

(b) The Administrator shall by regulation establish any procedures and guidelines which the Administrator deems necessary to carry out this section. Such regulations shall require the application to such discharge of each criterion, factor, procedure, and requirement applicable to a permit issued under section 402 of this title, as the Administrator determines necessary to carry out the objective of this Act.

(c) Each State desiring to administer its own permit program within its jurisdiction for discharge of a specific pollutant or pollutants under controlled conditions associated with an approved aquaculture project may do so if upon submission of such program the Administrator determines such program is adequate to carry out the objective of this Act.

(33 U.S.C. 1328)

SEC. 319. NONPOINT SOURCE MANAGEMENT PROGRAMS.

(a) STATE ASSESSMENT REPORTS.—

(1) CONTENTS.—The Governor of each State shall, after notice and opportunity for public comment, prepare and submit to the Administrator for approval, a report which—

(A) identifies those navigable waters within the State which, without additional action to control nonpoint sources of pollution, cannot reasonably be expected to attain or maintain applicable water quality standards or the goals and requirements of this Act;

(B) identifies those categories and subcategories of nonpoint sources or, where appropriate, particular nonpoint sources which add significant pollution to each portion of the navigable waters identified under subparagraph (A) in amounts which contribute to such portion not meeting such water quality standards or such goals and requirements;

(C) describes the process, including intergovernmental coordination and public participation, for identifying best management practices and measures to control each category and subcategory of nonpoint sources and, where appropriate, particular nonpoint sources identified under subparagraph (B) and to reduce, to the maximum extent practicable, the level of pollution resulting from such category, subcategory, or source; and

(D) identifies and describes State and local programs for controlling pollution added from nonpoint sources to, and improving the quality of, each such portion of the navigable waters, including but not limited to those programs which are receiving Federal assistance under subsections (h) and (i).

(2) INFORMATION USED IN PREPARATION.—In developing the report required by this section, the State (A) may rely upon information developed pursuant to sections 208, 303(e), 304(f), 305(b), and 314, and other information as appropriate, and (B) may utilize appropriate elements of the waste treatment management plans developed pursuant to sections 208(b) and 303, to the extent such elements are consistent with and fulfill the requirements of this section.

(b) STATE MANAGEMENT PROGRAMS.—

(1) IN GENERAL.—The Governor of each State, for that State or in combination with adjacent States, shall, after notice and opportunity for public comment, prepare and submit to the Administrator for approval a management program which such State proposes to implement in the first four fiscal years beginning after the date of submission of such management program for controlling pollution added from nonpoint sources to the

navigable waters within the State and improving the quality of such waters.

(2) SPECIFIC CONTENTS.—Each management program proposed for implementation under this subsection shall include each of the following:

(A) An identification of the best management practices and measures which will be undertaken to reduce pollutant loadings resulting from each category, subcategory, or particular nonpoint source designated under paragraph (1)(B), taking into account the impact of the practice on ground water quality.

(B) An identification of programs (including, as appropriate, nonregulatory or regulatory programs for enforcement, technical assistance, financial assistance, education, training, technology transfer, and demonstration projects) to achieve implementation of the best management practices by the categories, subcategories, and particular nonpoint sources designated under subparagraph (A).

(C) A schedule containing annual milestones for (i) utilization of the program implementation methods identified in subparagraph (B), and (ii) implementation of the best management practices identified in subparagraph (A) by the categories, subcategories, or particular nonpoint sources designated under paragraph (1)(B). Such schedule shall provide for utilization of the best management practices at the earliest practicable date.

(D) A certification of the attorney general of the State or States (or the chief attorney of any State water pollution control agency which has independent legal counsel) that the laws of the State or States, as the case may be, provide adequate authority to implement such management program or, if there is not such adequate authority, a list of such additional authorities as will be necessary to implement such management program. A schedule and commitment by the State or States to seek such additional authorities as expeditiously as practicable.

(E) Sources of Federal and other assistance and funding (other than assistance provided under subsections (h) and (i)) which will be available in each of such fiscal years for supporting implementation of such practices and measures and the purposes for which such assistance will be used in each of such fiscal years.

(F) An identification of Federal financial assistance programs and Federal development projects for which the State will review individual assistance applications or development projects for their effect on water quality pursuant to the procedures set forth in Executive Order 12372 as in effect on September 17, 1983, to determine whether such assistance applications or development projects would be consistent with the program prepared under this subsection; for the purposes of this subparagraph, identification shall not be limited to the assistance programs or development projects subject to Executive Order 12372 but may include any programs listed in the most recent Catalog of Federal Domestic Assistance which may have an ef-

fect on the purposes and objectives of the State's nonpoint source pollution management program.

(3) UTILIZATION OF LOCAL AND PRIVATE EXPERTS.—In developing and implementing a management program under this subsection, a State shall, to the maximum extent practicable, involve local public and private agencies and organizations which have expertise in control of nonpoint sources of pollution.

(4) DEVELOPMENT ON WATERSHED BASIS.—A State shall, to the maximum extent practicable, develop and implement a management program under this subsection on a watershed-by-watershed basis within such State.

(c) ADMINISTRATIVE PROVISIONS.—

(1) COOPERATION REQUIREMENT.—Any report required by subsection (a) and any management program and report required by subsection (b) shall be developed in cooperation with local, substate regional, and interstate entities which are actively planning for the implementation of nonpoint source pollution controls and have either been certified by the Administrator in accordance with section 208, have worked jointly with the State on water quality management planning under section 205(j), or have been designated by the State legislative body or Governor as water quality management planning agencies for their geographic areas.

(2) TIME PERIOD FOR SUBMISSION OF REPORTS AND MANAGEMENT PROGRAMS.—Each report and management program shall be submitted to the Administrator during the 18-month period beginning on the date of the enactment of this section.

(d) APPROVAL OR DISAPPROVAL OF REPORTS AND MANAGEMENT PROGRAMS.—

(1) DEADLINE.—Subject to paragraph (2), not later than 180 days after the date of submission to the Administrator of any report or management program under this section (other than subsections (h), (i), and (k)), the Administrator shall either approve or disapprove such report or management program, as the case may be. The Administrator may approve a portion of a management program under this subsection. If the Administrator does not disapprove a report, management program, or portion of a management program in such 180-day period, such report, management program, or portion shall be deemed approved for purposes of this section.

(2) PROCEDURE FOR DISAPPROVAL.—If, after notice and opportunity for public comment and consultation with appropriate Federal and State agencies and other interested persons, the Administrator determines that—

(A) the proposed management program or any portion thereof does not meet the requirements of subsection (b)(2) of this section or is not likely to satisfy, in whole or in part, the goals and requirements of this Act;

(B) adequate authority does not exist, or adequate resources are not available, to implement such program or portion;

(C) the schedule for implementing such program or portion is not sufficiently expeditious; or

(D) the practices and measures proposed in such program or portion are not adequate to reduce the level of pollution in navigable waters in the State resulting from nonpoint sources and to improve the quality of navigable waters in the State;

the Administrator shall within 6 months of the receipt of the proposed program notify the State of any revisions or modifications necessary to obtain approval. The State shall thereupon have an additional 3 months to submit its revised management program and the Administrator shall approve or disapprove such revised program within three months of receipt.

(3) FAILURE OF STATE TO SUBMIT REPORT.—If a Governor of a State does not submit the report required by subsection (a) within the period specified by subsection (c)(2), the Administrator shall, within 30 months after the date of the enactment of this section, prepare a report for such State which makes the identifications required by paragraphs (1)(A) and (1)(B) of subsection (a). Upon completion of the requirement of the preceding sentence and after notice and opportunity for comment, the Administrator shall report to Congress on his actions pursuant to this section.

(e) LOCAL MANAGEMENT PROGRAMS; TECHNICAL ASSISTANCE.—If a State fails to submit a management program under subsection (b) or the Administrator does not approve such a management program, a local public agency or organization which has expertise in, and authority to, control water pollution resulting from nonpoint sources in any area of such State which the Administrator determines is of sufficient geographic size may, with approval of such State, request the Administrator to provide, and the Administrator shall provide, technical assistance to such agency or organization in developing for such area a management program which is described in subsection (b) and can be approved pursuant to subsection (d). After development of such management program, such agency or organization shall submit such management program to the Administrator for approval. If the Administrator approves such management program, such agency or organization shall be eligible to receive financial assistance under subsection (h) for implementation of such management program as if such agency or organization were a State for which a report submitted under subsection (a) and a management program submitted under subsection (b) were approved under this section. Such financial assistance shall be subject to the same terms and conditions as assistance provided to a State under subsection (h).

(f) TECHNICAL ASSISTANCE FOR STATE.—Upon request of a State, the Administrator may provide technical assistance to such State in developing a management program approved under subsection (b) for those portions of the navigable waters requested by such State.

(g) INTERSTATE MANAGEMENT CONFERENCE.—

(1) CONVENING OF CONFERENCE; NOTIFICATION; PURPOSE.—If any portion of the navigable waters in any State which is implementing a management program approved under this section is not meeting applicable water quality standards or the goals and requirements of this Act as a result, in whole or in part, of pollution from nonpoint sources in another State,

such State may petition the Administrator to convene, and the Administrator shall convene, a management conference of all States which contribute significant pollution resulting from nonpoint sources to such portion. If, on the basis of information available, the Administrator determines that a State is not meeting applicable water quality standards or the goals and requirements of this Act as a result, in whole or in part, of significant pollution from nonpoint sources in another State, the Administrator shall notify such States. The Administrator may convene a management conference under this paragraph not later than 180 days after giving such notification, whether or not the State which is not meeting such standards requests such conference. The purpose of such conference shall be to develop an agreement among such States to reduce the level of pollution in such portion resulting from nonpoint sources and to improve the water quality of such portion. Nothing in such agreement shall supersede or abrogate rights to quantities of water which have been established by interstate water compacts, Supreme Court decrees, or State water laws. This subsection shall not apply to any pollution which is subject to the Colorado River Basin Salinity Control Act. The requirement that the Administrator convene a management conference shall not be subject to the provisions of section 505 of this Act.

(2) STATE MANAGEMENT PROGRAM REQUIREMENT.—To the extent that the States reach agreement through such conference, the management programs of the States which are parties to such agreements and which contribute significant pollution to the navigable waters or portions thereof not meeting applicable water quality standards or goals and requirements of this Act will be revised to reflect such agreement. Such management programs shall be consistent with Federal and State law.

(h) GRANT PROGRAM.—

(1) GRANTS FOR IMPLEMENTATION OF MANAGEMENT PROGRAMS.—Upon application of a State for which a report submitted under subsection (a) and a management program submitted under subsection (b) is approved under this section, the Administrator shall make grants, subject to such terms and conditions as the Administrator considers appropriate, under this subsection to such State for the purpose of assisting the State in implementing such management program. Funds reserved pursuant to section 205(j)(5) of this Act may be used to develop and implement such management program.

(2) APPLICATIONS.—An application for a grant under this subsection in any fiscal year shall be in such form and shall contain such other information as the Administrator may require, including an identification and description of the best management practices and measures which the State proposes to assist, encourage, or require in such year with the Federal assistance to be provided under the grant.

(3) FEDERAL SHARE.—The Federal share of the cost of each management program implemented with Federal assistance under this subsection in any fiscal year shall not exceed 60 percent of the cost incurred by the State in implementing such

management program and shall be made on condition that the non-Federal share is provided from non-Federal sources.

(4) LIMITATION ON GRANT AMOUNTS.—Notwithstanding any other provision of this subsection, not more than 15 percent of the amount appropriated to carry out this subsection may be used to make grants to any one State, including any grants to any local public agency or organization with authority to control pollution from nonpoint sources in any area of such State.

(5) PRIORITY FOR EFFECTIVE MECHANISMS.—For each fiscal year beginning after September 30, 1987, the Administrator may give priority in making grants under this subsection, and shall give consideration in determining the Federal share of any such grant, to States which have implemented or are proposing to implement management programs which will—

(A) control particularly difficult or serious nonpoint source pollution problems, including, but not limited to, problems resulting from mining activities;

(B) implement innovative methods or practices for controlling nonpoint sources of pollution, including regulatory programs where the Administrator deems appropriate;

(C) control interstate nonpoint source pollution problems; or

(D) carry out ground water quality protection activities which the Administrator determines are part of a comprehensive nonpoint source pollution control program, including research, planning, ground water assessments, demonstration programs, enforcement, technical assistance, education, and training to protect ground water quality from nonpoint sources of pollution.

(6) AVAILABILITY FOR OBLIGATION.—The funds granted to each State pursuant to this subsection in a fiscal year shall remain available for obligation by such State for the fiscal year for which appropriated. The amount of any such funds not obligated by the end of such fiscal year shall be available to the Administrator for granting to other States under this subsection in the next fiscal year.

(7) LIMITATION ON USE OF FUNDS.—States may use funds from grants made pursuant to this section for financial assistance to persons only to the extent that such assistance is related to the costs of demonstration projects.

(8) SATISFACTORY PROGRESS.—No grant may be made under this subsection in any fiscal year to a State which in the preceding fiscal year received a grant under this subsection unless the Administrator determines that such State made satisfactory progress in such preceding fiscal year in meeting the schedule specified by such State under subsection (b)(2).

(9) MAINTENANCE OF EFFORT.—No grant may be made to a State under this subsection in any fiscal year unless such State enters into such agreements with the Administrator as the Administrator may require to ensure that such State will maintain its aggregate expenditures from all other sources for programs for controlling pollution added to the navigable waters in such State from nonpoint sources and improving the quality of such waters at or above the average level of such ex-

penditures in its two fiscal years preceding the date of enactment of this subsection.

(10) REQUEST FOR INFORMATION.—The Administrator may request such information, data, and reports as he considers necessary to make the determination of continuing eligibility for grants under this section.

(11) REPORTING AND OTHER REQUIREMENTS.—Each State shall report to the Administrator on an annual basis concerning (A) its progress in meeting the schedule of milestones submitted pursuant to subsection (b)(2)(C) of this section, and (B) to the extent that appropriate information is available, reductions in nonpoint source pollutant loading and improvements in water quality for those navigable waters or watersheds within the State which were identified pursuant to subsection (a)(1)(A) of this section resulting from implementation of the management program.

(12) LIMITATION ON ADMINISTRATIVE COSTS.—For purposes of this subsection, administrative costs in the form of salaries, overhead, or indirect costs for services provided and charged against activities and programs carried out with a grant under this subsection shall not exceed in any fiscal year 10 percent of the amount of the grant in such year, except that costs of implementing enforcement and regulatory activities, education, training, technical assistance, demonstration projects, and technology transfer programs shall not be subject to this limitation.

(i) GRANTS FOR PROTECTING GROUNDWATER QUALITY.—

(1) ELIGIBLE APPLICANTS AND ACTIVITIES.—Upon application of a State for which a report submitted under subsection (a) and a plan submitted under subsection (b) is approved under this section, the Administrator shall make grants under this subsection to such State for the purpose of assisting such State in carrying out groundwater quality protection activities which the Administrator determines will advance the State toward implementation of a comprehensive nonpoint source pollution control program. Such activities shall include, but not be limited to, research, planning, groundwater assessment, demonstration programs, enforcement, technical assistance, education and training to protect the quality of groundwater and to prevent contamination of groundwater from nonpoint sources of pollution.

(2) APPLICATIONS.—An application for a grant under this subsection shall be in such form and shall contain such information as the Administrator may require.

(3) FEDERAL SHARE; MAXIMUM AMOUNT.—The Federal share of the cost of assisting a State in carrying out groundwater protection activities in any fiscal year under this subsection shall be 50 percent of the costs incurred by the State in carrying out such activities, except that the maximum amount of Federal assistance which any State may receive under this subsection in any fiscal year shall not exceed $150,000.

(j) AUTHORIZATION OF APPROPRIATIONS.—There is authorized to be appropriated to carry out subsections (h) and (i) not to exceed $70,000,000 for fiscal year 1988, $100,000,000 per fiscal year for

each of fiscal years 1989 and 1990, and $130,000,000 for fiscal year 1991; except that for each of such fiscal years not to exceed $7,500,000 may be made available to carry out subsection (i). Sums appropriated pursuant to this subsection shall remain available until expended.

(k) CONSISTENCY OF OTHER PROGRAMS AND PROJECTS WITH MANAGEMENT PROGRAMS.—The Administrator shall transmit to the Office of Management and Budget and the appropriate Federal departments and agencies a list of those assistance programs and development projects identified by each State under subsection (b)(2)(F) for which individual assistance applications and projects will be reviewed pursuant to the procedures set forth in Executive Order 12372 as in effect on September 17, 1983. Beginning not later than sixty days after receiving notification by the Administrator, each Federal department and agency shall modify existing regulations to allow States to review individual development projects and assistance applications under the identified Federal assistance programs and shall accommodate, according to the requirements and definitions of Executive Order 12372, as in effect on September 17, 1983, the concerns of the State regarding the consistency of such applications or projects with the State nonpoint source pollution management program.

(l) COLLECTION OF INFORMATION.—The Administrator shall collect and make available, through publications and other appropriate means, information pertaining to management practices and implementation methods, including, but not limited to, (1) information concerning the costs and relative efficiencies of best management practices for reducing nonpoint source pollution; and (2) available data concerning the relationship between water quality and implementation of various management practices to control nonpoint sources of pollution.

(m) SET ASIDE FOR ADMINISTRATIVE PERSONNEL.—Not less than 5 percent of the funds appropriated pursuant to subsection (j) for any fiscal year shall be available to the Administrator to maintain personnel levels at the Environmental Protection Agency at levels which are adequate to carry out this section in such year.

(33 U.S.C. 1329)

SEC. 320. NATIONAL ESTUARY PROGRAM.

(a) MANAGEMENT CONFERENCE.—

(1) NOMINATION OF ESTUARIES.—The Governor of any State may nominate to the Administrator an estuary lying in whole or in part within the State as an estuary of national significance and request a management conference to develop a comprehensive management plan for the estuary. The nomination shall document the need for the conference, the likelihood of success, and information relating to the factors in paragraph (2).

(2) CONVENING OF CONFERENCE.—

(A) IN GENERAL.—In any case where the Administrator determines, on his own initiative or upon nomination of a State under paragraph (1), that the attainment or maintenance of that water quality in an estuary which assures protection of public water supplies and the protection and propagation of a balanced, indigenous population of shell-

fish, fish, and wildlife and allows recreational activities, in and on the water, requires the control of point and nonpoint sources of pollution to supplement existing controls of pollution in more than one State, the Administrator shall select such estuary and convene a management conference.

(B) PRIORITY CONSIDERATION.—The Administrator shall give priority consideration under this section to Long Island Sound, New York and Connecticut; Narragansett Bay, Rhode Island; Buzzards Bay, Massachusetts; Massachusetts Bay, Massachusetts (including Cape Cod Bay and Boston Harbor);[1] Puget Sound, Washington; New York-New Jersey Harbor, New York and New Jersey; Delaware Bay, Delaware and New Jersey; Delaware Inland Bays, Delaware; Albermarle Sound, North Carolina; Sarasota Bay, Florida; San Francisco Bay, California; Santa Monica Bay, California; Galveston Bay, Texas;[2] Barataria-Terrebonne Bay estuary complex, Louisiana; Indian River Lagoon, Florida; Lake Pontchartrain Basin, Louisiana and Mississippi; and Peconic Bay, New York.

(3) BOUNDARY DISPUTE EXCEPTION.—In any case in which a boundary between two States passes through an estuary and such boundary is disputed and is the subject of an action in any court, the Administrator shall not convene a management conference with respect to such estuary before a final adjudication has been made of such dispute.

(b) PURPOSES OF CONFERENCE.—The purposes of any management conference convened with respect to an estuary under this subsection shall be to—

(1) assess trends in water quality, natural resources, and uses of the estuary;

(2) collect, characterize, and assess data on toxics, nutrients, and natural resources within the estuarine zone to identify the causes of environmental problems;

(3) develop the relationship between the inplace loads and point and nonpoint loadings of pollutants to the estuarine zone and the potential uses of the zone, water quality, and natural resources;

(4) develop a comprehensive conservation and management plan that recommends priority corrective actions and compliance schedules addressing point and nonpoint sources of pollution to restore and maintain the chemical, physical, and biological integrity of the estuary, including restoration and maintenance of water quality, a balanced indigenous population of shellfish, fish and wildlife, and recreational activities in the estuary, and assure that the designated uses of the estuary are protected;

(5) develop plans for the coordinated implementation of the plan by the States as well as Federal and local agencies participating in the conference;

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[1] Both P.L. 100–653 and P.L. 100–658 inserted the same Massachusetts Bay phrase after Buzzards Bay; so that the phrase appears twice.

[2] P.L. 100–688, section 2001(3) inserted the Louisiana, Florida, New York bays after "Galveston, Texas;" which technically could not be executed.

(6) monitor the effectiveness of actions taken pursuant to the plan; and

(7) review all Federal financial assistance programs and Federal development projects in accordance with the requirements of Executive Order 12372, as in effect on September 17, 1983, to determine whether such assistance program or project would be consistent with and further the purposes and objectives of the plan prepared under this section.

For purposes of paragraph (7), such programs and projects shall not be limited to the assistance programs and development projects subject to Executive Order 12372, but may include any programs listed in the most recent Catalog of Federal Domestic Assistance which may have an effect on the purposes and objectives of the plan developed under this section.

(c) MEMBERS OF CONFERENCE.—The members of a management conference convened under this section shall include, at a minimum, the Administrator and representatives of—

(1) each State and foreign nation located in whole or in part in the estuarine zone of the estuary for which the conference is convened;

(2) international, interstate, or regional agencies or entities having jurisdiction over all or a significant part of the estuary;

(3) each interested Federal agency, as determined appropriate by the Administrator;

(4) local governments having jurisdiction over any land or water within the estuarine zone, as determined appropriate by the Administrator; and

(5) affected industries, public and private educational institutions, and the general public, as determined appropriate by the Administrator.

(d) UTILIZATION OF EXISTING DATA.—In developing a conservation and management plan under this section, the management conference shall survey and utilize existing reports, data, and studies relating to the estuary that have been developed by or made available to Federal, interstate, State, and local agencies.

(e) PERIOD OF CONFERENCE.—A management conference convened under this section shall be convened for a period not to exceed 5 years. Such conference may be extended by the Administrator, and if terminated after the initial period, may be reconvened by the Administrator at any time thereafter, as may be necessary to meet the requirements of this section.

(f) APPROVAL AND IMPLEMENTATION OF PLANS.—

(1) APPROVAL.—Not later than 120 days after the completion of a conservation and management plan and after providing for public review and comment, the Administrator shall approve such plan if the plan meets the requirements of this section and the affected Governor or Governors concur.

(2) IMPLEMENTATION.—Upon approval of a conservation and management plan under this section, such plan shall be implemented. Funds authorized to be appropriated under titles II and VI and section 319 of this Act may be used in accordance with the applicable requirements of this Act to assist States with the implementation of such plan.

(g) GRANTS.—

(1) RECIPIENTS.—The Administrator is authorized to make grants to State, interstate, and regional water pollution control agencies and entities, State coastal zone management agencies, interstate agencies, other public or nonprofit private agencies, institutions, organizations, and individuals.

(2) PURPOSES.—Grants under this subsection shall be made to pay for activities necessary for the development and implementation of a comprehensive conservation and management plan under this section.

(3) FEDERAL SHARE.—The Federal share of a grant to any person (including a State, interstate, or regional agency or entity) under this subsection for a fiscal year—

(A) shall not exceed—

(i) 75 percent of the annual aggregate costs of the development of a comprehensive conservation and management plan; and

(ii) 50 percent of the annual aggregate costs of the implementation of the plan; and

(B) shall be made on condition that the non-Federal share of the costs are provided from non-Federal sources.

(h) GRANT REPORTING.—Any person (including a State, interstate, or regional agency or entity) that receives a grant under subsection (g) shall report to the Administrator not later than 18 months after receipt of such grants and biennially there after on the progress being made under this section.

(i) AUTHORIZATION OF APPROPRIATIONS.—There are authorized to be appropriated to the Administrator not to exceed $35,000,000 for each of fiscal years 2001 through 2005 for—

(1) expenses related to the administration of management conferences under this section, not to exceed 10 percent of the amount appropriated under this subsection;

(2) making grants under subsection (g); and

(3) monitoring the implementation of a conservation and management plan by the management conference or by the Administrator, in any case in which the conference has been terminated.

The Administrator shall provide up to $5,000,000 per fiscal year of the sums authorized to be appropriated under this subsection to the Administrator of the National Oceanic and Atmospheric Administration to carry out subsection (j).

(j) RESEARCH.—

(1) PROGRAMS.—In order to determine the need to convene a management conference under this section or at the request of such a management conference, the Administrator shall coordinate and implement, through the National Marine Pollution Program Office and the National Marine Fisheries Service of the National Oceanic and Atmospheric Administration, as appropriate, for one or more estuarine zones—

(A) a long-term program of trend assessment monitoring measuring variations in pollutant concentrations, marine ecology, and other physical or biological environmental paramenters which may affect estuarine zones, to provide the Administrator the capacity to determine the potential and actual effects of alternative management strategies and measures;

(B) a program of ecosystem assessment assisting in the development of (i) baseline studies which determine the state of estuarine zones and the effects of natural and anthropogenic changes, and (ii) predictive models capable of translating information on specific discharges or general pollutant loadings within estuarine zones into a set of probable effects on such zones;

(C) a comprehensive water quality sampling program for the continuous monitoring of nutrients, chlorine, acid precipitation dissolved oxygen, and potentially toxic pollutants (including organic chemicals and metals) in estuarine zones, after consultation with interested State, local, interstate, or international agencies and review and analysis of all environmental sampling data presently collected from estuarine zones; and

(D) a program of research to identify the movements of nutrients, sediments and pollutants through estuarine zones and the impact of nutrients, sediments, and pollutants on water quality, the ecosystem, and designated or potential uses of the estuarine zones.

(2) REPORTS.—The Administrator, in cooperation with the Administrator of the National Oceanic and Atmospheric Administration, shall submit to the Congress no less often than biennially a comprehensive report on the activities authorized under this subsection including—

(A) a listing of priority monitoring and research needs;

(B) an assessment of the state and health of the Nation's estuarine zones, to the extent evaluated under this subsection;

(C) a discussion of pollution problems and trends in pollutant concentrations with a direct or indirect effect on water quality, the ecosystem, and designated or potential uses of each estuarine zone, to the extent evaluated under this subsection; and

(D) an evaluation of pollution abatement activities and management measures so far implemented to determine the degree of improvement toward the objectives expressed in subsection (b)(4) of this section.

(k) DEFINITIONS.—For purposes of this section, the terms "estuary" and "estuarine zone" have the meanings such terms have in section 104(n)(3) of this Act, except that the term "estuarine zone" shall also include associated aquatic ecosystems and those portions of tributaries draining into the estuary up to the historic height of migration of anadromous fish or the historic head of tidal influence, whichever is higher.

(33 U.S.C. 1330)

TITLE IV—PERMITS AND LICENSES

CERTIFICATION

SEC. 401. (a)(1) Any applicant for a Federal license or permit to conduct any activity including, but not limited to, the construction or operation of facilities, which may result in any discharge into the navigable waters, shall provide the licensing or permitting agency a certification from the State in which the discharge origi-

nates or will originate, or, if appropriate, from the interstate water pollution control agency having jurisdiction over the navigable waters at the point where the discharge originates or will originate, that any such discharge will comply with the applicable provisions of sections 301, 302, 303, 306, and 307 of this Act. In the case of any such activity for which there is not an applicable effluent limitation or other limitation under sections 301(b) and 302, and there is not an applicable standard under sections 306 and 307, the State shall so certify, except that any such certification shall not be deemed to satisfy section 511(c) of this Act. Such State or interstate agency shall establish procedures for public notice in the case of all applications for certification by it and, to the extent it deems appropriate, procedures for public hearings in connection with specific applications. In any case where a State or interstate agency has no authority to give such a certification, such certification shall be from the Administrator. If the State, interstate agency, or Administrator, as the case may be, fails or refuses to act on a request for certification, within a reasonable period of time (which shall not exceed one year) after receipt of such request, the certification requirements of this subsection shall be waived with respect to such Federal application. No license or permit shall be granted until the certification required by this section has been obtained or has been waived as provided in the preceding sentence. No license or permit shall be granted if certification has been denied by the State, interstate agency, or the Administrator, as the case may be.

(2) Upon receipt of such application and certification the licensing or permitting agency shall immediately notify the Administrator of such application and certification. Whenever such a discharge may affect, as determined by the Administrator, the quality of the waters of any other State, the Administrator within thirty days of the date of notice of application for such Federal license or permit shall so notify such other State, the licensing or permitting agency, and the applicant. If, within sixty days after receipt of such notification, such other State determines that such discharge will affect the quality of its waters so as to violate any water quality requirement in such State, and within such sixty-day period notifies the Administrator and the licensing or permitting agency in writing of its objection to the issuance of such license or permit and requests a public hearing on such objection, the licensing or permitting agency shall hold such a hearing. The Administrator shall at such hearing submit his evaluation and recommendations with respect to any such objection to the licensing or permitting agency. Such agency, based upon the recommendations of such State, the Administrator, and upon any additional evidence, if any, presented to the agency at the hearing, shall condition such license or permit in such manner as may be necessary to insure compliance with applicable water quality requirements. If the imposition of conditions cannot insure such compliance such agency shall not issue such license or permit.

(3) The certification obtained pursuant to paragraph (1) of this subsection with respect to the construction of any facility shall fulfill the requirements of this subsection with respect to certification in connection with any other Federal license or permit required for the operation of such facility unless, after notice to the certifying State, agency, or Administrator, as the case may be, which shall be

given by the Federal agency to whom application is made for such operating license or permit, the State, or if appropriate, the interstate agency or the Administrator, notifies such agency within sixty days after receipt of such notice that there is no longer reasonable assurance that there will be compliance with the applicable provisions of sections 301, 302, 303, 306, and 307 of this Act because of changes since the construction license or permit certification was issued in (A) the construction or operation of the facility, (B) the characteristics of the waters into which such discharge is made, (C) the water quality criteria applicable to such waters or (D) applicable effluent limitations or other requirements. This paragraph shall be inapplicable in any case where the applicant for such operating license or permit has failed to provide the certifying State, or, if appropriate, the interstate agency or the Administrator, with notice of any proposed changes in the construction or operation of the facility with respect to which a construction license or permit has been granted, which changes may result in violation of section 301, 302, 303, 306, or 307 of this Act.

(4) Prior to the initial operation of any federally licensed or permitted facility or activity which may result in any discharge into the navigable waters and with respect to which a certification has been obtained pursuant to paragraph (1) of this subsection, which facility or activity is not subject to a Federal operating license or permit, the licensee or permittee shall provide an opportunity for such certifying State, or, if appropriate, the interstate agency or the Administrator to review the manner in which the facility or activity shall be operated or conducted for the purposes of assuring that applicable effluent limitations or other limitations or other applicable water quality requirements will not be violated. Upon notification by the certifying State, or if appropriate, the interstate agency or the Administrator that the operation of any such federally licensed or permitted facility or activity will violate applicable effluent limitations or other limitations or other water quality requirements such Federal agency may, after public hearing, suspend such license or permit. If such license or permit is suspended, it shall remain suspended until notification is received from the certifying State, agency, or Administrator, as the case may be, that there is reasonable assurance that such facility or activity will not violate the applicable provisions of section 301, 302, 303, 306, or 307 of this Act.

(5) Any Federal license or permit with respect to which a certification has been obtained under paragraph (1) of this subsection may be suspended or revoked by the Federal agency issuing such license or permit upon the entering of a judgment under this Act that such facility or activity has been operated in violation of the applicable provisions of section 301, 302, 303, 306, or 307 of this Act.

(6) Except with respect to a permit issued under section 402 of this Act, in any case where actual construction of a facility has been lawfully commenced prior to April 3, 1970, no certification shall be required under this subsection for a license or permit issued after April 3, 1970, to operate such facility, except that any such license or permit issued without certification shall terminate April 3, 1973, unless prior to such termination date the person having such license or permit submits to the Federal agency which

issued such license or permit a certification and otherwise meets the requirements of this section.

(b) Nothing in this section shall be construed to limit the authority of any department or agency pursuant to any other provision of law to require compliance with any applicable water quality requirements. The Administrator shall, upon the request of any Federal department or agency, or State or interstate agency, or applicant, provide, for the purpose of this section, any relevant information on applicable effluent limitations, or other limitations, standards, regulations, or requirements, or water quality criteria, and shall, when requested by any such department or agency or State or interstate agency, or applicant, comment on any methods to comply with such limitations, standards, regulations, requirements, or criteria.

(c) In order to implement the provisions of this section, the Secretary of the Army, acting throught the Chief of Engineers, is authorized, if he deems it to be in the public interest, to permit the use of spoil disposal areas under his jurisdiction by Federal licenses or permittees, and to make an appropriate charge for such use. Moneys received from such licensees or permittees shall be deposited in the Treasury as miscellaneous receipts.

(d) Any certification provided under this section shall set forth any effluent limitations and other limitations, and monitoring requirements necessary to assure that any applicant for a Federal license or permit will comply with any applicable effluent limitations and other limitations, under section 301 or 302 of this Act, standard of performance under section 306 of this Act, or prohibition, effluent standard, or pretreatment standard under section 307 of this Act, and with any other appropriate requirement of State law set forth in such certification, and shall become a condition on any Federal license or permit subject to the provisions of this section.

(33 U.S.C. 1341)

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

SEC. 402. (a)(1) Except as provided in sections 318 and 404 of this Act, the Administrator may, after opportunity for public hearing, issue a permit for the discharge of any pollutant, or combination of pollutants, notwithstanding section 301(a), upon condition that such discharge will meet either (A) all applicable requirements under sections 301, 302, 306, 307, 308, and 403 of this Act, or (B) prior to the taking of necessary implementing actions relating to all such requirements, such conditions as the Administrator determines are necessary to carry out the provisions of this Act.

(2) The Administrator shall prescribe conditions for such permits to assure compliance with the requirements of paragraph (1) of this subsection, including conditions on data and information collection, reporting, and such other requirements as he deems appropriate.

(3) The permit program of the Administrator under paragraph (1) of this subsection, and permits issued thereunder, shall be subject to the same terms, conditions, and requirements as apply to a State permit program and permits issued thereunder under subsection (b) of this section.

(4) All permits for discharges into the navigable waters issued pursuant to section 13 of the Act of March 3, 1899, shall be deemed to be permits issued under this title, and permits issued under this title shall be deemed to be permits issued under section 13 of the Act of March 3, 1899, and shall continue in force and effect for their term unless revoked, modified, or suspended in accordance with the provisions of this Act.

(5) No permit for a discharge into the navigable waters shall be issued under section 13 of the Act of March 3, 1899, after the date of enactment of this title. Each application for a permit under section 13 of the Act of March 3, 1899, pending on the date of enactment of this Act shall be deemed to be an application for a permit under this section. The Administrator shall authorize a State, which he determines has the capability of administering a permit program which will carry out the objective of this Act, to issue permits for discharges into the navigable waters within the jurisdiction of such State. The Administrator may exercise the authority granted him by the preceding sentence only during the period which begins on the date of enactment of this Act and ends either on the ninetieth day after the date of the first promulgation of guidelines required by section 304(h)(2) of this Act, or the date of approval by the Administrator of a permit program for such State under subsection (b) of this section, whichever date first occurs, and no such authorization to a State shall extend beyond the last day of such period. Each such permit shall be subject to such conditions as the Administrator determines are necessary to carry out the provisions of this Act. No such permit shall issue if the Administrator objects to such issuance.

(b) At any time after the promulgation of the guidelines required by subsection (h)(2) of section 304 of this Act, the Governor of each State desiring to administer its own permit program for discharges into navigable waters within its jurisdiction may submit to the Administrator a full and complete discription of the program it proposes to establish and administer under State law or under an interstate compact. In addition, such State shall submit a statement from the attorney general (or the attorney for those State water pollution control agencies which have independent legal counsel), or from the chief legal officer in the case of an interstate agency, that the laws of such State, or the interstate compact, as the case may be, provide adequate authority to carry out the described program. The Administrator shall approve each such submitted program unless he determines that adequate authority does not exist:

(1) To issue permits which—

(A) apply, and insure compliance with, any applicable requirements of sections 301, 302, 306, 307, and 403;

(B) are for fixed terms not exceeding five years; and

(C) can be terminated or modified for cause including, but not limited to, the following:

(i) violation of any condition of the permit;

(ii) obtaining a permit by misrepresentation, or failure to disclose fully all relevant facts;

(iii) change in any condition that requires either a temporary or permanent reduction or elimination of the permitted discharge;

(D) control the disposal of pollutants into wells;

(2)(A) To issue permits which apply, and insure compliance with, all applicable requirements of section 308 of this Act, or

(B) To inspect, monitor, enter, and require reports to at least the same extent as required in section 308 of this Act;

(3) To insure that the public, and any other State the waters of which may be affected, receive notice of each application for a permit and to provide an opportunity for public hearing before a ruling on each such application;

(4) To insure that the Administrator receives notice of each application (including a copy thereof) for a permit;

(5) To insure that any State (other than the permitting State), whose waters may be affected by the issuance of a permit may submit written recommendations to the permitting State (and the Administrator) with respect to any permit application and, if any part of such written recommendations are not accepted by the permitting State, that the permitting State will notify such affected State (and the Administrator) in writing of its failure to so accept such recommendations together with its reasons for so doing;

(6) To insure that no permit will be issued if, in the judgment of the Secretary of the Army acting through the Chief of Engineers, after consultation with the Secretary of the department in which the Coast Guard is operating, anchorage and navigation of any of the navigable waters would be substantially impaired thereby;

(7) To abate violations of the permit or the permit program, including civil and criminal penalties and other ways and means of enforcement;

(8) To insure that any permit for a discharge from a publicly owned treatment works includes conditions to require the identification in terms of character and volume of pollutants of any significant source introducing pollutants subject to pretreatment standards under section 307(b) of this Act into such works and a program to assure compliance with such pretreatment standards by each such source, in addition to adequate notice to the permitting agency of (A) new introductions into such works of pollutants from any source which would be a new source as defined in section 306 if such source were discharging pollutants, (B) new introductions of pollutants into such works from a source which would be subject to section 301 if it were discharging such pollutants, or (C) a substantial change in volume or character of pollutants being introduced into such works by a source introducing pollutants into such works at the time of issuance of the permit. Such notice shall include information on the quality and quantity of effluent to be introduced into such treatment works and any anticipated impact of such change in the quantity or quality of effluent to be discharged from such publicly owned treatment works; and

(9) To insure that any industrial user of any publicly owned treatment works will comply with sections 204(b), 307, and 308.

(c)(1) Not later than ninety days after the date on which a State has submitted a program (or revision thereof) pursuant to subsection (b) of this section, the Administrator shall suspend the issuance of permits under subsection (a) of this section as to those discharges subject to such program unless he determines that the State permit program does not meet the requirements of subsection (b) of this section or does not conform to the guidelines issued

under section 304(i)(2) of this Act. If the Administrator so determines, he shall notify the State or any revisons or modifications necessary to conform to such requirements or guidelines.

(2) Any State permit program under this section shall at all times be in accordance with this section and guidelines promulgated pursuant to section 304(h)(2) of this Act.

(3) Whenever the Administrator determines after public hearing that a State is not administering a program approved under this section in accordance with requirements of this section, he shall so notify the State and, if appropriate corrective action is not taken within a reasonable time, not to exceed ninety days, the Administrator shall withdraw approval of such program. The Administrator shall not withdraw approval of any such program unless he shall first have notified the State, and made public, in writing, the reasons for such withdrawal.

(4) LIMITATIONS ON PARTIAL PERMIT PROGRAM RETURNS AND WITHDRAWALS.—A State may return to the Administrator administration, and the Administrator may withdraw under paragraph (3) of this subsection approval, of—

(A) a State partial permit program approved under subsection (n)(3) only if the entire permit program being administered by the State department or agency at the time is returned or withdrawn; and

(B) a State partial permit program approved under subsection (n)(4) only if an entire phased component of the permit program being administered by the State at the time is returned or withdrawn.

(d)(1) Each State shall transmit to the Administrator a copy of each permit application received by such State and provide notice to the Administrator of every action related to the consideration of such permit application, including each permit proposed to be issued by such State.

(2) No permit shall issue (A) if the Administrator within ninety days of the date of his notification under subsection (b)(5) of this section objects in writing to the issuance of such permit, or (B) if the Administrator within ninety days of the date of transmittal of the proposed permit by the State objects in writing to the issuance of such permit as being outside the guidelines and requirements of this Act. Whenever the Administrator objects to the issuance of a permit under this paragraph such written objection shall contain a statement of the reasons for such objection and the effluent limitations and conditions which such permit would include if it were issued by the Administrator.

(3) The Administrator may, as to any permit application, waive paragraph (2) of this subsection.

(4) In any case where, after the date of enactment of this paragraph, the Administrator, pursuant to paragraph (2) of this subsection, objects to the issuance of a permit, on request of the State, a public hearing shall be held by the Administrator on such objection. If the State does not resubmit such permit revised to meet such objection within 30 days after completion of the hearing, or, if no hearing is requested within 90 days after the date of such objection, the Administrator may issue the permit pursuant to subsection (a) of this section for such source in accordance with the guidelines and requirements of this Act.

(e) In accordance with guidelines promulgated pursuant to subsection (h)(2) of section 304 of this Act, the Administrator is authorized to waive the requirements of subsection (d) of this section at the time he approves a program pursuant to subsection (b) of this section for any category (including any class, type, or size within such category) of point sources within the State submitting such program.

(f) The Administrator shall promulgate regulations establishing categories of point sources which he determines shall not be subject to the requirements of subsection (d) of this section in any State with a program approved pursuant to subsection (b) of this section. The Administrator may distinguish among classes, types, and sizes within any category of point sources.

(g) Any permit issued under this section for the discharge of pollutants into the navigable waters from a vessel or other floating craft shall be subject to any applicable regulations promulgated by the Secretary of the Department in which the Coast Guard is operating, establishing specifications for safe transportation, handling, carriage, storage, and stowage of pollutants.

(h) In the event any condition of a permit for discharges from a treatment works (as defined in section 212 of this Act) which is publicly owned is violated, a State with a program approved under subsection (b) of this section or the Administrator, where no State program is approved or where the Administrator determines pursuant to section 309(a) of this Act that a State with an approved program has not commenced appropriate enforcement action with respect to such permit, may proceed in a court of competent jurisdiction to restrict or prohibit the introduction of any pollutant into such treatment works by a source not utilizing such treatment works prior to the finding that such condition was violated.

(i) Nothing in this section shall be construed to limit the authority of the Administrator to take action pursuant to section 309 of this Act.

(j) A copy of each permit application and each permit issued under this section shall be available to the public. Such permit application or permit, or portion thereof, shall further be available on request for the purpose of reproduction.

(k) Compliance with a permit issued pursuant to this section shall be deemed compliance, for purposes of sections 309 and 505, with sections 301, 302, 306, 307, and 403, except any standard imposed under section 307 for a toxic pollutant injurious to human health. Until December 31, 1974, in any case where a permit for discharge has been applied for pursuant to this section, but final administrative disposition of such application has not been made, such discharge shall not be a violation of (1) section 301, 306, or 402 of this Act, or (2) section 13 of the Act of March 3, 1899, unless the Administrator or other plaintiff proves that final administrative disposition of such application has not been made because of the failure of the applicant to furnish information reasonably required or requested in order to process the application. For the 180-day period beginning on the date of enactment of the Federal Water Pollution Control Act Amendments of 1972, in the case of any point source discharging any pollutant or combination of pollutants immediately prior to such date of enactment which source is not subject to section 13 of the Act of March 3, 1899, the dis-

charge by such source shall not be a violation of this Act if such a source applies for a permit for discharge pursuant to this section within such 180-day period.

(l) LIMITATION ON PERMIT REQUIREMENT.—

(1) AGRICULTURAL RETURN FLOWS.—The Administrator shall not require a permit under this section for discharges composed entirely of return flows from irrigated agriculture, nor shall the Administrator directly or indirectly, require any State to require such a permit.

(2) STORMWATER RUNOFF FROM OIL, GAS, AND MINING OPERATIONS.—The Administrator shall not require a permit under this section, nor shall the Administrator directly or indirectly require any State to require a permit, for discharges of stormwater runoff from mining operations or oil and gas exploration, production, processing, or treatment operations or transmission facilities, composed entirely of flows which are from conveyances or systems of conveyances (including but not limited to pipes, conduits, ditches, and channels) used for collecting and conveying precipitation runoff and which are not contaminated by contact with, or do not come into contact with, any overburden, raw material, intermediate products, finished product, byproduct, or waste products located on the site of such operations.

(m) ADDITIONAL PRETREATMENT OF CONVENTIONAL POLLUTANTS NOT REQUIRED.—To the extent a treatment works (as defined in section 212 of this Act) which is publicly owned is not meeting the requirements of a permit issued under this section for such treatment works as a result of inadequate design or operation of such treatment works, the Administrator, in issuing a permit under this section, shall not require pretreatment by a person introducing conventional pollutants identified pursuant to a section 304(a)(4) of this Act into such treatment works other than pretreatment required to assure compliance with pretreatment standards under subsection (b)(8) of this section and section 307(b)(1) of this Act. Nothing in this subsection shall affect the Administrator's authority under sections 307 and 309 of this Act, affect State and local authority under sections 307(b)(4) and 510 of this Act, relieve such treatment works of its obligations to meet requirements established under this Act, or otherwise preclude such works from pursuing whatever feasible options are available to meet its responsibility to comply with its permit under this section.

(n) PARTIAL PERMIT PROGRAM.—

(1) STATE SUBMISSION.—The Governor of a State may submit under subsection (b) of this section a permit program for a portion of the discharges into the navigable waters in such State.

(2) MINIMUM COVERAGE.—A partial permit program under this subsection shall cover, at a minimum, administration of a major category of the discharges into the navigable waters of the State or a major component of the permit program required by subsection (b).

(3) APPROVAL OF MAJOR CATEGORY PARTIAL PERMIT PROGRAMS.—The Administrator may approve a partial permit program covering administration of a major category of discharges under this subsection if—

(A) such program represents a complete permit program and covers all of the discharges under the jurisdiction of a department or agency of the State; and

(B) the Administrator determines that the partial program represents a significant and identifiable part of the State program required by subsection (b).

(4) APPROVAL OF MAJOR COMPONENT PARTIAL PERMIT PROGRAMS.—The Administrator may approve under this subsection a partial and phased permit program covering administration of a major component (including discharge categories) of a State permit program required by subsection (b) if—

(A) the Administrator determines that the partial program represents a significant and identifiable part of the State program required by subsection (b); and

(B) the State submits, and the Administrator approves, a plan for the State to assume administration by phases of the remainder of the State program required by subsection (b) by a specified date not more than 5 years after submission of the partial program under this subsection and agrees to make all reasonable efforts to assume such administration by such date.

(o) ANTI-BACKSLIDING.—

(1) GENERAL PROHIBITION.—In the case of effluent limitations established on the basis of subsection (a)(1)(B) of this section, a permit may not be renewed, reissued, or modified on the basis of effluent guidelines promulgated under section 304(b) subsequent to the original issuance of such permit, to contain effluent limitations which are less stringent than the comparable effluent limitations in the previous permit. In the case of effluent limitations established on the basis of section 301(b)(1)(C) or section 303(d) or (e), a permit may not be renewed, reissued, or modified to contain effluent limitations which are less stringent than the comparable effluent limitations in the previous permit except in compliance with section 303(d)(4).

(2) EXCEPTIONS.—A permit with respect to which paragraph (1) applies may be renewed, reissued, or modified to contain a less stringent effluent limitation applicable to a pollutant if—

(A) material and substantial alterations or additions to the permitted facility occurred after permit issuance which justify the application of a less stringent effluent limitation;

(B)(i) information is available which was not available at the time of permit issuance (other than revised regulations, guidance, or test methods) and which would have justified the application of a less stringent effluent limitation at the time of permit issuance; or

(ii) the Administrator determines that technical mistakes or mistaken interpretations of law were made in issuing the permit under subsection (a)(1)(B);

(C) a less stringent effluent limitation is necessary because of events over which the permittee has no control and for which there is no reasonably available remedy;

(D) the permittee has received a permit modification under section 301(c), 301(g), 301(h), 301(i), 301(k), 301(n), or 316(a); or

(E) the permittee has installed the treatment facilities required to meet the effluent limitations in the previous permit and has properly operated and maintained the facilities but has nevertheless been unable to achieve the previous effluent limitations, in which case the limitations in the reviewed, reissued, or modified permit may reflect the level of pollutant control actually achieved (but shall not be less stringent than required by effluent guidelines in effect at the time of permit renewal, reissuance, or modification).

Subparagraph (B) shall not apply to any revised waste load allocations or any alternative grounds for translating water quality standards into effluent limitations, except where the cumulative effect of such revised allocations results in a decrease in the amount of pollutants discharged into the concerned waters, and such revised allocations are not the result of a discharger eliminating or substantially reducing its discharge of pollutants due to complying with the requirements of this Act or for reasons otherwise unrelated to water quality.

(3) LIMITATIONS.—In no event may a permit with respect to which paragraph (1) applies be renewed, reissued, or modified to contain an effluent limitation which is less stringent than required by effluent guidelines in effect at the time the permit is renewed, reissued, or modified. In no event may such a permit to discharge into waters be renewed, reissued, or modified to contain a less stringent effluent limitation if the implementation of such limitation would result in a violation of a water quality standard under section 303 applicable to such waters.

(p) MUNICIPAL AND INDUSTRIAL STORMWATER DISCHARGES.—

(1) GENERAL RULE.—Prior to October 1, 1994, the Administrator or the State (in the case of a permit program approved under section 402 of this Act) shall not require a permit under this section for discharges composed entirely of stormwater.

(2) EXCEPTIONS.—Paragraph (1) shall not apply with respect to the following stormwater discharges:

(A) A discharge with respect to which a permit has been issued under this section before the date of the enactment of this subsection.

(B) A discharge associated with industrial activity.

(C) A discharge from a municipal separate storm sewer system serving a population of 250,000 or more.

(D) A discharge from a municipal separate storm sewer system serving a population of 100,000 or more but less than 250,000.

(E) A discharge for which the Administrator or the State, as the case may be, determines that the stormwater discharge contributes to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States.

(3) PERMIT REQUIREMENTS.—

(A) INDUSTRIAL DISCHARGES.—Permits for discharges associated with industrial activity shall meet all applicable provisions of this section and section 301.

(B) MUNICIPAL DISCHARGE.—Permits for discharges from municipal storm sewers—

(i) may be issued on a system- or jurisdiction-wide basis;

(ii) shall include a requirement to effectively prohibit non-stormwater discharges into the storm sewers; and

(iii) shall require controls to reduce the discharge of pollutants to the maximum extent practicable, including management practices, control techniques and system, design and engineering methods, and such other provisions as the Administrator or the State determines appropriate for the control of such pollutants.

(4) PERMIT APPLICATION REQUIREMENTS.—

(A) INDUSTRIAL AND LARGE MUNICIPAL DISCHARGES.—Not later than 2 years after the date of the enactment of this subsection, the Administrator shall establish regulations setting forth the permit application requirements for stormwater discharges described in paragraphs (2)(B) and (2)(C). Applications for permits for such discharges shall be filed no later than 3 years after such date of enactment. Not later than 4 year after such date of enactment the Administrator or the State, as the case may be, shall issue or deny each such permit. Any such permit shall provide for compliance as expeditiously as practicable, but in no event later than 3 years after the date of issuance of such permit.

(B) OTHER MUNICIPAL DISCHARGES.—Not later than 4 years after the date of the enactment of this subsection, the Administrator shall establish regulations setting forth the permit application requirements for stormwater discharges described in paragraph (2)(D). Applications for permits for such discharges shall be filed no later than 5 years after such date of enactment. Not later than 6 years after such date of enactment, the Administrator or the State, as the case may be, shall issue or deny each such permit. Any such permit shall provide for compliance as expeditiously as practicable, but in no event later than 3 years after the date of issuance of such permit.

(5) STUDIES.—The Administrator, in consultation with the States, shall conduct a study for the purposes of—

(A) identifying those stormwater discharges or classes of stormwater discharges for which permits are not required pursuant to paragraphs (1) and (2) of this subsection;

(B) determining, to the maximum extent practicable, the nature and extent of pollutants in such discharges; and

(C) establishing procedures and methods to control stormwater discharges to the extent necessary to mitigate impacts on water quality.

Not later than October 1, 1988, the Administrator shall submit to Congress a report on the results of the study described in

subparagraphs (A) and (B). Not later than October 1, 1989, the Administrator shall submit to Congress a report on the results of the study described in subparagraph (C).

(6) REGULATIONS.—Not later than October 1, 1993, the Administrator, in consultation with State and local officials, shall issue regulations (based on the results of the studies conducted under paragraph (5)) which designate stormwater discharges, other than those discharges described in paragraph (2), to be regulated to protect water quality and shall establish a comprehensive program to regulate such designated sources. The program shall, at a minimum, (A) establish priorities, (B) establish requirements for State stormwater management programs, and (C) establish expeditious deadlines. The program may include performance standards, guidelines, guidance, and management practices and treatment requirements, as appropriate.

(q) COMBINED SEWER OVERFLOWS.—

(1) REQUIREMENT FOR PERMITS, ORDERS, AND DECREES.—Each permit, order, or decree issued pursuant to this Act after the date of enactment of this subsection for a discharge from a municipal combined storm and sanitary sewer shall conform to the Combined Sewer Overflow Control Policy signed by the Administrator on April 11, 1994 (in this subsection referred to as the "CSO control policy").

(2) WATER QUALITY AND DESIGNATED USE REVIEW GUIDANCE.—Not later than July 31, 2001, and after providing notice and opportunity for public comment, the Administrator shall issue guidance to facilitate the conduct of water quality and designated use reviews for municipal combined sewer overflow receiving waters.

(3) REPORT.—Not later than September 1, 2001, the Administrator shall transmit to Congress a report on the progress made by the Environmental Protection Agency, States, and municipalities in implementing and enforcing the CSO control policy.

(33 U.S.C. 1342)

OCEAN DISCHARGE CRITERIA

SEC. 403. (a) No permit under section 402 of this Act for a discharge into the territorial sea, the waters of the contiguous zone, or the oceans shall be issued, after promulgation of guidelines established under subsection (c) of this section, except in compliance with such guidelines. Prior to the promulgation of such guidelines, a permit may be issued under such section 402 if the Administrator determines it to be in the public interest.

(b) The requirements of subsection (d) of section 402 of this Act may not be waived in the case of permits for discharges into the territorial sea.

(c)(1) The Administrator shall, within one hundred and eighty days after enactment of this Act (and from time to time thereafter), promulgate guidelines for determining the degradation of the waters of the territorial seas, the contiguous zone, and the oceans, which shall include:

(A) the effect of disposal of pollutants on human health or welfare, including but not limited to plankton, fish, shellfish, wildlife, shorelines, and beaches;

(B) the effect of disposal of pollutants on marine life including the transfer, concentration, and dispersal of pollutants or their byproducts through biological, physical, and chemical processes; changes in marine ecosystem diversity, productivity, and stability; and species and community population changes;

(C) the effect of disposal, of pollutants on esthetic, recreation, and economic values;

(D) the persistence and permanence of the effects of disposal of pollutants;

(E) the effect of the disposal at varying rates, of particular volumes and concentrations of pollutants;

(F) other possible locations and methods of disposal or recycling of pollutants including land-based alternatives; and

(G) the effect on alternate uses of the oceans, such as mineral exploitation and scientific study.

(2) In any event where insufficient information exists on any proposed discharge to make a reasonable judgment on any of the guidelines established pursuant to this subsection no permit shall be issued under section 402 of this Act.

(33 U.S.C. 1343)

PERMITS FOR DREDGED OR FILL MATERIAL

SEC. 404. (a) The Secretary may issue permits, after notice and opportunity for public hearings for the discharge of dredged or fill material into the navigable waters at specified disposal sites. Not later than the fifteenth day after the date an applicant submits all the information required to complete an application for a permit under this subsection, the Secretary shall publish the notice required by this subsection.

(b) Subject to subsection (c) of this section, each such disposal site shall be specified for each such permit by the Secretary (1) through the application of guidelines developed by the Administrator, in conjunction with the Secretary which guidelines shall be based upon criteria comparable to the criteria applicable to the territorial seas, the contiguous zone, and the ocean under section 403(c), and (2) in any case where such guidelines under clause (1) alone would prohibit the specification of a site, through the application additionally of the economic impact of the site on navigation and anchorage.

(c) The Administrator is authorized to prohibit the specification (including the withdrawal of specification) of any defined area as a disposal site, and he is authorized to deny or restrict the use of any defined area for specification (including the withdrawal of specification) as a disposal site, whenever he determines, after notice and opportunity for public hearings, that the discharge of such materials into such area will have an unacceptable adverse effect on municipal water supplies, shellfish beds and fishery areas (including spawning and breeding areas), wildlife, or recreational areas. Before making such determination, the Administrator shall consult with the Secretary. The Administrator shall set forth in writing

and make public his findings and his reasons for making any determination under this subsection.

(d) The term "Secretary" as used in this section means the Secretary of the Army, acting through the Chief of Engineers.

(e)(1) In carrying out his functions relating to the discharge of dredged or fill material under this section, the Secretary may, after notice and opportunity for public hearing, issue general permits on a State, regional, or nationwide basis for any category of activities involving discharges of dredged or fill material if the Secretary determines that the activities in such category are similar in nature, will cause only minimal adverse environmental effects when performed separately, and will have only minimal cumulative adverse effect on the environment. Any general permit issued under this subsection shall (A) be based on the guidelines described in subsection (b)(1) of this section, and (B) set forth the requirements and standards which shall apply to any activity authorized by such general permit.

(2) No general permit issued under this subsection shall be for a period of more than five years after the date of its issuance and such general permit may be revoked or modified by the Secretary if, after opportunity for public hearing, the Secretary determines that the activities authorized by such general permit have an adverse impact on the environment or such activities are more appropriately authorized by individual permits.

(f)(1) Except as provided in paragraph (2) of this subsection, the discharge of dredge or fill material—

(A) from normal farming, silviculture, and ranching activities such as plowing, seeding, cultivating, minor drainage, harvesting for the production of food, fiber, and forest products, or upland soil and water conservation practices;

(B) for the purpose of maintenance, including emergency reconstruction of recently damaged parts, of currently serviceable structures such as dikes, dams, levees, groins, riprap, breakwaters, causeways, and bridge abutments or approaches, and transportation structures;

(C) for the purpose of construction or maintenance of farm or stock ponds or irrigation ditches, or the maintenance of drainage ditches;

(D) for the purpose of construction of temporary sedimentation basins on a construction site which does not include placement of fill material into the navigable waters;

(E) for the purpose of construction or maintenance of farm roads or forest roads, or temporary roads for moving mining equipment, where such roads are constructed and maintained, in accordance with best management practices, to assure that flow and circulation patterns and chemical and biological characteristics of the navigable waters are not impaired, that the reach of the navigable waters is not reduced, and that any adverse effect on the aquatic environment will be otherwise minimized;

(F) resulting from any activity with respect to which a State has an approved program under section 208(b)(4) which meets the requirements of subparagraphs (B) and (C) of such section,

is not prohibited by or otherwise subject to regulation under this section or section 301(a) or 402 of this Act (except for effluent standards or prohibitions under section 307).

(2) Any discharge of dredged or fill material into the navigable waters incidental to any activity having as its purpose bringing an area of the navigable waters into a use to which it was not previously subject, where the flow or circulation of navigable waters may be impaired or the reach of such waters be reduced, shall be required to have a permit under this section.

(g)(1) The Governor of any State desiring to administer its own individual and general permit program for the discharge of dredged or fill material into the navigable waters (other than those waters which are presently used, or are susceptible to use in their natural condition or by reasonable improvement as a means to transport interstate or foreign commerce shoreward to their ordinary high water mark, including all waters which are subject to the ebb and flow of the tide shoreward to their mean high water mark, or mean higher high water mark on the west coast, including wetlands adjacent thereto), within its jurisdiction may submit to the Administrator a full and complete description of the program it proposes to establish and administer under State law or under an interstate compact. In addition, such State shall submit a statement from the attorney general (or the attorney for those State agencies which have independent legal counsel), or from the chief legal officer in the case of an interstate agency, that the laws of such State, or the interstate compact, as the case may be, provide adequate authority to carry out the described program.

(2) Not later than the tenth day after the date of the receipt of the program, and statement submitted by any State under paragraph (1) of this subsection, the Administrator shall provide copies of such program and statement to the Secretary and the Secretary of the Interior, acting through the Director of the United States Fish and Wildlife Service.

(3) Not later than the ninetieth day after the date of the receipt by the Administrator of the program and statement submitted by any State, under paragraph (1) of this subsection, the Secretary and the Secretary of the Interior, acting through the Director of the United States Fish and Wildlife Service, shall submit any comments with respect to such program and statement to the Administrator in writing.

(h)(1) Not later than the one-hundred-twentieth day after the date of the receipt by the Administrator of a program and statement submitted by any State under paragraph (1) of this subsection, the Administrator shall determine, taking into account any comments submitted by the Secretary and the Secretary of the Interior, acting through the Director of the United States Fish and Wildlife Service, pursuant to subsection (g) of this section, whether such State has the following authority with respect to the issuance of permits pursuant to such program:

(A) To issue permits which—

(i) apply, and assure compliance with, any applicable requirements of this section, including, but not limited to, the guidelines established under subsection (b)(1) of this section, and sections 307 and 403 of this Act;

(ii) are for fixed terms not exceeding five years; and

(iii) can be terminated or modified for cause including, but not limited to, the following:

(I) violation of any condition of the permit;

(II) obtaining a permit by misrepresentation, or failure to disclose fully all relevant facts;

(III) change in any condition that requires either a temporary or permanent reduction or elimination of the permitted discharge.

(B) To issue permits which apply, and assure compliance with, all applicable requirements of section 308 of this Act, or to inspect, monitor, enter, and requrie reports to at least the same extent as required in section 308 of this Act.

(C) To assure that the public, and any other State the waters of which may be affected, receive notice of each application for a permit and to provide an opportunity for public hearing before a ruling on each such application.

(D) To assure that the Administrator receives notice of each application (including a copy thereof) for a permit.

(E) To assure that any State (other than the permitting State), whose waters may be affected by the issuance of a permit may submit written recommendation to the permitting State (and the Administrator) with respect to any permit application and, if any part of such written recommendations are not accepted by the permitting State, that the permitting State will notify such affected State (and the Administrator) in writing of its failure to so accept such recommendations together with its reasons for so doing.

(F) To assure that no permit will be issued if, in the judgment of the Secretary, after consultation with the Secretary of the department in which the Coast Guard is operating, anchorage and navigation of any of the navigable waters would be substantially impaired thereby.

(G) To abate violations of the permit or the permit program, including civil and criminal penalties and other ways and means of enforcement.

(H) To assure continued coordination with Federal and Federal-State water-related planning and review processes.

(2) If, with respect to a State program submitted under subsection (g)(1) of this section, the Administrator determines that such State—

(A) has the authority set forth in paragraph (1) of this subsection, the Administrator shall approve the program and so notify (i) such State, and (ii) the Secretary, who upon subsequent notification from such State that it is administering such program, shall suspend the issuance of permits under subsection (a) and (e) of this section for activities with respect to which a permit may be issued pursuant to such State program; or

(B) does not have the authority set forth in paragraph (1) of this subsection, the Administrator shall so notify such State, which notification shall also describe the revisions or modifications necessary so that such State may resubmit such program for a determination by the Administrator under this subsection.

(3) If the Administrator fails to make a determination with respect to any program submitted by a State under subsection (g)(1) of this section within one-hundred-twenty days after the date of the receipt of such program, such program shall be deemed approved pursuant to paragraph (2)(A) of this subsection and the Administrator shall so notify such State and the Secretary who, upon subsequent notification from such State that it is administering such program, shall suspend the issuance of permits under subsection (a) and (e) of this section for activities with respect to which a permit may be issued by such State.

(4) After the Secretary receives notification from the Administrator under paragraph (2) or (3) of this subsection that a State permit program has been approved, the Secretary shall transfer any applications for permits pending before the Secretary for activities with respect to which a permit may be issued pursuant to such State program to such State for appropriate action.

(5) Upon notification from a State with a permit program approved under this subsection that such State intends to administer and enforce the terms and conditions of a general permit issed by the Secretary under subsection (e) of this section with respect to activities in such State to which such general permit applies, the Secretary shall suspend the administration and enforcement of such general permit with respect to such activities.

(i) Whenever the Administrator determines after public hearing that a State is not administering a program approved under section (h)(2)(A) of this section, in accordance with this section, including, but not limited to, the guidelines established under subsection (b)(1) of this section, the Administrator shall so notify the State, and, if appropriate corrective action is not taken within a reasonable time, not to exceed ninety days after the date of the receipt of such notification, the Administrator shall (1) withdraw approval of such program until the Administrator determines such corrective action has been taken, and (2) notify the Secretary that the Secretary shall resume the program for the issuance of permits under subsections (a) and (e) of this section for activities with respect to which the State was issuing permits and that such authority of the Secretary shall continue in effect until such time as the Administrator makes the determination described in clause (1) of this subsection and such State again has an approved program.

(j) Each State which is administering a permit program pursuant to this section shall transmit to the Administrator (1) a copy of each permit application received by such State and provide notice to the Administrator of every action related to the consideration of such permit application, including each permit proposed to be issued by such State, and (2) a copy of each proposed general permit which such State intends to issue. Not later than the tenth day after the date of the receipt of such permit application or such proposed general permit, the Administrator shall provide copies of such permit application or such proposed general permit to the Secretary and the Secretary of the Interior, acting through the Director of the United States Fish and Wildlife Service. If the Administrator intends to provide written comments to such State with respect to such permit application or such proposed general permit, he shall so notify such State not later than the thirtieth day after the date of the receipt of such application or such proposed general

permit and provide such written comments to such State, after consideration of any comments made in writing with respect to such application or such proposed general permit by the Secretary and the Secretary of the Interior, acting through the Director of the United States Fish and Wildlife Service, not later than the ninetieth day after the date of such receipt. If such State is so notified by the Administrator, it shall not issue the proposed permit until after the receipt of such comments from the Administrator, or after such ninetieth day, whichever first occurs. Such State shall not issue such proposed permit after such ninetieth day if it has received such written comments in which the Administrator objects (A) to the issuance of such proposed permit and such proposed permit is one that has been submitted to the Administrator pursuant to subsection (h)(1)(E), or (B) to the issuance of such proposed permit as being outside the requirements of this section, including, but not limited to, the guidelines developed under subsection (b)(1) of this section unless it modifies such proposed permit in accordance with such comments. Whenever the Administrator objects to the issuance of a permit under the preceding sentence such written objection shall contain a statement of the reasons for such objection and the conditions which such permit would include if it were issued by the Administrator. In any case where the Administrator objects to the issuance of a permit, on request of the State, a public hearing shall be held by the Administrator on such objection. If the State does not resubmit such permit revised to meet such objection within 30 days after completion of the hearing or, if no hearing is requested within 90 days after the date of such objection, the Secretary may issue the permit pursuant to subsection (a) or (e) of this section, as the case may be, for such source in accordance with the guidelines and requirements of this Act.

(k) In accordance with guidelines promulgated pursuant to subsection (i)(2) of section 304 of this Act, the Administrator is authorized to waive the requirements of subsection (j) of this section at the time of the approval of a program pursuant to subsection (h)(2)(A) of this section for any category (including any class, type, or size within such category) of discharge within the State submitting such program.

(l) The Administrator shall promulgate regulations establishing categories of discharges which he determines shall not be subject to the requirements of subsection (j) of this section in any State with a program approved pursuant to subsection (h)(2)(A) of this section. The Administrator may distinguish among classes, types, and sizes within any category of discharges.

(m) Not later than the ninetieth day after the date on which the Secretary notifies the Secretary of the Interior, acting through the Director of the United States Fish and Wildlife Service that (1) an application for a permit under subsection (a) of this section has been received by the Secretary, or (2) the Secretary proposes to issue a general permit under subsection (e) of this section, the Secretary of the Interior, acting through the Director of the United States Fish and Wildlife Service, shall submit any comments with respect to such application or such proposed general permit in writing to the Secretary.

(n) Nothing in this section shall be construed to limit the authority of the Administrator to take action pursuant to section 309 of this Act.

(o) A copy of each permit application and each permit issued under this section shall be available to the public. Such permit application or portion thereof, shall further be available on request for the purpose of reproduction.

(p) Compliance with a permit issued pursuant to this section, including any activity carried out pursuant to a general permit issued under this section, shall be deemed compliance, for purposes of sections 309 and 505, with sections 301, 307, and 403.

(q) Not later than the one-hundred-eightieth day after the date of enactment of this subsection, the Secretary shall enter into agreements with the Administrator, the Secretaries of the Departments of Agriculture, Commerce, Interior, and Transportation, and the heads of other appropriate Federal agencies to minimize, to the maximum extent practicable, duplication, needless paperwork, and delays in the issuance of permits under this section. Such agreements shall be developed to assure that, to the maximum extent practicable, a decision with respect to an application for a permit under subsection (a) of this section will be made not later than the ninetieth day after the date the notice of such application is published under subsection (a) of this section.

(r) The discharge of dredged or fill material as part of the construction of a Federal project specifically authorized by Congress, whether prior to or on or after the date of enactment of this subsection, is not prohibited by or otherwise subject to regulation under this section, or a State program approved under this section, or section 301(a) or 402 of the Act (except for effluent standards or prohibitions under section 307), if information on the effects of such discharge, including consideration of the guidelines developed under subsection (b)(1) of this section, is included in an environmental impact statement for such project pursuant to the National Environmental Policy Act of 1969 and such environmental impact statement has been submitted to Congress before the actual discharge of dredged or fill material in connection with the construction of such project and prior to either authorization of such project or an appropriation of funds for each construction.

(s)(1) Whenever on the basis of any information available to him the Secretary finds that any person is in violation of any condition or limitation set forth in a permit issued by the Secretary under this section, the Secretary shall issue an order requiring such persons to comply with such condition or limitation, or the Secretary shall bring a civil action in accordance with paragraph (3) of this subsection.

(2) A copy of any order issued under this subsection shall be sent immediately by the Secretary to the State in which the violation occurs and other affected States. Any order issued under this subsection shall be by personal service and shall state with reasonable specificity the nature of the violation, specify a time for compliance, not to exceed thirty days, which the Secretary determines is reasonable, taking into account the seriousness of the violation and any good faith efforts to comply with applicable requirements. In any case in which an order under this subsection is issued to

a corporation, a copy of such order shall be served on any appropriate corporate officers.

(3) The Secretary is authorized to commence a civil action for appropriate relief, including a permanent or temporary injunction for any violation for which he is authorized to issue a compliance order under paragraph (1) of this subsection. Any action under this paragraph may be brought in the district court of the United States for the district in which the defendant is located or resides or is doing business, and such court shall have jurisdiction to restrain such violation and to require compliance. Notice of the commencement of such acton [1] shall be given immediately to the appropriate State.

(4) Any person who violates any condition or limitation in a permit issued by the Secretary under this section, and any person who violates any order issued by the Secretary under paragraph (1) of this subsection, shall be subject to a civil penalty not to exceed $25,000 per day for each violation. In determining the amount of a civil penalty the court shall consider the seriousness of the violation or violations, the economic benefit (if any) resulting from the violaltion, any history of such violations, any good-faith efforts to comply with the applicable requirements, the economic impact of the penalty on the violator, and such other matters as justice may require.

(t) Nothing in the section shall preclude or deny the right of any State or interstate agency to control the discharge of dredged or fill material in any portion of the navigable waters within the jurisdiction of such State, including any activity of any Federal agency, and each such agency shall comply with such State or interstate requirements both substantive and procedural to control the discharge of dredged or fill material to the same extent that any person is subject to such requirements. This section shall not be construed as affecting or impairing the authority of the Secretary to maintain navigation.

(33 U.S.C. 1344)

DISPOSAL OF SEWAGE SLUDGE

SEC. 405. (a) Notwithstanding any other provision of this Act or of any other law, in the case where the disposal of sewage sludge resulting from the operation of a treatment works as defined in section 212 of this Act (including the removal of in-place sewage sludge from one location and its deposit at another location) would result in any pollutant from such sewage sludge entering the navigable waters, such disposal is prohibited except in accordance with a permit issued by the Administrator under section 402 of this Act.

(b) The Administrator shall issue regulations governing the issuance of permits for the disposal of sewage sludge subject to subsection (a) of this section and section 402 of this Act. Such regulations shall require the application to such disposal of each criterion, factor, procedure, and requirement applicable to a permit issued under section 402 of this title.

(c) Each State desiring to administer its own permit program for disposal of sewage sludge subject to subsection (a) of this sec-

[1] So in law. Probably should be "action".

tion within its jurisdiction may do so in accordance with section 402 of this Act.

(d) REGULATIONS.—

(1) REGULATIONS.—The Administrator, after consultation with appropriate Federal and State agencies and other interested persons, shall develop and publish, within one year after the date of enactment of this subsection and from time to time thereafter, regulations poroviding guidelines for the disposal of sludge and the utilization of sludge for various purposes. Such regulations shall—

(A) identify uses for sludge, including disposal;

(B) specify factors to be taken into account in determining the measures and practices applicable to each such use or disposal (including publication of information on costs);

(C) identify concentrations of pollutants which interfere with each such use or disposal.

The Administrator is authorized to revise any regulation issued under this subsection.

(2) IDENTIFICATION AND REGULATION OF TOXIC POLLUTANTS.—

(A) ON BASIS OF AVAILABLE INFORMATION.—

(i) PROPOSED REGULATIONS.—Not later than November 30, 1986, the Administrator shall identify those toxic pollutants which, on the basis of available information on their toxicity, persistence, concentration, mobility, or potential for exposure, may be present in sewage sludge in concentrations which may adversely affect public health or the environment, and propose regulations specifying acceptable management practices for sewage sludge containing each such toxic pollutant and establishing numerical limitations for each such pollutant for each use identified under paragraph (1)(A).

(ii) FINAL REGULATIONS.—Not later than August 31, 1987, and after opportunity for public hearing, the Administrator shall promulgate the regulations required by subparagraph (A)(i).

(B) OTHERS.—

(i) PROPOSED REGULATIONS.—Not later than July 31, 1987, the Administrator shall identify those toxic pollutants not identified under subparagraph (A)(i) which may be present in sewage sludge in concentrations which may adversely affect public health or the environment, and propose regulations specifying acceptable management practices for sewage sludge containing each such toxic pollutant and establishing numerical limitations for each pollutant for each such use identified under paragraph (1)(A).

(ii) FINAL REGULATIONS.—Not later than June 15, 1988, the Administrator shall promulate the regulations required by subparagraph (B)(i).

(C) REVIEW.—From time to time, but not less often than every 2 years, the Administrator shall review the regulations promulgated under this paragraph for the purpose

of identifying additional toxic pollutants and promulgating regulations for such pollutants consistent with the requirements of this paragraph.

(D) MINIMUM STANDARDS; COMPLIANCE DATE.—The management practices and numerical criteria established under subparagraphs (A), (B), and (C) shall be adequate to protect public health and the environment from any reasonably anticipated adverse effects of each pollutant. Such regulations shall require compliance as expeditiously as practicable but in no case later than 12 months after their publication, unless such regulations require the construction of new pollution control facilities, in which case the regulations shall require compliance as expeditiously as practicable but in no case later than two years from the date of their publication.

(3) ALTERNATIVE STANDARDS.—For purposes of this subsection, if, in the judgment of the Administrator, it is not feasible to prescribe or enforce a numerical limitation for a pollutant identified under paragraph (2), the Administrator may instead promulgate a design, equipment, management practice, or operational standard, or combination thereof, which in the Administrator's judgment is adequate to protect public health and the environment from any reasonably anticipated adverse effects of such pollutant. In the event the Administrator promulgates a design or equipment standard under this subsection, the Administrator shall include as part of such standard such requirements as will assure the proper operation and maintenance of any such element of design or equipment.

(4) CONDITIONS ON PERMITS.—Prior to the promulgation of the regulations required by paragraph (2), the Administrator shall impose conditions in permits issued to publicly owned treatment works under section 402 of this Act or take such other measures as the Administrator deems appropriate to protect public health and the environment from any adverse effects which may occur from toxic pollutants in sewage sludge.

(5) LIMITATION ON STATUTORY CONSTRUCTION.—Nothing in this section is intended to waive more stringent requirements established by this Act or any other law.

(e) MANNER OF SLUDGE DISPOSAL.—The determination of the manner of disposal or use of sludge is a local determination, except that it shall be unlawful for any person to dispose of sludge from a publicly owned treatment works or any other treatment works treating domestic sewage for any use for which regulations have been established pursuant to subsection (d) of this section, except in accordance with such regulations.

(f) IMPLEMENTATION OF REGULATIONS.—

(1) THROUGH SECTION 402 PERMITS.—Any permit issued under section 402 of this Act to a publicly owned treatment works or any other treatment works treating domestic sewage shall include requirements for the use and disposal of sludge that implement the regulations established pursuant to subsection (d) of this section, unless such requirements have been included in a permit issued under the appropriate provisions of subtitle C of the Solid Waste Disposal Act, part C of the Safe Drinking Water Act, the Marine Protection, Research, and

Sanctuaries Act of 1972, or the Clean Air Act, or under State permit programs approved by the Administrator, where the Administrator determines that such programs assure compliance with any applicable requirements of this section. Not later than December 15, 1986, the Administrator shall promulgate procedures for approval of State programs pursuant to this paragraph.

(2) THROUGH OTHER PERMITS.—In the case of a treatment works described in paragraph (1) that is not subject to section 402 of this Act and to which none of the other above listed permit programs nor approved State permit authority apply, the Administrator may issue a permit to such treatment works solely to impose requirements for the use and disposal of sludge that implement the regulations established pursuant to subsection (d) of this section. The Administrator shall include in the permit appropriate requirements to assure compliance with the regulations established pursuant to subsection (d) of this section. The Administrator shall establish procedures for issuing permits pursuant to this paragraph.

(g) STUDIES AND PROJECTS.—

(1) GRANT PROGRAM; INFORMATION GATHERING.—The Administrator is authorized to conduct or initiate scientific studies, demonstration projects, and public information and education projects which are designed to promote the safe and beneficial management or use of sewage sludge for such purposes as aiding the restoration of abandoned mine sites, conditioning soil for parks and recreation areas, agricultural and horticultural uses, and other beneficial purposes. For the purposes of carrying out this subsection, the Administrator may make grants to State water pollution control agencies, other public or nonprofit agencies, institutions, organizations, and individuals. In cooperation with other Federal departments and agencies, other public and private agencies, institutions, and organizations, the Administrator is authorized to collect and disseminate information pertaining to the safe and beneficial use of sewage sludge.

(2) AUTHORIZATION OF APPROPRIATIONS.—For the purposes of carrying out the scientific studies, demonstration projects, and public information and education projects authorized in this section, there is authorized to be appropriated for fiscal years beginning after September 30, 1986, not to exceed $5,000,000.

(33 U.S.C. 1345)

SEC. 406. COASTAL RECREATION WATER QUALITY MONITORING AND NOTIFICATION.

(a) MONITORING AND NOTIFICATION.—

(1) IN GENERAL.—Not later than 18 months after the date of the enactment of this section, after consultation and in cooperation with appropriate Federal, State, tribal, and local officials (including local health officials), and after providing public notice and an opportunity for comment, the Administrator shall publish performance criteria for—

(A) monitoring and assessment (including specifying available methods for monitoring) of coastal recreation wa-

ters adjacent to beaches or similar points of access that are used by the public for attainment of applicable water quality standards for pathogens and pathogen indicators; and

(B) the prompt notification of the public, local governments, and the Administrator of any exceeding of or likelihood of exceeding applicable water quality standards for coastal recreation waters described in subparagraph (A).

(2) LEVEL OF PROTECTION.—The performance criteria referred to in paragraph (1) shall provide that the activities described in subparagraphs (A) and (B) of that paragraph shall be carried out as necessary for the protection of public health and safety.

(b) PROGRAM DEVELOPMENT AND IMPLEMENTATION GRANTS.—

(1) IN GENERAL.—The Administrator may make grants to States and local governments to develop and implement programs for monitoring and notification for coastal recreation waters adjacent to beaches or similar points of access that are used by the public.

(2) LIMITATIONS.—

(A) IN GENERAL.—The Administrator may award a grant to a State or a local government to implement a monitoring and notification program if—

(i) the program is consistent with the performance criteria published by the Administrator under subsection (a);

(ii) the State or local government prioritizes the use of grant funds for particular coastal recreation waters based on the use of the water and the risk to human health presented by pathogens or pathogen indicators;

(iii) the State or local government makes available to the Administrator the factors used to prioritize the use of funds under clause (ii);

(iv) the State or local government provides a list of discrete areas of coastal recreation waters that are subject to the program for monitoring and notification for which the grant is provided that specifies any coastal recreation waters for which fiscal constraints will prevent consistency with the performance criteria under subsection (a); and

(v) the public is provided an opportunity to review the program through a process that provides for public notice and an opportunity for comment.

(B) GRANTS TO LOCAL GOVERNMENTS.—The Administrator may make a grant to a local government under this subsection for implementation of a monitoring and notification program only if, after the 1-year period beginning on the date of publication of performance criteria under subsection (a)(1), the Administrator determines that the State is not implementing a program that meets the requirements of this subsection, regardless of whether the State has received a grant under this subsection.

(3) OTHER REQUIREMENTS.—

(A) REPORT.—A State recipient of a grant under this subsection shall submit to the Administrator, in such for-

mat and at such intervals as the Administrator determines to be appropriate, a report that describes—

(i) data collected as part of the program for monitoring and notification as described in subsection (c); and

(ii) actions taken to notify the public when water quality standards are exceeded.

(B) DELEGATION.—A State recipient of a grant under this subsection shall identify each local government to which the State has delegated or intends to delegate responsibility for implementing a monitoring and notification program consistent with the performance criteria published under subsection (a) (including any coastal recreation waters for which the authority to implement a monitoring and notification program would be subject to the delegation).

(4) FEDERAL SHARE.—

(A) IN GENERAL.—The Administrator, through grants awarded under this section, may pay up to 100 percent of the costs of developing and implementing a program for monitoring and notification under this subsection.

(B) NON-FEDERAL SHARE.—The non-Federal share of the costs of developing and implementing a monitoring and notification program may be—

(i) in an amount not to exceed 50 percent, as determined by the Administrator in consultation with State, tribal, and local government representatives; and

(ii) provided in cash or in kind.

(c) CONTENT OF STATE AND LOCAL GOVERNMENT PROGRAMS.—As a condition of receipt of a grant under subsection (b), a State or local government program for monitoring and notification under this section shall identify—

(1) lists of coastal recreation waters in the State, including coastal recreation waters adjacent to beaches or similar points of access that are used by the public;

(2) in the case of a State program for monitoring and notification, the process by which the State may delegate to local governments responsibility for implementing the monitoring and notification program;

(3) the frequency and location of monitoring and assessment of coastal recreation waters based on—

(A) the periods of recreational use of the waters;

(B) the nature and extent of use during certain periods;

(C) the proximity of the waters to known point sources and nonpoint sources of pollution; and

(D) any effect of storm events on the waters;

(4)(A) the methods to be used for detecting levels of pathogens and pathogen indicators that are harmful to human health; and

(B) the assessment procedures for identifying short-term increases in pathogens and pathogen indicators that are harmful to human health in coastal recreation waters (including increases in relation to storm events);

(5) measures for prompt communication of the occurrence, nature, location, pollutants involved, and extent of any exceeding of, or likelihood of exceeding, applicable water quality standards for pathogens and pathogen indicators to—

(A) the Administrator, in such form as the Administrator determines to be appropriate; and

(B) a designated official of a local government having jurisdiction over land adjoining the coastal recreation waters for which the failure to meet applicable standards is identified;

(6) measures for the posting of signs at beaches or similar points of access, or functionally equivalent communication measures that are sufficient to give notice to the public that the coastal recreation waters are not meeting or are not expected to meet applicable water quality standards for pathogens and pathogen indicators; and

(7) measures that inform the public of the potential risks associated with water contact activities in the coastal recreation waters that do not meet applicable water quality standards.

(d) FEDERAL AGENCY PROGRAMS.—Not later than 3 years after the date of the enactment of this section, each Federal agency that has jurisdiction over coastal recreation waters adjacent to beaches or similar points of access that are used by the public shall develop and implement, through a process that provides for public notice and an opportunity for comment, a monitoring and notification program for the coastal recreation waters that—

(1) protects the public health and safety;

(2) is consistent with the performance criteria published under subsection (a);

(3) includes a completed report on the information specified in subsection (b)(3)(A), to be submitted to the Administrator; and

(4) addresses the matters specified in subsection (c) .

(e) DATABASE.—The Administrator shall establish, maintain, and make available to the public by electronic and other means a national coastal recreation water pollution occurrence database that provides—

(1) the data reported to the Administrator under subsections (b)(3)(A)(i) and (d)(3); and

(2) other information concerning pathogens and pathogen indicators in coastal recreation waters that—

(A) is made available to the Administrator by a State or local government, from a coastal water quality monitoring program of the State or local government; and

(B) the Administrator determines should be included.

(f) TECHNICAL ASSISTANCE FOR MONITORING FLOATABLE MATERIAL.—The Administrator shall provide technical assistance to States and local governments for the development of assessment and monitoring procedures for floatable material to protect public health and safety in coastal recreation waters.

(g) LIST OF WATERS.—

(1) IN GENERAL.—Beginning not later than 18 months after the date of publication of performance criteria under subsection (a), based on information made available to the Administrator,

the Administrator shall identify, and maintain a list of, discrete coastal recreation waters adjacent to beaches or similar points of access that are used by the public that—

(A) specifies any waters described in this paragraph that are subject to a monitoring and notification program consistent with the performance criteria established under subsection (a); and

(B) specifies any waters described in this paragraph for which there is no monitoring and notification program (including waters for which fiscal constraints will prevent the State or the Administrator from performing monitoring and notification consistent with the performance criteria established under subsection (a)).

(2) AVAILABILITY.—The Administrator shall make the list described in paragraph (1) available to the public through—

(A) publication in the Federal Register; and

(B) electronic media.

(3) UPDATES.—The Administrator shall update the list described in paragraph (1) periodically as new information becomes available.

(h) EPA IMPLEMENTATION.—In the case of a State that has no program for monitoring and notification that is consistent with the performance criteria published under subsection (a) after the last day of the 3-year period beginning on the date on which the Administrator lists waters in the State under subsection (g)(1)(B), the Administrator shall conduct a monitoring and notification program for the listed waters based on a priority ranking established by the Administrator using funds appropriated for grants under subsection (i)—

(1) to conduct monitoring and notification; and

(2) for related salaries, expenses, and travel.

(i) AUTHORIZATION OF APPROPRIATIONS.—There is authorized to be appropriated for making grants under subsection (b), including implementation of monitoring and notification programs by the Administrator under subsection (h), $30,000,000 for each of fiscal years 2001 through 2005.

(33 U.S.C. 1346)

TITLE V—GENERAL PROVISIONS

ADMINISTRATION

SEC. 501. (a) The Administrator is authorized to prescribe such regulations as are necessary to carry out his functions under this Act.

(b) The Administrator, with the consent of the head of any other agency of the United States, may utilize such officers and employees of such agency as may be found necessary to assist in carrying out the purposes of this Act.

(c) Each recipient of financial assistance under this Act shall keep such records as the Administrator shall prescribe, including records which fully disclose the amount and disposition by such recipient of the proceeds of such assistance, the total cost of the project or undertaking in connection with which such assistance is given or used, and the amount of that portion of the cost of the

project or undertaking supplied by other sources, and such other records as will facilitate an effective audit.

(d) The Administrator and the Comptroller General of the United States, or any of their duly authorized representatives, shall have access, for the purpose of audit and examination, to any books, documents, papers, and records of the recipients that are pertinent to the grants received under this Act. For the purpose of carrying out audits and examinations with respect to recipients of Federal assistance under this Act, the Administrator is authorized to enter into noncompetitive procurement contracts with independent State audit organizations, consistent with chapter 75 of title 31, United States Code. Such contracts may only be entered into to the extent and in such amounts as may be provided in advance in appropriation Acts.

(e)(1) It is the purpose of this subsection to authorize a program which will provide official recognition by the United States Government to those industrial organizations and political subdivisions of States which during the preceding year demonstrated an outstanding technological achievement or an innovative process, method, or device in their waste treatment and pollution abatement programs. The Administrator shall, in consultation with the appropriate State water pollution control agencies, establish regulations under which such recognition may be applied for and granted, except that no applicant shall be eligible for an award under this subsection if such applicant is not in total compliance with all applicable water quality requirements under this Act, or otherwise does not have a satisfactory record with respect to environmental quality.

(2) The Administrator shall award a certificate or plaque of suitable design to each industrial organization or political subdivision which qualifies for such recognition under regulations established under this subsection.

(3) The President of the United States, the Governor of the appropriate State, the Speaker of the House of Representatives, and the President pro tempore of the Senate shall be notified of the award by the Administrator and the awarding of such recognition shall be published in the Federal Register.

(f) Upon the request of a State water pollution control agency, personnel of the Environmental Protection Agency may be detailed to such agency for the purpose of carrying out the provisions of this Act.

(33 U.S.C. 1361)

GENERAL DEFINITIONS

SEC. 502. Except as otherwise specifically provided, when used in this Act:

(1) The term "State water pollution control agency" means the State agency designated by the Governor having responsibility for enforcing State laws relating to the abatement of pollution.

(2) The term "interstate agency" means an agency of two or more States established by or pursuant to an agreement or compact approved by the Congress, or any other agency of two or more States, having substantial powers or duties pertaining to the control of pollution as determined and approved by the Adminstrator.

(3) The term "State" means a State, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, the Commonwealth of the Northern Mariana Islands, and the Trust Territory of the Pacific Islands.

(4) The term "municipality" means a city, town, borough, county, parish, district, association, or other public body created by or pursuant to State law and having jurisdiction over disposal of sewage, industrial wastes, or other wastes, or an Indian tribe or an authorized Indian tribal organization, or a designated and approved management agency under section 208 of this Act.

(5) The term "person" means an individual, corporation, partnership, association, State, municipality, commission, or political subdivision of a State, or any interstate body.

(6) The term "pollutant" means dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water. This term does not mean (A) "sewage from vessels or a discharge incidental to the normal operation of a vessel of the Armed Forces" within the meaning of section 312 of this Act; or (B) water, gas, or other material which is injected into a well to facilitate production of oil or gas, or water derived in association with oil or gas production and disposed of in a well, if the well used either to facilitate production or for disposal purpose is approved by authority of the State in which the well is located, and if such State determines that such injection or disposal will not result in the degradation of ground or surface water resources.

(7) The term "navigable waters" means the waters of the United States, including the territorial seas.

(8) The term "territorial seas" means the belt of the seas measured from the line of ordinary low water along that portion of the coast which is in direct contact with the open sea and the line marking the seaward limit of inland waters, and extending seaward a distance of three miles.

(9) The term "contiguous zone" means the entire zone established or to be established by the United States under article 24 of the Convention of the Territorial Sea and the Contiguous Zone.

(10) The term "ocean" means any portion of the high seas beyond the contiguous zone.

(11) The term "effluent limitation" means any restriction established by a State or the Administrator on quantities, rates, and concentrations of chemical, physical, biological, and other constituents which are discharged from point sources into navigable waters, the waters of the contiguous zone, or the ocean, including schedules of compliance.

(12) The term "discharge of a pollutant" and the term "discharge of pollutants" each means (A) any addition of any pollutant to navigable waters from any point source, (B) any addition of any pollutant to the waters of the contiguous zone or the ocean from any point source other than a vessel or other floating craft.

(13) The term "toxic pollutant" means those pollutants, or combinations of pollutants, including disease-causing agents, which after discharge and upon exposure, ingestion, inhalation or assimilation into any organism, either directly from the environment or

indirectly by ingestion through food chains, will, on the basis of information available to the Administrator, cause death, disease, behavioral abnormalities, cancer, genetic mutations, physiological malfunctions (including malfunctions in reproduction) or physical deformations, in such organisms or their offspring.

(14) The term "point source" means any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural stormwater discharges and return flows from irrigated agriculture.

(15) The term "biological monitoring" shall mean the determination of the effects on aquatic life, including accumulation of pollutants in tissue, in receiving waters due to the discharge of pollutants (A) by techniques and procedures, including sampling of organisms representative of appropriate levels of the food chain appropriate to the volume and the physical, chemical, and biological characteristics of the effluent, and (B) at appropriate frequencies and locations.

(16) The term "discharge" when used without qualification includes a discharge of a pollutant, and a discharge of pollutants.

(17) The term "schedule of compliance" means a schedule of remedial measures including an enforceable sequence of actions or operations leading to compliance with an effluent limitation, other limitation, prohibition, or standard.

(18) The term "industrial user" means those industries identified in the Standard Industrial Classification Manual, Bureau of the Budget, 1967, as amended and supplemented, under the category "Division D—Manufacturing" and such other classes of significant waste producers as, by regulation, the Administrator deems appropriate.

(19) The term "pollution" means the man-made or man-induced alteration of the chemical, physical, biological, and radiological integrity of water.

(20) The term "medical waste" means isolation wastes; infectious agents; human blood and blood products; pathological wastes; sharps; body parts; contaminated bedding; surgical wastes and potentially contaminated laboratory wastes; dialysis wastes; and such additional medical items as the Administrator shall prescribe by regulation.

(21) COASTAL RECREATION WATERS.—

(A) IN GENERAL.—The term "coastal recreation waters" means—

(i) the Great Lakes; and

(ii) marine coastal waters (including coastal estuaries) that are designated under section 303(c) by a State for use for swimming, bathing, surfing, or similar water contact activities.

(B) EXCLUSIONS.—The term "coastal recreation waters" does not include—

(i) inland waters; or

(ii) waters upstream of the mouth of a river or stream having an unimpaired natural connection with the open sea.

(22) FLOATABLE MATERIAL.—

(A) IN GENERAL.—The term "floatable material" means any foreign matter that may float or remain suspended in the water column.

(B) INCLUSIONS.—The term "floatable material" includes—

(i) plastic;
(ii) aluminum cans;
(iii) wood products;
(iv) bottles; and
(v) paper products.

(23) PATHOGEN INDICATOR.—The term "pathogen indicator" means a substance that indicates the potential for human infectious disease.

(33 U.S.C. 1362)

WATER POLLUTION CONTROL ADVISORY BOARD

SEC. 503. (a)(1) There is hereby established in the Environmental Protection Agency a Water Pollution Control Advisory Board, composed of the Administrator or his designee, who shall be Chairman, and nine members appointed by the President, none of whom shall be Federal officers or employees. The appointed members, having due regard for the purposes of this Act, shall be selected from among representatives of various State, interstate, and local governmental agencies, of public or private interests contributing to, affected by, or concerned with pollution, and of other public and private agencies, organizations, or groups demonstrating an active interest in the field of pollution prevention and control, as well as other individuals who are expert in this field.

(2)(A) Each member appointed by the President shall hold office for a term of three years, except that (i) any member appointed to fill a vacancy occurring prior to the expiration of the term for which his predecessor was appointed shall be appointed for the remainder of such term, and (ii) the terms of office of the members first taking office after June 30, 1956, shall expire as follows: three at the end of one year after such date, three at the end of two years after such date, and three at the end of three years after such date, as designated by the President at the time of appointment, and (iii) the term of any member under the preceding provisions shall be extended until the date on which his successor's appointment is effective. None of the members appointed by the President shall be eligible for reappointment within one year after the end of his preceding term.

(B) The members of the Board who are not officers or employees of the United States, while attending conferences or meetings of the Board or while otherwise serving at the request of the Administrator, shall be entitled to receive compensation at a rate to be fixed by the Administrator, but not exceeding $100 per diem, including traveltime, and while away from their homes or regular places of business they may be allowed travel expenses, including per diem in lieu of subsistence, as authorized by law (5 U.S.C. 73b–2) for persons in the Government service employed intermittently.

(b) The Board shall advise, consult with, and make recommendations to the Administrator on matters of policy relating to the activities and functions of the Administrator under this Act.

(c) Such clerical and technical assistance as may be necessary to discharge the duties of the Board shall be provided from the personnel of the Environmental Protection Agency.

(33 U.S.C. 1363)

EMERGENCY POWERS

SEC. 504. (a) Notwithstanding any other provision of this Act, the Administrator upon receipt of evidence that a pollution source or combination of sources is presenting an imminent and substantial endangerment to the health of persons or to the welfare of persons where such endangerment is to the livelihood of such persons, such as inability to market shellfish, may bring suit on behalf of the United States in the appropriate district court to immediately restrain any person causing or contributing to the alleged pollution to stop the discharge of pollutants causing or contributing to such pollution or to take such other action as may be necessary.

[Subsection (b) repealed by §304(a) of P.L. 96–510, Dec. 11, 1980, 94 Stat. 2809]

(33 U.S.C. 1364)

CITIZEN SUITS

SEC. 505. (a) Except as provided in subsection (b) of this section and section 309(g)(6), any citizen may commence a civil action on his own behalf—

(1) against any person (including (i) the United States, and (ii) any other governmental instrumentality or agency to the extent permitted by the eleventh amendment to the Constitution) who is alleged to be in violation of (A) an effluent standard or limitation under this Act or (B) an order issued by the Administrator or a State with respect to such a standard or limitation, or

(2) against the Administrator where there is alleged a failure of the Administrator to perform any act or duty under this Act which is not discretionary with the Administrator.

The district courts shall have jurisdiction, without regard to the amount in controversy or the citizenship of the parties, to enforce such an effluent standard or limitation, or such an order, or to order the Administrator to perform such act or duty, as the case may be, and to apply any appropriate civil penalties under section 309(d) of this Act.

(b) No action may be commenced—

(1) under subsection (a)(1) of this section—

(A) prior to sixty days after the plaintiff has given notice of the alleged violation (i) to the Administrator, (ii) to the State in which the alleged violation occurs, and (iii) to any alleged violator of the standard, limitation, or order, or

(B) if the Administrator or State has commenced and is diligently prosecuting a civil or criminal action in a court of the United States, or a State to require compliance with the standard, limitation, or order, but in any such ac-

tion in a court of the United States any citizen may intervene as a matter of right.

(2) under subsection (a)(2) of this section prior to sixty days after the plaintiff has given notice of such action to the Administrator,

except that such action may be brought immediately after such notification in the case of an action under this section respecting a violation of sections 306 and 307(a) of this Act. Notice under this subsection shall be given in such manner as the Administrator shall prescribe by regulation.

(c)(1) Any action respecting a violation by a discharge source of an effluent standard or limitation or an order respecting such standard or limitation may be brought under this section only in the judicial district in which such source is located.

(2) In such action under this section, the Administrator, if not a party, may intervene as a matter of right.

(3) PROTECTION OF INTERESTS OF UNITED STATES.—Whenever any action is brought under this section in a court of the United States, the plaintiff shall serve a copy of the complaint on the Attorney General and the Administrator. No consent judgment shall be entered in an action in which the United States is not a party prior to 45 days following the receipt of a copy of the proposed consent judgment by the Attorney General and the Administrator.

(d) The court, in issuing any final order in any action brought pursuant to this section, may award costs of litigation (including reasonable attorney and expert witness fees) to any prevailing or substantially prevailing party, whenever the court determines such award is appropriate. The court may, if a temporary restraining order or preliminary injunction is sought, require the filing of a bond or equivalent security in accordance with the Federal Rules of Civil Procedure.

(e) Nothing in this section shall restrict any right which any person (or class of persons) may have under any statute or common law to seek enforcement of any effluent standard or limitation or to seek any other relief (including relief against the Administrator or a State agency).

(f) For purposes of this section, the term "effluent standard or limitation under this Act" means (1) effective July 1, 1973, an unlawful act under subsection (a) of section 301 of this Act; (2) an effluent limitation or other limitation under section 301 or 302 of this Act; (3) standard or performance under section 306 of this Act; (4) prohibition, effluent standard or pretreatment standards under section 307 of this Act; (5) certification under section 401 of this Act; (6) a permit or condition thereof issued under section 402 of this Act, which is in effect under this Act (including a requirement applicable by reason of section 313 of this Act); or (7) a regulation under section 405(d) of this Act,.[1]

(g) For the purposes of this section the term "citizen" means a person or persons having an interest which is or may be adversely affected.

(h) A Governor of a State may commence a civil action under subsection (a), without regard to the limitations of subsection (b) of

[1] So in law. See P.L. 100–4, sec. 406(d)(2), 101 Stat. 73.

this section, against the Administrator where there is alleged a failure of the Administrator to enforce an effluent standard or limitation under this Act the violation of which is occurring in another State and is causing an adverse effect on the public health or welfare in his State, or is causing a violation of any water quality requirement in his State.

(33 U.S.C. 1365)

APPEARANCE

SEC. 506. The Administrator shall request the Attorney General to appear and represent the United States in any civil or criminal action instituted under this Act to which the Administrator is a party. Unless the Attorney General notifies the Administrator within a reasonable time, that he will appear in a civil action, attorneys who are officers or employees of the Environmental Protection Agency shall appear and represent the United States in such action.

(33 U.S.C. 1366)

EMPLOYEE PROTECTION

SEC. 507. (a) No person shall fire, or in any other way discriminate against, or cause to be fired or discriminated against, any employee or any authorized representative or employees by reason of the fact that such employee or representative has filed, instituted, or caused to be filed or instituted any proceeding under this Act, or has testified or is about to testify in any proceeding resulting from the administration or enforcement of the provisions of this Act.

(b) Any employee or a representative of employees who believes that he has been fired or otherwise discriminated against by any person in violation of subsection (a) of this section may, within thirty days after such alleged violation occurs, apply to the Secretary of Labor for a review of such firing or alleged discrimination. A copy of the application shall be sent to such person who shall be the respondent. Upon receipt of such application, the Secretary of Labor shall cause such investigation to be made as he deems appropriate. Such investigation shall provide an opportunity for a public hearing at the request of any party to such review to enable the parties to present information relating to such alleged violation. The parties shall be given written notice of the time and place of the hearing at least five days prior to the hearing. Any such hearing shall be of record and shall be subject to section 554 of title 5 of the United States Code. Upon receiving the report of such investigation, the Secretary of Labor shall make findings of fact. If he finds that such violation did occur, he shall issue a decision, incorporating an order therein and his findings, requiring the party committing such violation to take such affirmative action to abate the violation as the Secretary of Labor deems appropriate, including, but not limited to, the rehiring or reinstatement of the employee or representative of employees to his former position with compensation. If he finds that there was no such violation, he shall issue an order denying the application. Such order issued by the Secretary of Labor under this subparagraph shall be subject to ju-

dicial review in the same manner as orders and decisions of the Administrator are subject to judicial review under this Act.

(c) Whenever an order is issued under this section to abate such violation, at the request of the applicant, a sum equal to the aggregate amount of all costs and expenses (including the attorney's fees), as determined by the Secretary of Labor, to have been reasonably incurred by the applicant for, or in connection with, the institution and prosecution of such proceedings, shall be assessed against the person committing such violation.

(d) This section shall have no application to any employee who, acting without direction from his employer (or his agent) deliberately violates any prohibition of effluent limitation or other limitation under section 301 or 302 of this Act, standards of performance under section 306 of this Act, effluent standard, prohibition or pretreatment standard under section 307 of this Act, or any other prohibition or limitation established under this Act.

(e) The Administrator shall conduct continuing evaluations of potential loss or shifts of employment which may result from the issuance of any effluent limitation or order under this Act, including, where appropriate, investigating threatened plant closures or reductions in employment allegedly resulting from such limitation or order. Any employee who is discharged or laid off, threatened with discharge or lay-off, or otherwise discriminated against by any person because of the alleged results of any effluent limitation or order issued under this Act, or any representative of such employee, may request the Administrator to conduct a full investigation of the matter. The Administrator shall thereupon investigate the matter and, at the request of any party, shall hold public hearings on not less than five days notice, and shall at such hearings require the parties, including the employer involved, to present information relating to the actual or potential effect of such limitation or order on employment and on any alleged discharge, lay-off, or other discrimination and the detailed reasons or justification therefor. Any such hearing shall be of record and shall be subject to section 554 of title 5 of the United States Code. Upon receiving the report of such investigation, the Administrator shall make findings of fact as to the effect of such effluent limitation or order on employment and on the alleged discharge, lay-off, or discrimination and shall make such recommendations as he deems appropriate. Such report, findings, and recommendations shall be available to the public. Nothing in this subsection shall be construed to require or authorize the Administrator to modify or withdraw any effluent limitation or order issued under this Act.

(33 U.S.C. 1367)

FEDERAL PROCUREMENT

SEC. 508. (a) No Federal agency may enter into any contract with any person, who has been convicted of any offense under section 309(c) of this Act, for the procurement of goods, materials, and services if such contract is to be performed at any facility at which the violation which gave rise to such conviction occurred, and if such facility is owned, leased, or supervised by such person. The prohibition in the preceding sentence shall continue until the Ad-

ministrator certifies that the condition giving rise to such conviction has been corrected.

(b) The Administrator shall establish procedures to provide all Federal agencies with the notification necessary for the purposes of subsection (a) of this section.

(c) In order to implement the purposes and policy of this Act to protect and enhance the quality of the Nation's water, the President shall, not more than one hundred and eighty days after enactment of this Act, cause to be issued an order (1) requiring each Federal agency authorized to enter into contracts and each Federal agency which is empowered to extend Federal assistance by way of grant, loan, or contract to effectuate the purpose and policy of this Act in such contracting or assistance activities, and (2) setting forth procedures, sanctions, penalties, and such other provisions, as the President determines necessary to carry out such requirement.

(d) The President may exempt any contract, loan, or grant from all or part of the provisions of this section where he determines such exemption is necessary in the paramount interest of the United States and he shall notify the Congress of such exemption.

(e) The President shall annually report to the Congress on measures taken in compliance with the purpose and intent of this section, including, but not limited to, the progress and problems associated with such compliance.

(f)(1) No certification by a contractor, and no contract clause, may be required in the case of a contract for the acquisition of commercial items in order to implement a prohibition or requirement of this section or a prohibition or requirement issued in the implementation of this section.

(2) In paragraph (1), the term "commercial item" has the meaning given such term in section 4(12) of the Office of Federal Procurement Policy Act (41 U.S.C. 403(12)).

(33 U.S.C. 1368)

ADMINISTRATIVE PROCEDURE AND JUDICIAL REVIEW

SEC. 509. (a)(1) For purposes of obtaining information under section 305 of this Act, or carrying out section 507(e) of this Act, the Administrator may issue subpenas for the attendance and testimony of witnesses and the production of relevant papers, books, and documents, and he may administer oaths. Except for effluent data, upon a showing satisfactory to the Administrator that such papers, books, documents, or information or particular part thereof, if made public, would divulge trade secrets or secret processes, the Administrator shall consider such record, report, or information or particular portion thereof confidential in accordance with the purposes of section 1905 of title 18 of the United States Code, except that such paper, book, document, or information may be disclosed to other officers, employees, or authorized representatives of the United States concerned with carrying out this Act, or when relevant in any proceeding under this Act. Witnesses summoned shall be paid the same fees and mileage that are paid witnesses in the courts of the United States. In case of contumacy or refusal to obey a subpena served upon any person under this subsection, the district court of the United States for any district in which such per-

son is found or resides or transacts business, upon application by the United States and after notice to such person, shall have jurisdiction to issue an order requiring such person to appear and give testimony before the Administrator, to appear and produce papers, books, and documents before the Administrator, or both, and any failure to obey such order of the court may be punished by such court as a contempt thereof.

(2) The district courts of the United States are authorized, upon application by the Administrator, to issue subpenas for attendance and testimony of witnesses and the production of relevant papers, books, and documents, for purposes of obtaining information under sections 304 (b) and (c) of this Act. Any papers, books, documents, or other information or part thereof, obtained by reason of such a subpena shall be subject to the same requirements as are provided in paragraph (1) of this subsection.

(b)(1) Review of the Administrator's action (A) in promulgating any standard of performance under section 306, (B) in making any determination pursuant to section 306(b)(1)(C), (C) in promulgating any effluent standard, prohibition, or pretreatment standard under section 307, (D) in making any determination as to a State permit program submitted under section 402(b), (E) in approving or promulgating any effluent limitation or other limitation under sections 301, 302, 306, or 405, (F) in issuing or denying any permit under section 402, and (G) in promulgating any individual control strategy under section 304(l), may be had by any interested person in the Circuit Court of Appeals of the United States for the Federal judicial district in which such person resides or transacts business which is directly affected by such action upon application by such person. Any such application shall be made within 120 days from the date of such determination, approval, promulgation, issuance or denial, or after such date only if such application is based solely on grounds which arose after such 120th day.

(2) Action of the Administrator with respect to which review could have been obtained under paragraph (1) of this subsection shall not be subject to judicial review in any civil or criminal proceeding for enforcement.

(3) AWARD OF FEES.—In any judicial proceeding under this subsection, the court may award costs of litigation (including reasonable attorney and expert witness fees) to any prevailing or substantially prevailing party whenever it determines that such award is appropriate.

(c) In any judicial proceeding brought under subsection (b) of this section in which review is sought of a determination under this Act required to be made on the record after notice and opportunity for hearing, if any party applies to the court for leave to adduce additional evidence, and shows to the satisfaction of the court that such additional evidence is material and that there were reasonable grounds for the failure to adduce such evidence in the proceeding before the Administrator, the court may order such additional evidence (and evidence in rebuttal thereof) to be taken before the Administrator, in such manner and upon such terms and conditions as the court may deem proper. The Administrator may modify his findings as to the facts, or make new findings, by reason of the additional evidence so taken and he shall file such modified or new findings, and his recommendation, if any, for the modification or

setting aside of his original determination with the return of such additional evidence.

(33 U.S.C. 1369)

STATE AUTHORITY

SEC. 510. Except as expressly provided in this Act, nothing in this Act shall (1) preclude or deny the right of any State or political subdivision thereof or interstate agency to adopt or enforce (A) any standard or limitation respecting discharges of pollutants, or (B) any requirement respecting control or abatement of pollution; except that if an effluent limitation, or other limitation, effluent standard, prohibition, pretreatment standard, or standard of performance is in effect under this Act, such State or political subdivision or interstate agency may not adopt or enforce any effluent limitation, or other limitation, effluent standard, prohibition, pretreatment standard, or standard of performance which is less stringent than the effluent limitation, or other limitation, effluent standard prohibition, pretreatment standard, or standard of performance under this Act; or (2) be construed as impairing or in any manner affecting any right or jurisdiction of the States with respect to the waters (including boundary waters) of such States.

(33 U.S.C. 1370)

OTHER AFFECTED AUTHORITY

SEC. 511. (a) This Act shall not be construed as (1) limiting the authority or functions of any officer or agency of the United States under any other law or regulation not inconsistent with this Act; (2) affecting or impairing the authority of the Secretary of the Army (A) to maintain navigation or (B) under the Act of March 3, 1899 (30 Stat. 1112); except that any permit issued under section 404 of this Act shall be conclusive as to the effect on water quality of any discharge resulting from any activity subject to section 10 of the Act of March 3, 1899, or (3) affecting or impairing the provisions of any treaty of the United States.

(b) Discharges of pollutants into the navigable waters subject to the Rivers and Harbors Act of 1910 (36 Stat. 593; 33 U.S.C. 421) and the Supervisory Harbors, Act of 1888 (25 Stat. 209; 33 U.S.C. 441–451b) shall be regulated pursuant to this Act, and not subject to such Act of 1910 and the Act of 1888 except as to effect on navigation and anchorage.

(c)(1) Except for the provision of Federal financial assistance for the purpose of assisting the construction of publicly owned treatment works as authorized by section 201 of this Act, and the issuance of a permit under section 402 of this Act for the discharge of any pollutant by a new source as defined in section 306 of this Act, no action of the Administrator taken pursuant to this Act shall be deemed a major Federal action significantly affecting the quality of the human environment within the meaning of the National Environmental Policy Act of 1969 (83 Stat. 852); and

(2) Nothing in the National Environmental Policy Act of 1969 (83 Stat. 852) shall be deemed to—

(A) authorize any Federal agency authorized to license or permit the conduct of any activity which may result in the discharge of a pollutant into the navigable waters to review any

effluent limitation or other requirement established pursuant to this Act or the adequacy of any certification under section 401 of ths Act; or

(B) authorize any such agency to impose, as a condition precedent to the issuance of any license or permit, any effluent limitation other than any such limitation established pursuant to this Act.

(d) Notwithstanding this Act or any other provisions of law, the Administrator (1) shall not require any State to consider in the development of the ranking in order of priority of needs for the construction of treatment works (as defined in title II of this Act), any water pollution control agreement which may have been entered into between the United States and any other nation, and (2) shall not consider any such agreement in the approval of any such priority ranking.

(33 U.S.C. 1371)

SEPARABILITY

SEC. 512. If any provision of this Act, or the application of any provision of this Act to any person or circumstance, is held invalid, the application of such provision to other persons or circumstances, and the remainder of this Act shall not be affected thereby.

(33 U.S.C. 1251 note)

LABOR STANDARDS

SEC. 513. The Administrator shall take such action as may be necessary to insure that all laborers and mechanics employed by contractors or subcontractors on treatment works for which grants are made under this Act shall be paid wages at rates not less than those prevailing for the same type of work on similar construction in the immediate locality, as determied by the Secretry of Labor, in accordance with the Act of March 3, 1931, as amended, known as the Davis-Bacon Act (46 Stat. 1494; 40 U.S.C., sec. 276a through 276a–5). The Secretary of Labor shall have, with respect to the labor standards specified in this subsection, the authority and functions set forth in Reorganization Plan Numbered 14 of 1950 (15 F.R. 3176) and section 2 of the Act of June 13, 1934, as amended (48 Stat. 948; 40 U.S.C. 276c).

(33 U.S.C. 1372)

PUBLIC HEALTH AGENCY COORDINATION

SEC. 514. The permitting agency under section 402 shall assist the applicant for a permit under such section in coordinating the requirements of this Act with those of the appropriate public health agencies.

(33 U.S.C. 1373)

EFFLUENT STANDARDS AND WATER QUALITY INFORMATION ADVISORY COMMITTEE

SEC. 515. (a)(1) There is established on Effluent Standards and Water Quality Information Advisory Committee, which shall be composed of a Chairman and eight members who shall be ap-

pointed by the Administrator within sixty days after the date of enactment of this Act.

(2) All members of the Committee shall be selected from the scientific community, qualified by education, training, and experience to provide assess, and evaluate scientific and technical information on effluent standards and limitations.

(3) Members of the Committee shall serve for a term of four years, and may be reappointed.

(b)(1) No later than one hundred and eighty days prior to the date on which the Administrator is required to publish any proposed regulations required by section 304(b) of this Act, any proposed standard of performance for new sources required by section 306 of this Act, or any proposed toxic effluent standard required by section 307 of this Act, he shall transmit to the Committee a notice of intent to propose such regulations. The Chairman of the Committee within ten days after receipt of such notice may publish a notice of a public hearing by the Committee, to be held within thirty days.

(2) No later than one hundred and twenty days after receipt of such notice, the Committee shall transmit to the Administrator such scientific and technical information as is in its possession, including that presented at any public hearing, related to the subject matter contained in such notice.

(3) Information so transmitted to the Administrator shall constitute a part of the administrative record and comments on any proposed regulations or standards as information to be considered with other comments and information in making any final determinations.

(4) In preparing information for transmittal, the Committee shall avail itself of the technical and scientific services of any Federal agency, including the United States Geological Survey and any national environmental laboratories which may be established.

(c)(1) The Committee shall appoint and prescribe the duties of a Secretary, and such legal counsel as it deems necessary. The Committee shall appoint such other employees as it deems necessary to exercise and fulfill its powers and responsibilities. The compensation of all employees appointed by the Committee shall be fixed in accordance with chapter 51 and subchapter III of chapter 53 of title V of the United States Code.

(2) Members of the Committee shall be entitled to receive compensation at a rate to be fixed by the President but not in excess of the maximum rate of pay grade for GS–18, as provided in the General Schedule under section 5332 of title V of the United States Code.

(d) Five members of the Committee shall constitute a quorum, and official actions of the Committee shall be taken only on the affirmative vote of at least five members. A special panel composed of one or more members upon order of the Committee shall conduct any hearing authorized by this section and submit the transcript of such hearing to the entire Committee for its action thereon.

(e) The Committee is authorized to make such rules as are necessary for the orderly transaction of its business.

(33 U.S.C. 1374)

REPORTS TO CONGRESS

SEC. 516. The Administrator, in cooperation with the States, including water pollution control agencies and other water pollution control planning agencies, shall make (1) a detailed estimate of the cost of carrying out the provisions of this Act; (2) a detailed estimate, biennially revised, of the cost of construction of all needed publicly owned treatment works in all of the States and of the cost of construction of all needed publicly owned treatment works in each of the States; (3) a comprehensive study of the economic impact on affected units of government of the cost of installation of treatment facilities; and (4) a comprehensive analysis of the national requirements for and the cost of treating municipal, industrial, and other effluent to attain the water quality objectives as established by this Act or applicable State law. The Administrator shall submit such detailed estimate and such comprehensive study of such cost to the Congress no later than February 10 of each odd-numbered year. Whenever the Administrator, pursuant to this subsection, requests and receives an estimate of cost from a State, he shall furnish copies of such estimate together with such detailed estimate to Congress.

(33 U.S.C. 1375)

GENERAL AUTHORIZATION

SEC. 517. There are authorized to be appropriated to carry out this Act, other than sections 104, 105, 106(a), 107, 108, 112, 113, 114, 115, 206, 207, 208 (f) and (h), 209, 304, 311 (c), (d), (i), (l), and (k), 314, 315, and 317, $250,000,000 for the fiscal year ending June 30, 1973, $300,000,000 for the fiscal year ending June 30, 1974, $350,000,000 for the fiscal year ending June 30, 1975, $100,000,000 for the fiscal year ending September 30, 1977, $150,000,000 for the fiscal year ending September 30, 1978, $150,000,000 for the fiscal year ending September 30, 1979, $150,000,000 for the fiscal year ending September 30, 1980, $150,000,000 for the fiscal year ending September 30, 1981, $161,000,000 for the fiscal year ending September 30, 1982, such sums as may be necessary for fiscal years 1983 through 1985, and $135,000,000 per fiscal year for each of the fiscal years 1986 through 1990.

(33 U.S.C. 1376)

SEC. 518. INDIAN TRIBES.

(a) POLICY.—Nothing in this section shall be construed to affect the application of section 101(g) of this Act, and all of the provisions of this section shall be carried out in accordance with the provisions of such section 101(g). Indian tribes shall be treated as States for purposes of such section 101(g).

(b) ASSESSMENT OF SEWAGE TREATMENT NEEDS; REPORT.—The Administrator, in cooperation with the Director of the Indian Health Service, shall assess the need for sewage treatment works to serve Indian tribes, the degree to which such needs will be met through funds allotted to States under section 205 of this Act and priority lists under section 216 of this Act, and any obstacles which prevent such needs from being met. Not later than one year after the date of the enactment of this section, the Administrator shall submit a report to Congress on the assessment under this sub-

section, along with recommendations specifying (1) how the Administrator intends to provide assistance to Indian tribes to develop waste treatment management plans and to construct treatment works under this Act, and (2) methods by which the participation in and administration of programs under this Act by Indian tribes can be maximized.

(c) RESERVATION OF FUNDS.—The Administrator shall reserve each fiscal year beginning after September 30, 1986, before allotments to the States under section 205(e), one-half of one percent of the sums appropriated under section 207. Sums reserved under this subsection shall be available only for grants for the develoment of waste treatment management plans and for the construction of sewage treatment works to serve Indian tribes, as defined in subsection (h) and former Indian reservations in Oklahoma (as determined by the Secretary of the Interior) and Alaska Native Villages as defined in Public Law 92–203.

(d) COOPERATIVE AGREEMENTS.—In order to ensure the consistent implementation of the requirements of this Act, an Indian tribe and the State or States in which the lands of such tribe are located may enter into a cooperative agreement, subject to the review and approval of the Administrator, to jointly plan and administer the requirements of this Act.

(e) TREATMENT AS STATES.—The Administrator is authorized to treat an Indian tribe as a State for purposes of title II and sections 104, 106, 303, 305, 308, 309, 314, 319, 401, 402, 404, and 406 of this Act to the degree necessary to carry out the objectives of this section, but only if—

(1) the Indian tribe has a governing body carrying out substantial governmental duties and powers;

(2) the functions to be exercised by the Indian tribe pertain to the management and protection of water resources which are held by an Indian tribe, held by the United States in trust for Indians, held by a member of an Indian tribe if such property interest is subject to a trust restriction on alienation, or otherwise within the borders of an Indian reservation; and

(3) the Indian tribe is reasonably expected to be capable, in the Administrator's judgment, of carrying out the functions to be exercised in a manner consistent with the terms and purposes of this Act and of all applicable regulations.

Such treatment as a State may include the direct provision of funds reserved under subsection (c) to the governing bodies of Indian tribes, and the determination of priorities by Indian tribes, where not determined by the Administrator in cooperation with the Director of the Indian Health Service. The Administrator, in cooperation with the Director of the Indian Health Service, is authorized to make grants under title II of this Act in an amount not to exceed 100 percent of the cost of a project. Not later than 18 months after the date of the enactment of this section, the Administrator shall, in consultation with Indian tribes, promulgate final regulations which specify how Indian tribes shall be treated as States for purposes of this Act. The Administrator shall, in promulgating such regulations, consult affected States sharing common water bodies and provide a mechanism for the resolution of any unreasonable consequences that may arise as a result of differing water quality standards that may be set by States and Indian

tribes located on common bodies of water. Such mechanism shall provide for explicit consideration of relevant factors including, but not limited to, the effects of differing water quality permit requirements on upstream and downstream dischargers, economic impacts, and present and historical uses and quality of the waters subject to such standards. Such mechanism should provide for the avoidance of such unreasonable consequences in a manner consistent with the objective of this Act.

(f) GRANTS FOR NONPOINT SOURCE PROGRAMS.—The Administrator shall make grants to an Indian tribe under section 319 of this Act as though such tribe was a State. Not more than one-third of one percent of the amount appropriated for any fiscal year under section 319 may be used to make grants under this subsection. In addition to the requirements of section 319, an Indian tribe shall be required to meet the requirements of paragraphs (1), (2), and (3) of subsection (d)[1] of this section in order to receive such a grant.

(g) ALASKA NATIVE ORGANIZATIONS.—No provision of this Act shall be construed to—

(1) grant, enlarge, or diminish, or in any way affect the scope of the governmental authority, if any, of any Alaska Native organization, including any federally-recognized tribe, traditional Alaska Native council, or Native council organized pursuant to the Act of June 18, 1934 (48 Stat. 987), over lands or persons in Alaska;

(2) create or validate any assertion by such organization or any form of governmental authority over lands or persons in Alaska; or

(3) in any way affect any assertion that Indian country, as defined in section 1151 of title 18, United States Code, exists or does not exist in Alaska.

(h) DEFINITIONS.—For purposes of this section, the term—

(1) "Federal Indian reservation" means all land within the limits of any Indian reservation under the jurisdiction of the United States Government, notwithstanding the issuance of any patent, and including rights-of-way running through the reservation; and

(2) "Indian tribe" means any Indian tribe, band, group, or community recognized by the Secretary of the Interior and exercising governmental authority over a Federal Indian reservation.

(33 U.S.C. 1377)

SHORT TITLE

SEC. 519. This Act may be cited as the "Federal Water Pollution Control Act" (commonly referred to as the Clean Water Act).

(33 U.S.C. 1251 note)

[1] Probably should be subsection (e).

TITLE VI—STATE WATER POLLUTION CONTROL REVOLVING FUNDS

SEC. 601. GRANTS TO STATES FOR ESTABLISHMENT OF REVOLVING FUNDS.

(a) GENERAL AUTHORITY.—Subject to the provisions of this title, the Administrator shall make capitalization grants to each State for the purpose of establishing a water pollution control revolving fund for providing assistance (1) for construction of treatment works (as defined in section 212 of this Act) which are publicly owned, (2) for implementing a management program under section 319, and (3) for developing and implementing a conservation and management plan under section 320.

(b) SCHEDULE OF GRANT PAYMENTS.—The Administrator and each State shall jointly establish a schedule of payments under which the Administrator will pay to the State the amount of each grant to be made to the State under this title. Such schedule shall be based on the State's intended use plan under section 606(c) of this Act, except that—

(1) such payments shall be made in quarterly installments, and

(2) such payments shall be made as expeditiously as possible, but in no event later than the earlier of—

(A) 8 quarters after the date such funds were obligated by the State, or

(B) 12 quarters after the date such funds were allotted to the State.

(33 U.S.C. 1381)

SEC. 602. CAPITALIZATION GRANT AGREEMENTS.

(a) GENERAL RULE.—To receive a capitalization grant with funds made available under this title and section 205(m) of this Act, a State shall enter into an agreement with the Administrator which shall include but not be limited to the specifications set forth in subsection (b) of this section.

(b) SPECIFIC REQUIREMENTS.—The Administrator shall enter into an agreement under this section with a State only after the State has established to the satisfaction of the Administrator that—

(1) the State will accept grant payments with funds to be made available under this title and section 205(m) of this Act in accordance with a payment schedule established jointly by the Administrator under section 601(b) of this Act and will deposit all such payments in the water pollution control revolving fund established by the State in accordance with this title;

(2) the State will deposit in the fund from State moneys an amount equal to at least 20 percent of the total amount of all capitalization grants which will be made to the State with funds to be made available under this title and section 205(m) of this Act on or before the date on which each quarterly grant payment will be made to the State under this title;

(3) the State will enter into binding commitments to provide assistance in accordance with the requirements of this title in an amount equal to 120 percent of the amount of each such grant payment within 1 year after the receipt of such grant payment;

(4) all funds in the fund will be expended in an expeditious and timely manner;

(5) all funds in the fund as a result of capitalization grants under this title and section 205(m) of this Act will first be used to assure maintenance of progress, as determined by the Governor of the State, toward compliance with enforceable deadlines, goals, and requirements of this Act, including the municipal compliance deadline;

(6) treatment works eligible under section 603(c)(1) of this Act which will be constructed in whole or in part before fiscal year 1995 with funds directly made available by capitalization grants under this title and section 205(m) of this Act will meet the requirements of, or otherwise be treated (as determined by the Governor of the State) under sections 201(b), 201(g)(1), 201(g)(2), 201(g)(3), 201(g)(5), 201(g)(6), 201(n)(1), 201(o), 204(a)(1), 204(a)(2), 204(b)(1), 204(d)(2), 211, 218, 511(c)(1), and 513 of this Act in the same manner as treatment works constructed with assistance under title II of this Act;

(7) in addition to complying with the requirements of this title, the State will commit or expend each quarterly grant payment which it will receive under this title in accordance with laws and procedures applicable to the commitment or expenditure of revenues of the State;

(8) in carrying out the requirements of section 606 of this Act, the State will use accounting, audit, and fiscal procedures conforming to generally accepted government accounting standards;

(9) the State will require as a condition of making a loan or providing other assistance, as described in section 603(d) of this Act, from the fund that the recipient of such assistance will maintain project accounts in accordance with generally accepted government accounting standards; and

(10) the State will make annual reports to the Administrator on the actual use of funds in accordance with section 606(d) of this Act.

(33 U.S.C. 1382)

SEC. 603. WATER POLLUTION CONTROL REVOLVING LOAN FUNDS.[1]

(a) REQUIREMENTS FOR OBLIGATION OF GRANT FUNDS.—Before a State may receive a capitalization grant with funds made available under this title and section 205(m) of this Act, the State shall first establish a water pollution control revolving fund which complies with the requirements of this section.

(b) ADMINISTRATOR.—Each State water pollution control revolving fund shall be administered by an instrumentality of the State with such powers and limitations as may be required to operate such fund in accordance with the requirements and objectives of this Act.

(c) PROJECTS ELIGIBLE FOR ASSISTANCE.—The amounts of funds available to each State water pollution control revolving fund shall be used only for providing financial assistance (1) to any municipality, intermunicipal, interstate, or State agency for construc-

[1] See section 104B of the Marine Protection, Research and Sanctuaries Act of 1972 (33 U.S.C. 1414G) for additional amounts that are to be deposited into a State's fund and treatment of such deposits.

tion of publicly owned treatment works (as defined in section 212 of this Act), (2) for the implementation of a management program established under section 319 of this Act, and (3) for development and implementation of a conservation and management plan under section 320 of this Act. The fund shall be established, maintained, and credited with repayments, and the fund balance shall be available in perpetuity for providing such financial assistance.[2]

(d) TYPES OF ASSISTANCE.—Except as otherwise limited by State law, a water pollution control revolving fund of a State under this section may be used only—

(1) to make loans, on the condition that—

(A) such loans are made at or below market interest rates, including interest free loans, at terms not to exceed 20 years;

(B) annual principal and interest payments will commence not later than 1 year after completion of any project and all loans will be fully amortized not later than 20 years after project completion;

(C) the recipient of a loan will establish a dedicated source of revenue for repayment of loans; and

(D) the fund will be credited with all payments of principal and interest on all loans;

(2) to buy or refinance the debt obligation of municipalities and intermunicipal and interstate agencies within the State at or below market rates, where such debt obligations were incurred after March 7, 1985;

(3) to guarantee, or purchase insurance for, local obligations where such action would improve credit market access or reduce interest rates;

(4) as a source of revenue or security for the payment of principal and interest on revenue or general obligation bonds issued by the State if the proceeds of the sale of such bonds will be deposited in the fund;

(5) to provide loan guarantees for similar revolving funds established by municipalities or intermunicipal agencies;

(6) to earn interest on fund accounts; and

(7) for the reasonable costs of administering the fund and conducting activities under this title, except that such amounts

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[2] Section 1006 of the Ocean Dumping Ban Act of 1988 (P.L. 100–688) is as follows:

SEC. 1066. USE OF STATE WATER POLLUTION CONTROL REVOLVING FUND GRANTS FOR DEVELOPING ALTERNATIVE SYSTEMS.

(a) GENERAL REQUIREMENT.—Notwithstanding the provisions of title VI of the Federal Water Pollution Control Act, each of the States of New York and New Jersey shall use 10 percent of the amount of a grant payment made to such State under such title for each of the fiscal years 1990 and 1991 and 10 percent of the State's contribution associated with such grant payment in the 6-month period beginning on the date of receipt of such grant payment for making loans and providing other assistance as described in section 603(d) of the Federal Water Pollution Control Act to any governmental entity in such State which has entered into a compliance agreement or enforcement agreement under section 104B of the Marine Protection, Research, and Sanctuaries Act of 1972 for identifying, developing, and implementing pursuant to such section alternative systems for management of sewage sludge.

(b) LIMITATION.—If, after the last day of the 6-month period beginning on the date of receipt of a grant payment by the State of New York or New Jersey under title VI of the Federal Water Pollution Control Act for each of fiscal years 1990 and 1991, 10 percent of the amount of such grant payment and the State's contribution associated with such grant payment has not been used for providing assistance described in subsection (a) as a result of insufficient applications for such assistance from persons eligible for such assistance, the 10 percent limitations set forth in subsection (a) shall not be applicable with respect to such grant payment and associated State contribution.

shall not exceed 4 percent of all grant awards to such fund under this title.

(e) LIMITATION TO PREVENT DOUBLE BENEFITS.—If a State makes, from its water pollution revolving fund, a loan which will finance the cost of facility planning and the preparation of plans, specifications, and estimates for construction of publicly owned treatment works, the State shall ensure that if the recipient of such loan receives a grant under section 201(g) of this Act for construction of such treatment works and an allowance under section 201(l)(1) of this Act for non-federal funds expended for such planning and preparation, such recipient will promptly repay such loan to the extent of such allowance.

(f) CONSISTENCY WITH PLANNING REQUIREMENTS.—A State may provide financial assistance from its water pollution control revolving fund only with respect to a project which is consistent with plans, if any, developed under sections 205(j), 208, 303(e), 319, and 320 of this Act.

(g) PRIORITY LIST REQUIREMENT.—The State may provide financial assistance from its water pollution control revolving fund only with respect to a project for construction of a treatment works described in subsection (c)(1) if such project is on the State's priority list under section 216 of this Act. Such assistance may be provided regardless of the rank of such project on such list.

(h) ELIGIBILITY OF NON-FEDERAL SHARE OF CONSTRUCTION GRANT PROJECTS.—A State water pollution control revolving fund may provide assistance (other than under subsection (d)(1) of this section) to a municipality or intermunicipal or interstate agency with respect to the non-Federal share of the costs of a treatment works project for which such municipality or agency is receiving assistance from the Administrator under any other authority only if such assistance is necessary to allow such project to proceed.

(33 U.S.C. 1383)

SEC. 604. ALLOTMENT OF FUNDS.

(a) FORMULA.—Sums authorized to be appropriated to carry out this section for each of fiscal years 1989 and 1990 shall be allotted by the Administrator in accordance with section 205(c) of this Act.

(b) RESERVATION OF FUNDS FOR PLANNING.—Each State shall reserve each fiscal year 1 percent of the sums allotted to such State under this section for such fiscal year, or $100,000, whichever amount is greater, to carry out planning under sections 205(j) and 303(e) of this Act.

(c) ALLOTMENT PERIOD.—

(1) PERIOD OF AVAILABILITY FOR GRANT AWARD.—Sums allotted to a State under this section for a fiscal year shall be available for obligation by the State during the fiscal year for which sums are authorized and during the following fiscal year.

(2) REALLOTMENT OF UNOBLIGATED FUNDS.—The amount of any allotment not obligated by the State by the last day of the 2-year period of availability established by paragraph (1) shall be immediately reallotted by the Administrator on the basis of the same ratio as is applicable to sums allotted under title II of this Act for the second fiscal year of such 2-year period.

None of the funds reallotted by the Administrator shall be reallotted to any State which has not obligated all sums allotted to such State in the first fiscal year of such 2-year period.

(33 U.S.C. 1384)

SEC. 605. CORRECTIVE ACTION.

(a) NOTIFICATION OF NONCOMPLIANCE.—If the Administrator determines that a State has not complied with its agreement with the Administrator under section 602 of this Act or any other requirement of this title, the Administrator shall notify the State of such noncompliance and the necessary corrective action.

(b) WITHHOLDING OF PAYMENTS.—If a State does not take corrective action within 60 days after the date a State receives notification of such action under subsection (a), the Administrator shall withhold additional payments to the State until the Administrator is satisfied that the State has taken the necessary corrective action.

(c) REALLOTMENT OF WITHHELD PAYMENTS.—If the Administrator is not satisfied that adequate corrective actions have been taken by the State within 12 months after the State is notified of such actions under subsection (a), the payments withheld from the State by the Administrator under subsection (b) shall be made available for reallotment in accordance with the most recent formula for allotment of funds under this title.

(33 U.S.C. 1385)

SEC. 606. AUDITS, REPORTS, AND FISCAL CONTROLS; INTENDED USE PLAN.

(a) FISCAL CONTROL AND AUDITING PROCEDURES.—Each State electing to establish a water pollution control revolving fund under this title shall establish fiscal controls and accounting procedures sufficient to assure proper accounting during appropriate accounting periods for—

(1) payments received by the fund;

(2) disbursements made by the fund; and

(3) fund balances at the beginning and end of the accounting period.

(b) ANNUAL FEDERAL AUDITS.—The Administrator shall, at least on an annual basis, conduct or require each State to have independently conducted reviews and audits as may be deemed necessary or appropriate by the Administrator to carry out the objectives of this section. Audits of the use of funds deposited in the water pollution revolving fund established by such State shall be conducted in accordance with the auditing procedures of the General Accounting Office, including chapter 75 of title 31, United States Code.

(c) INTENDED USE PLAN.—After providing for public comment and review, each State shall annually prepare a plan identifying the intended uses of the amounts available to its water pollution control revolving fund. Such intended use plan shall include, but not be limited to—

(1) a list of those projects for construction of publicly owned treatment works on the State's priority list developed pursuant to section 216 of this Act and a list of activities eligible for assistance under sections 319 and 320 of this Act;

(2) a description of the short- and long-term goals and objectives of its water pollution control revolving fund;

(3) information on the activities to be supported, including a description of project categories, discharge requirements under titles III and IV of this Act, terms of financial assistance, and communities served;

(4) assurances and specific proposals for meeting the requirements of paragraphs (3), (4), (5), and (6) of section 602(b) of this Act; and

(5) the criteria and method established for the distribution of funds.

(d) ANNUAL REPORT.—Beginning the first fiscal year after the receipt of payments under this title, the State shall provide an annual report to the Administrator describing how the State has met the goals and objectives for the previous fiscal year as identified in the plan prepared for the previous fiscal year pursuant to subsection (c), including identification of loan recipients, loan amounts, and loan terms and similar details on other forms of financial assistance provided from the water pollution control revolving fund.

(e) ANNUAL FEDERAL OVERSIGHT REVIEW.—The Administrator shall conduct an annual oversight review of each State plan prepared under subsection (c), each State report prepared under subsection (d), and other such materials as are considered necessary and appropriate in carrying out the purposes of this title. After reasonable notice by the Administrator to the State or the recipient of a loan from a water pollution control revolving fund, the State or loan recipient shall make available to the Administrator such records as the Administrator reasonably requires to review and determine compliance with this title.

(f) APPLICABILITY OF TITLE II PROVISIONS.—Except to the extent provided in this title, the provisions of title II shall not apply to grants under this title.

(33 U.S.C. 1386)

SEC. 607. AUTHORIZATION OF APPROPRIATIONS.

There is authorized to be appropriated to carry out the purposes of this title the following sums:

(1) $1,200,000,000 per fiscal year for each of fiscal year 1989 and 1990;

(2) $2,400,000,000 for fiscal year 1991;

(3) $1,800,000,000 for fiscal year 1992;

(4) $1,200,000,000 for fiscal year 1993; and

(5) $600,000,000 for fiscal year 1994.

(33 U.S.C. 1387)

Concepts for ecologically sustainable sanitation in formal and continuing education

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A Preface

This publication dealing with educational aspects linked to ecologically sustainable sanitation (referred to as ecosan) is the result of a substantive collaborative effort between UNESCO's International Hydrological Programme (IHP) and the German Technical Cooperation Agency GTZ (Deutsche Gesellschaft für Technische Zusammenarbeit GmbH, Eschborn). The reader will find below some relevant background information that should prove useful to grasp more clearly the nature and scope of the publication.

Urban water issues have been addressed by the IHP for over twenty years and along with groundwater can be considered one of the oldest topics covered by IHP. However, the initial urban water programmes had little in common with contemporary challenges, which consider the sustainable management of water resources with due consideration of social and institutional issues. The aspects considered by IHP have thus gradually changed so as to arrive to today's approach. This development applies not only to urban water but also, in general, to the whole IHP. With the change of approach of the IHP, new aspects came into the picture, but these constituted an evolution in broadening the thematic scope without lessening the focus on sound science.

This innovative approach needs to be considered in order to fully understand the scope and the spirit in which this report has been conceived. The first historical development concerned the aspects of management since it had become apparent that science and management couldn't be separated. The initial focus, concentrating on scientific aspects, was expanded by adding environmental, particularly ecological, fields. With the introduction of environmental considerations anthropogenic aspects naturally followed. Thus, human attitudes in their eco-sociological context had to be included. A further step was to place the natural system in proper relation with man-made changes and to recognise the vulnerability of natural systems. Risk analysis helped to understand the fragility of nature and to propose remedial actions.

The Sixth Phase of IHP (2002-2007) "Water Interactions: Systems at Risk and Social Challenges", currently under execution, considers five major themes: (1) Global Changes and Water Resources; (2.) Integrated Watershed and Aquifer Dynamics; (3) Land Habitat Hydrology; (4) Water and Society; and (5) Water Education and Training. Theme 3 considers to water management in specific settings including a focal area on "Urban Areas and Rural settlement" which addresses different aspects of urban water management issues through specific projects.

In addition, one major activity channels the technical and scientific elements developed in connection to these urban water related projects into the context of education and training. The purpose is to offer in an integrated fashion the educational tools to enable training activities. The elements thus developed carry a dual purpose, one is to transmit knowledge relevant to a concrete field and the other is to provide the appropriate educational frame for this purpose.

In order to demonstrate the usefulness of this dual approach, a specific area has been selected: that of ecologically sustainable sanitation, ecosan. While ecosan clearly has the potential to become a promising alternative, for the developed and developing world alike, there is still a large gap on transmission of the relevant knowledge and capacity building on how to apply ecologically sustainable sanitation.

In these circumstances, IHP and GTZ identified their common interests and agreed on a joint venture to produce this publication. In this pursuit, IHP, GTZ and other ecosan partners held several meetings (Eschborn, May 2004; Paris, September 2004; Paris, February 2005; Delft, May 2005) and a concluding workshop in Paris, September 2005 in order to prepare this document.

The publication is largely derived from an ecosan source book issued by the GTZ in 2003 with regard to the first three chapters. The chapters on research and development as well as on education and training fully constitute innovation. IHP wishes to recognise a large number of contributors and reviewers but in particular is grateful to the main authors: Dr. A.R. Panesar, Mrs C. Werner, Dr. E. von Münch, Prof. C. Maksimovic, Mrs. A. Scheinberg, Prof. R Schertenleib, Mr. P. Bracken, and Mr. W.H. Gilbrich. The authors themselves wish to express their appreciation for UNESCO's interest and material help by arranging for meetings and consultancies. Mr. J.A. Tejada-Guibert, the project manager on behalf of UNESCO, with the assistance of Mrs. B. Radojevic, took charge of the corresponding technical-administrative duties.

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An ecosan-resource CD has been developed parallel to this publication and includes material from a range of organisations. It can be found attached to this publication or obtained via ecosan@gtz.de

For UNESCO the achievement of the sanitation Millenium Development Goals (MDGs) is one of the major challenges for sustainable development in the next decade. With this publication emphasis is put on education and research for ecologically sustainable sanitation to contribute in reaching this goal and to the achievement of the paradigm shift towards a holistic view on sustainable sanitation.

Paris, January 2006

Dr. András Szöllösi-Nagy

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C Executive Summary

The basic concept of collecting domestic liquid waste in water-borne sewer systems, treating the wastewater in centralised treatment plants and discharging the effluent to surface water bodies became the accepted, conventional approach to sanitation in urban areas in the last century. Although these conventional sewer systems have significantly improved the public health situation in those countries that can afford to install and operate them properly, the large number of people, particularly in the developing world, who still do not have adequate access to adequate sanitation is a clear indication that the conventional approach to sanitation is likely to be unable to meet needs universally.

The conventional sewer system was developed at a time, in regions, and under environmental conditions that made it in many cases an appropriate solution for removing liquid wastes from cities. Today with increased population pressure, changes in consumer habits and increasing pressure on freshwater and other resources, this human waste disposal system is no longer able to meet the pressing global needs and ideas of recycling have been developed.

A few decades ago it thus became a priority to:

- Identify appropriate simple, affordable decentralised sanitation systems and promote their adoption
- Implement appropriate technologies with the participation of the communities to be served, and
- Focus on health and hygiene education so that physical facilities would be properly used and maintained, and that hygienic behaviour would support the improvements brought about by the infrastructure.

Over the years, it became clear however that this health and hygiene driven paradigm shift was still incomplete: In practice faecal sludge management problems where often overlooked, as were negative downstream effects off effluents from sewer systems. Protection of the environment, resource conservation and waste reuse remained secondary concerns at best, or were neglected entirely, and operational problems reduced the health improvements expected of the technologies.

In the concept of ecological sanitation (ecosan) not only health issues but also conservation of water and other resources as well as the protection of aquatic ecosystems are taken into consideration. The ecosan approach places the emphasis on the hygenisation of the contaminated flow streams, and shifts the concept from waste disposal to resource conservation and safe reuse.

In addition to paying particular attention to the health aspects at household level, ecosan also emphasises:

- The destruction of pathogens through flow stream separation, containment and specific treatment.
- Resource conservation through a reduced use of potable water as a transport medium for human waste and by recovering wastewater for irrigation
- The elimination or minimisation of wastewater discharges to the environment
- The need to close the resource loops through the productive use of the nutrients contained in excreta

The modern ecosan concept thus represents the culmination of the paradigm shift initiated in response to satisfying the health needs of unserved, mostly poor population groups.
Education has a clear role to play, both in acknowledging the paradigm shift in sanitation and in incorporating the interdisciplinary theme of innovative sustainable sanitation systems into teaching curricula. Education on ecosan should enable the people to develop, plan and implement eco-sanitation systems that are hygienically safe, socially acceptable, economically feasible, environmentally sound and technically appropriate.

Educational institutions, universities, and technical schools can contribute to the mainstreaming of the new sanitation paradigm by fully integrating the discourse and criteria for sustainability into their curricula. They should make clear that defining criteria for sustainable sanitation is a political act and influences what is the accepted, legitimate form of sanitation, including the impacts from sanitation on other sectors. Sanitation capacity building should take the stakeholders in a sanitation project not as objects, but as partners for jointly developing sustainable sanitation solutions.

The education system has to prepare students to think about urine and faeces and grey/black water as resources. Emphasis has to shift from the simple disposal to the hygienisation of contaminated flow streams, and to resource conservation and safe reuse. Teaching must make clear that health and a healthy environment is a prerequisite for human productivity, and productivity determines economic well being.

Sanitation engineers and practitioners, policymakers, managers, and operators get their ideas and information during their education. Therefore the curricula of universities, continuing education programmes, technical schools, research institutes and training centres have to include the ecosan philosophy. Thus several objectives, such as the improvement of human health, poverty reduction in developing countries, the conservation of natural resources and sustainable water and sanitation management systems in both, industrialised and developing countries may be addressed. Those responsible for the content of curricula should be informed about the new developments in this field.

The present publication therefore constitutes a means of providing educational tools, up grading existing ones, and suggesting revised teaching plans. The educational platform being developed under IHP auspices could serve as an opportunity to include ecosan-related subjects in modernized course curricula.

Many proven technical elements are available for ecological sanitation systems and the number of pilot demonstration and research projects, and of large scale applications is continuously increasing.
The pilot research and demonstration projects should showcase innovative solutions in a variety of climatic, social, cultural, economic and geo-morphological contexts, and should enable the development of a series of model solutions covering the whole range of sanitation needs.

However, given the broad variety of local framework conditions and the large number of open question in this complex interdisciplinary field, there is still a great need to further develop technical and operational solutions and to enlarge the knowledge base with respect to public health, risk management, economics, logistics, material-flow-streams, socio-cultural and many other aspects. Research in these disciplines will require trans-sectoral and interdisciplinary co-operation and inputs from a range of research fields.

Research should concentrate on comparative studies between a range of conventional and innovative solutions comparing them against a set of sustainability criteria. It should also help in developing field tested and proven sustainable sanitation components and systems, and contribute to forming a knowledge base for drawing up technical standards. Documentation and case studies for innovative sanitation solutions should be easily made available in a uniform comprehensive format, and technical information for components of innovative sanitation solutions should be provided to accelerate their dissemination.

The achievement of the sanitation MDGs is one of the major challenges for sustainable development in the next decade. Putting emphasis on education and research for ecologically sustainable sanitation may largely contribute to reaching this goal.

1 Motivation: The new development paradigm - Millennium Development Goals and the Johannesburg Plan

Box 1: Millennium Development Goals and the Johannesburg Plan

The **Millennium Development Goals** aim to:

- Eradicate extreme poverty and hunger
- Achieve universal primary education
- Promote gender equality and empower women
- Reduce child mortality
- Improve maternal health
- Combat HIV / AIDS, malaria and other diseases
- Ensure environmental sustainability
- Develop a global partnership for development

With particular regard to water issues the goal of ensuring environmental stability the United Nations adopted the target of halving the proportion of people without sustainable access to safe drinking water by 2015.

(United Nations 2000: United Nations Millennium Declaration – September 2000)

Johannesburg Plan of Implementation

In the Johannesburg Plan of Implementation the goals of the United Nations Millennium Declaration were reaffirmed and further elaborated. With respect to the MDGs and water supply and sanitation they aim to:

(1) Halve, by 2015, the proportion of people without access to safe drinking water – thus reaffirming the target set in the Millennium Development Goals.

and

(2) Halve, by 2015, the proportion of people who do not have access to basic sanitation.

(United Nations 2002: Key commitments, targets, and timetables from the Johannesburg plan of implementation)

For many years, the international focus has been to provide safe drinking water supply. The Millennium Development Goals (MDGs) however represent a clear commitment to address sanitation with the same priority as water supply.

An analysis of existing data on global sanitation coverage from most recent international reports (e.g.UN 2005) reveals that the backdrop in sanitation provision is highest among the development goals. The UN Millennium Project Task Force on Water and Sanitation's Final Report (UN Millenium Project 2005) urges governments and stakeholders to move the sanitation crisis to the top of the international agenda.

How best to achieve the Millennium Development Goals has been recently discussed in the report “Health, dignity, and development: what will it take?” (UN Millenium Project 2005). Hans Olaf Ibrek, Member of the MDG Task Force on Water and Sanitation points out during the launching of the report: “Efforts to reach Target 10 must focus on sustainable service delivery, rather than construction of facilities alone”.

The world-wide endorsement of the millennium development goals calls for a radical re-thinking of the conventional, accepted approaches to urban infrastructure in general and sanitation in particular. Only a change in the basic paradigm from linear flow streams and disposal towards a cycle oriented management of renewable resources has the potential to deliver the kind and degree of change which the millennium development goals demand. While the new paradigm is partly in place and implemented in solid waste management, energy, and agriculture (to name a few leaders), the process of paradigm shift in sanitation is still in its infancy. Just how difficult it is to change from conventional approaches to better alternatives is demonstrated by the fact that forward looking engineers proposed to move from the linear to circular systems of managing water and wastewater (including excreta, and rainwater) back in the 1970s (Shaeffer and Stevens 1983). Today, 30 odd years later, the circular approach remains the exception.

This paper looks at this paradigm shift in sanitation in three ways. First, the paper focuses on the necessary changes in the sanitation system itself, and presents a vision of the new paradigm and its impact on the sectors related to water and sanitation (e.g. health and hygiene, solid waste and wastewater management, water resources management, natural resources management, environment, agriculture, urban planning, poverty reduction, food security, job creation, micro and macro economic development). The second focus is the education system, especially as it relates to the training of water- and environmental professionals and practitioners, as well as to brief and influence policy makers. The third relates to other aspects of knowledge management besides education: research, case studies, and also to the discourse around sanitation.

2 Introduction: education and the paradigm shift in sanitation

The paradigm shift in sanitation has not yet made structural inroads into the professional and university educational system. There is an urgent need for a different approach to professional and scholarly sanitation education and training, an approach that takes into consideration the need for holistic solutions, thus comprising all dimensions of sustainability, from health and socio-technical aspects to natural resources management, agriculture, micro- and macro-economics and institutional aspects. The current educational and training infrastructure is failing the field of sanitation and development in primarily two ways:

- most institutions uncritically continue to offer curricula in the basics of centralised sewered sanitation and end-of-pipe wastewater treatment and disposal, continuing to turn out sanitation engineers and planners whose education and training has led them to believe that this is the only adequate and serious approach; and
- despite almost 20 years of practice in participatory and holistic interdisciplinary planning approaches, the basic framework of education and training in sanitation (like that in other urban environmental fields) remains narrowly focused on the technical aspects, so that neither students nor scholars are learning the basic process skills to arrive at sustainable solutions.

There are three identifiable problems in relation to sanitation and education.

1. Sanitation is failing in sustainability and in serving the world‘s poor. The current sanitation paradigm delivers neither equity nor sustainability. There are alternatives, but they are neither fully developed nor fully legitimatised.
2. Education is failing in adapting to the required changes in the sanitation system. While the sanitation system is in transition, the educational system remains fixed on the old paradigm, with the result that young professionals look backwards towards 20th century models, rather than forwards towards a sustainable future.
3. Knowledge management in the urban environment is outdated and obsolete. Failures to support the new sanitation paradigm can be found in abundance in the areas of research, development, documentation, and the sanitation discourse – that is, in the area of knowledge management in sanitation. These failures compound and reinforce the failures in the education system, rather than challenging and counteracting them.

Each of these failures is further developed in the section below.

2.1 Sanitation is failing in sustainability

2.1.1 Sanitation and the world water crisis

The problems raised by the decreasing quality and quantity of fresh water resources are becoming increasingly serious. All indicators show that the world is facing a serious world water crisis which will affect all of us, but particularly the poor. The poor suffer most from this decrease in fresh water resources, and bear the brunt of water-related diseases and a damaged environment. This water crisis is in part a direct result of the failure of the current sanitation paradigm. Sewered sanitation, established in the era of European urbanisation in the 1870s, has the status of a widely accepted solution, or scientific truth. There is little discussion about its core problems, which result in health and environmental problems around the world. The fact that our current sanitary systems are, for the most part, directly connected to the water cycle requires that both the sanitation and water crises be considered, before we can begin trying to de-couple them.
A look at some of the figures of both these crises provides an insight into the scale of the problem facing us today:

- The estimated mortality rate as a result of illnesses caused by contaminated drinking water and poor sanitation and hygiene in developing countries is approximately 2.2 million people per year, most of them children under the age of five (WHO/UNICEF JMP 2000)
- An estimated 2.6 billion people, representing almost half of the world population do not have access to adequate sanitation / wastewater treatment facilities (WHO/UNICEF JMP 2005)
- 1.1 billion people do not have access to safe drinking water (WHO/UNICEF JMP 2005)
- In the developing regions of the world between 100% (Africa) and 65% (Asia) of the urban wastewater are not treated appropriately (WHO/UNICEF JMP 2000)
- 80 % of all diseases and 25 % of all deaths in developing countries are caused by polluted water (UN 1992)
- World-wide, over 200 million people were infected with schistosomiasis and intestinal helminths, of which 20 million suffered serious illness, most of them children under the age of 5 (WHO 2003)

The current global population is expected to increase by 2 billion people, to 8 billion, within the next 25 years. Most of these people will be born in developing and emerging market economies and will live in urban areas. Without a concerted effort, many of these people are doomed to poverty and will increase the number of those lacking basic water and sanitation services.

The United Nations Summit on Sustainable Development, held in Johannesburg, South Africa, in autumn of 2002, returned to the targets set by the Millennium Development Goals with regard to water supply and extended it to also include the provision of sanitation. The current international target is therefore to halve the proportion of people without access to safe drinking water and to adequate sanitation by 2015.

2.1.2 Limitations of conventional sanitation systems

Conventional sanitation systems, based on water-borne sewerage, are the accepted manner for removal of human waste from cities. However, in recent years they have proven to be unable to make a significant impact on the backlog of nearly half of the world's population. Moreover, even if a sufficient investment could be made, so that conventional sanitation systems could be provided to address who lack access to adequate sanitation, the resulting sanitation systems would not be sustainable.

In many places, sewered sanitation results in polluted ground and surface waters. It can therefore lead to a whole new series of problems. In India, the idea of every person having their own car brought to the public eye vivid images of a social and environmental catastrophe. Today, the idea of every family having access to a flush toilet evokes images of a much greater disaster, as this would both sharply increase drinking water consumption, and lead to increased water pollution and health hazards (Narain 2004; Werner et al. 2003b).

Water-borne sewer systems

"Modern" water-borne sewer systems are a relatively new technology, which only began to spread in European cities from around the end of the 19th century, when piped water supplies and the use of flush toilets lead to an increased water consumption, and wastewater production. This led to streams and stagnant pools of wastewater in city streets, causing outbreaks of cholera and other diseases. To tackle this problem, sewer systems were gradually introduced. Later, when this was seen to cause serious water pollution, step by step mechanical wastewater treatment plants, biological treatment for the degradation of organic substances, and tertiary treatment for the removal of nutrients were added to reduce the pollution and resulting eutrophication of the receiving water bodies. These now represent the present state-of-the-art in wastewater treatment.

Such wastewater treatment plants have improved the hygienic situation in a large number of urban areas, particularly in those where water is in abundant supply, treated wastewater can be relatively harmlessly disposed of, and the costs of operation and maintenance can be assured. When built and functioning correctly, conventional water-borne sewers and treatment plants allow a relatively well assured hydraulic transport of excreta, used water and rainwater away from urban areas. They also help avoid the pollution of surface waters within urban areas, which are often a source of health and

environmental problems. This very obviously improves the hygienic situation of those inhabitants of urban areas being served by well functioning sewer systems.

However, due mainly to a lack of adequate human and financial resources, these systems cannot be correctly operated in many countries in north and south. As a result, improvements in the sanitary situation in sewered areas of towns (which most often cover the wealthier section of the population) often directly lead to a deterioration in the sanitary situation in surrounding, unsewered, and usually poorer, neighbourhoods, as sewage is often discharged with little or no treatment into water bodies. Poorer communities are often exposed to these contaminated waters in their every-day life, perhaps using them as a source of drinking or washing water or during flooding. These problems become particularly serious when there is a rapid increase in the urban population.

Conventional centralised systems require a huge financial investment, and have relatively high maintenance and operation costs. The difficulties caused by these expenses do not only prevent developing nations from correctly building and operating centralised sanitation systems, but industrialised nations also face huge problems in the maintenance and operation of their sewer systems and treatment plants. In Latin America less than 20% of the wastewater collected is actually treated, whilst in Europe, of 540 major cities, only 79 have advanced tertiary sewage treatment, 223 have secondary treatment, 72 have incomplete primary treatment and 168 cities have no or an unknown form of treatment of their wastewater (EcoSanRes 2005a).

Outside of the cost considerations, conventional water-borne sanitation systems have further fundamental shortcomings. As water is used to transport the wastes, they have a high water-consumption, making them unsuitable in the long term for regions with water scarcity. In many places this has already led to an over-exploitation of the limited renewable water resources. Overuse is resulting in drinking water becoming an expensive good, only available to the better off, who are usually connected to the central water supply and receive piped water at such a low price that flushing it down the toilet does not seem to be a worry. Clean drinking water is too precious a resource to be flushed down the toilet, and the use of flush toilets in areas where the water supply only operates for a few hours per week clearly makes no sense.

Even if such systems contribute to a healthier environment in the cities where they are installed, they do the opposite for those living downstream. When functioning properly, the discharge from conventional wastewater treatment plants is still not safe from a health point of view, failing to meet the quality requirements of bathing water, if the dilution is not sufficient. Conventional treatment plants have been developed for the removal of large particles, biodegradable organic substances and nutrients in order to protect receiving waters. The reduction of pathogenic organisms is, however, insufficient.

The effluent from these plants also contains other potentially dangerous substances. For example, recent research has highlighted the effects of endocrine substances, contained in human excreta, on fish populations, reducing their fertility, and even changing the sex of male trout. The effects of pharmaceutical residues in the effluent and their impact on the environment and humans living downstream who obtain their drinking water from the same river are also being discussed. For combined sewer systems (carrying both storm water and wastewater), a further problem, is that heavy rainfall generally leads to the diluted wastewater being discharged untreated directly into rivers as treatment plants are only designed for a limited influent.

Shortcomings of "conventional" pit toilets

Conventional on-site sanitation systems have been used for centuries to provide excreta disposal at the household level. There are two basic types, dry systems (pit toilets) and water based systems (flush toilets). The former have been used in the “North” until the mid 19th century, when water-borne sewerage started its triumphal march across industrialized nations and became the accepted standard for excreta disposal worldwide. Given the limited financial means of most developing countries, the pit toilet has remained their principal means of excreta disposal except for their well to do classes who are often provided with government subsidised sewerage systems. On-site pour flush toilets are today popular and widely used in South-Asia, especially in India.

Neither pit toilets nor pour flush toilets development included resource recovery as part of their function. Indeed, the health impact of underground waste disposal, particularly its impact on groundwater, was rarely considered. Fortunately, pathogenic organisms as a rule, did not survive in the ground, and in any event did not travel very far. However, the increasing density of populations meanwhile often has led to situations where the required minimum distance between drinking water well and pit toilets can not be respected.

In many densely populated areas, for example in Dakkar, the capital of Senegal, the use of pit toilets has also led to nitrate concentrations in groundwater, which exceed the maximum level recommended by the WHO for drinking water and which have been linked to serious health problems, particularly for babies. This became a concern when low income societies adopted the western custom of bottle feeding their babies, thus exposing them to the danger of methemoglobinemia (blue baby syndrome).

Shallow groundwater is still a major source of water supply in rural and peri-urban areas, especially for the poor. The design of the conventional “drop and store” pit-toilet (and of most other on-plot systems) pollutes this precious groundwater as it deliberately aims to retain only solid matter in the pit and infiltrates as much of the liquids as possible into the subsoil. As these liquids contain all the soluble elements of the excreta as well as viruses and pathogens, this type of sanitation, depending on the hydro-geological situation, can be a highway to groundwater contamination.

Pit toilets should be emptied when they are full, with the content being treated before being put to any other use (e.g. in agriculture). In practice, however, faecal sludge management aspects are often overlooked and old pits are often simply abandoned, with users preferring to dig a new pit toilet than to attempt the unpleasant job of emptying the old one.

For a household, digging a new pit, and providing a new superstructure each time the old pit is full, can prove to be an expensive business. This is added to by the difficulty faced by homeowners living in densely populated areas, where plots are small and tend to already be crowded with old, previously abandoned pits. Many conventional latrines also smell quite badly, are a breeding place for flies, insects and other vectors and are very inconvenient to use, especially for children, women and girls, as they have to be built at a distance from the house, making night-time visits highly undesirable. Added to this are the problems of pit construction in areas with a high groundwater table, or where the ground is rocky, making the use of a pit extremely impractical. Pits are also susceptible to flooding during heavy rainfall and subsequent collapse.

Project Box 1: The Durban experience, South Africa (Macleod 2005)

The Municipality of eThekwini (Durban), South Africa, is aware that emptying full toilet pits is a difficult and costly task. Here the municipality had given the task of emptying pit toilets to a private service provider, however the cost of emptying the pit often exceeded 1.000 Rand (or 135 EUR) per pit toilet. These costs were a result of several factors, including the inaccessibility or precarious location of many of the toilets, and the heterogeneous nature of the contents which included rags, household refuse, and plastic bags, which made pumping extremely difficult. The emptying cost were seen as being unacceptably high as the price of a new pit toilet was between 1.000 and 3.000 Rand.

Figure 1: Emptying conventional pit toilets required special equipment (left picture) and turned out to be extremely costly - often exceeding 1000 Rand per pit. The urine diversion dehydration toilet (right picture) was selected by the communities as preferred solution after extensive awareness raising measures (Macleod 2005).

As a result alternative, innovative sanitation systems, with higher initial installation costs but lower running costs, became increasingly economically interesting. After extensive community education and awareness raising in the peri-urban and rural communities, and after a number of different options of toilet designs were constructed and demonstrated to the communities, they decided upon the “double vault urine-diverting dehydration toilet” (overall construction cost in Durban around 3.500 Rand), with emptying offered by a private service provider for 25 Rand (or 3-4 EUR) per toilet.

The criteria against which the different toilet designs were measured included: (1) Construction and maintenance costs; (2) Ease of emptying by the household, or at an affordable price by a service provider; (3) Environmental sustainability; (4) Compatibility with the available water supply (preferably requiring no water for its effective use); (5) Acceptability to the communities using the toilets.

Over 20.000 double vault urine-diverting dehydration toilets have been installed in eThekwini with some having been in use for a sufficiently long period of time to prove that emptying them is not a problem. Currently research projects are underway to analyse how to make best use of the nutrients collected by the toilets in the given context.

Lack of attention to macro-nutrient cycling

Our conventional wastewater systems are largely linear, end-of-pipe systems where drinking water is misused to transport waste into the water cycle, causing environmental damage and hygienic hazards, and contributing to the water crisis. If we continue to promote these technologies in order to meet the Millennium Development Goals, the overall result could be disastrous as the hygienic situation of our waters would be further deteriorated and even more resources would be dissipated and introduced into water bodies.

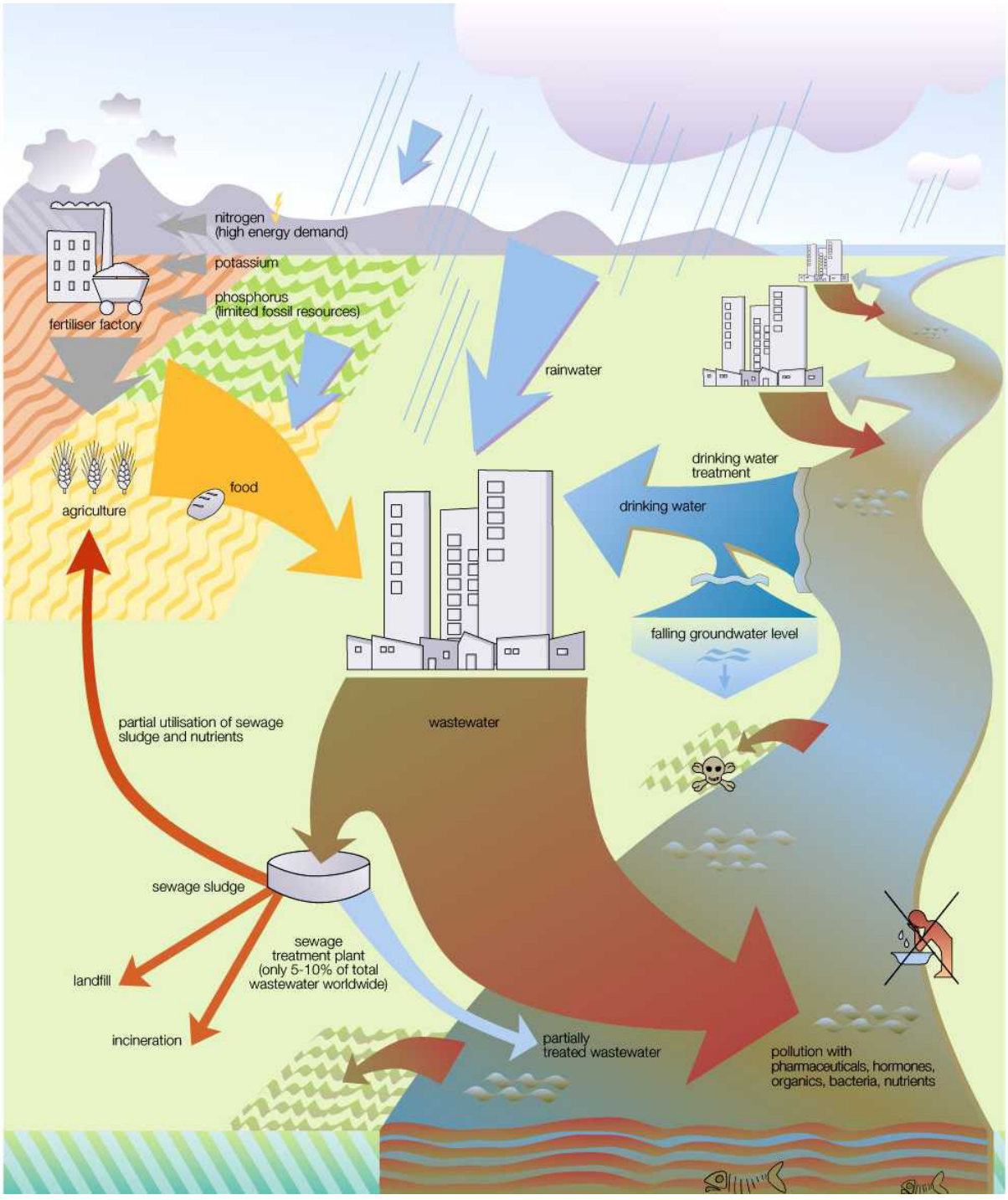


Figure 2: Schematic illustration of the main limitations of conventional wastewater management systems (GTZ)

While the above are serious disadvantages of both water-borne and dry conventional sanitation systems, a far more fundamental problem is that they do not facilitate the reuse of macro and micro nutrients present in excreta and wastewater. This lack of nutrient recovery and -use leads to a linear flow of nutrients from agriculture, via humans to recipient water bodies. The valuable nutrients and trace elements contained in human excrement are very rarely re-channelled back into agriculture in conventional systems. Even when sewage sludge is used in agriculture, only a very small fraction of the nutrients contained in the excrement are reintroduced into the living soil layer. Most are either

destroyed in the treatment process (e.g. by nitrogen elimination) or enter the water cycle, where they pollute the environment, causing the eutrophication of lakes and rivers.

Not returning the nutrients to the soil has led to a situation where there is an increasing demand for chemical fertilisers, in response to the problem of decreasing soil fertility. To produce the required chemical fertilisers, large amounts of energy are needed, and finite mineral resources, such as phosphorous, must be exploited. Current estimates say that phosphorous reserves will be exhausted in between 60 and 130 years at the present rate of consumption (Rosemarin 2004). The relatively inexpensive phosphorous used today will almost certainly cease to exist in the next 50 years. Farmers around the world yearly require 135 Mio. tons of mineral fertiliser for their crops, while at the same time conventional sanitation dumps 50 Mio tons of fertiliser equivalents flows into our water bodies - nutrients with a market value of around 15 Billion US dollars. Figure 2 schematically illustrates the main limitations of conventional wastewater management systems.

2.1.3 Conclusion

The current sanitation paradigm is failing the world, with the poor suffering most, threatening the integrity of fresh water supplies, and in general creating unsustainable linear flows that can ultimately make life on earth difficult or no longer feasible. The problems with conventional sanitation are fundamental, and a radically different approach is needed. Ecological sanitation, presented in Chapter 3, represents a different paradigm, one that offers a path out of the current vicious circles of water over-consumption and undervaluing by the rich, lack of access to safe water and sanitation and high costs for the poor, water and environmental pollution and depletion of nutrients.

2.2 Education is failing the sanitation system

In spite of the serious problems with the conventional sanitation paradigm, educational institutions, universities, and technical schools continue to present it to new generations of students as the only legitimate form of sanitation. The problem is compounded by the fact that the training treats the sanitation system as the focus, and pure removal of faeces and urine (and the water that bears them) as the goal. The users are objectified, and their ideas and preferences are largely ignored. If the users of the sanitation system are considered at all, it is as objects of PR campaigns aimed at “changing behaviour”, “enforcing” payment or use norms, or “stimulating” compliance. The potential users of the recycling products are usually completely neglected (e.g. with regard to their quality and logistical requirements how the products reach the users). The conventional sanitation discourse as presented in engineering and technical schools simply does not accord the system users any status at all in the decision-making process, thus often leading to inappropriate expensive and/or unsustainable solutions.

The current education system also fails in preparing students to think about urine and faeces and grey/black water as resources. The emphasis, as one would expect in a removal-based approach is on their negative or dangerous physical, chemical, and biological characteristics, and not on their resource value as sources of nutrients, energy, or water for irrigation or other purposes. This is the reflection of an education system influenced by the culture of the North, where societies are wealthy and still behave, as if they could afford to have a linear attitude towards resources.

Problems in education for sanitation

Sanitation engineers and practitioners, policymakers, managers, and operators get their ideas and information during the education process. And here is one key problem: Curricula of Universities, continuing education programmes, technical schools, research institutes and training centres mostly continue to present conventional sanitation as the only legitimate approach. Indeed those responsible for the content of curricula are often even unaware of the new developments in this field.

2.3 Knowledge management in the urban environment needs to be updated.

Failures in the areas of research, development, documentation, and the sanitation discourse – that is, in the area of knowledge management in sanitation – compound and reinforce the failures in the education system, rather than challenging and counteracting them.

Research is still concentrated on the optimisation of centralised and unsustainable systems. It is e.g. proposed to burn sludge from centralised treatment facilities, to extract phosphorus from the ashes in a highly energy consuming process - instead of separating streams at the source by collecting phosphorous rich material like urine with urine separating devices (comp. below).

Development and applied research follows the same line. In Europe currently applied research is suggested for acceleration of providing up-to-date systems for the eastern European countries. The danger is that what happened in several cases in East-Germany (uncritical provision of costly and oversized centralised systems) will now be repeated in large scale in Eastern-Europe. Examples of environmental approaches in East-Europe are rare (Samwel and Gabizon 2005). However they illustrate, that neither the science community nor the exporting or local industry are equipped to facilitate the participatory processes necessary for the introduction of innovative sanitation solutions.

Documentation, criteria and case studies for innovative sanitation solutions are therefore urgently needed. A first start for such efforts can be seen in the GTZ-ecosan website, where demonstration projects from all over the world are presented in a uniform comprehensive format, and technical data sheets for components of innovative sanitation solutions are provided to accelerate their standardisation.

Textbooks and scholarly articles usually are restricted to the description of centralised sanitation systems or on-site pit toilets as described above. They usually do not address the interrelation between sanitation, agriculture, food-security and job-creation - hence the inter-sectoral approach needed to address the sanitation crisis in a holistic and sustainable way. A positive exception can be seen e.g. in a Swedish textbook for master students, with references to the Baltic Sea Basin situation (Hultman and Levlin 1999).

The discourse on sanitation in the urban environment, while largely dominated by the discussion of the conventional systems, is slightly changing in the recent years. Some impact can be noted e.g. for the conferences on ecological sanitation held in Bonn, Germany (2000), Nanjing, China (2001), Lübeck, Germany (2003), Durban, South Africa (2005). Holistic approaches to sanitation in Mega-cities get increasing attention, and were discussed e.g. during the meetings of the UN Commission on Sustainable Development (CSD) in 2004 and 2005 as well as during the Stockholm Water Week of the respective years.

Professional associations increasingly start addressing ecosan: The International Water Association (IWA) has since several years a specialist group on ecological sanitation and during the 4th IWA world-congress ecosan was an important topic. The Indian Water Works Association (IWWA) recently organised a larger international ecosan conference in Mumbai (Nov 2005) and is actively engaged in a series of ecosan projects in India. The German Water Association (DWA) has now put up several expert groups to focus on different aspects of ecosan, aiming at the provision of standards and reliable fact sheets for the innovative ecosan approach.

3 The new sanitation paradigm: ecological sanitation (ecosan)

In order to reach the MDGs and achieve sustainability in the field of wastewater management and sanitation, a new paradigm is clearly needed. This was the unanimous conclusion of a group of experts from a wide range of international organisations involved in environmental sanitation that met in February 2000 in Bellagio, Italy. The group called for a radical rethinking of conventional sanitation policies and practices world-wide. This group formulated the four "Bellagio Principles" the basis for a new paradigm and approach in environmental sanitation (SANDEC/WSSCC 2000a).

Box 2: The Bellagio Principles

The Bellagio Principles (2000)

(1) Human dignity, quality of life and environmental security at household level should be at the centre of the new approach, which should be responsive and accountable to needs and demands in the local and national setting.

- solutions should be tailored to the full spectrum of social, economic, health and environmental concerns
- the household and community environment should be protected
- the economic opportunities of waste recovery and use should be harnessed

(2) In line with good governance principles, decision making should involve participation of all stakeholders, especially the consumers and providers of services.

- decision making at all levels should be based on informed choices
- incentives for provision and consumption of services and facilities should be consistent with the overall goal and objective
- rights of consumer and providers should be balanced by responsibilities to the wider human community and environment

(3) Waste should be considered a resource, and its management should be holistic and form part of integrated water resources, nutrient flow and sanitation.

- inputs should be reduced so as to promote efficiency and water and environmental security
- exports of waste should be minimised to promote efficiency and reduce the spread of pollution
- wastewater should be recycled and added to the water budget

(4) The domain in which environmental sanitation problems are resolved should be kept to the minimum practical size (household, community, town, district, catchment, city) and wastes diluted as little as possible.

- waste should be managed as close as possible to the source
- water should be minimally used to transport waste
- additional technologies for waste sanitisation (sic) and reuse should be developed

These principles were endorsed by the members of the WSSCC during its 5th Global Forum in November 2000 in Iguacu, Brazil (SANDEC/WSSCC 2000b).

3.1 Ecosan, the new paradigm

The new paradigm in sanitation must be based on ecosystem approaches and the closure of material flow cycles rather than on linear, expensive and energy intensive end-of-pipe technologies. Sanitation systems are part of several cycles, of which the most important cycles are the pathogen-, water-, nutrient- and energy cycle. In order to ensure public health, sanitation approaches primarily aim at interrupting the life cycle of pathogens. In addition, the new approach is recognising human excreta and water from households not as a waste but as a resource that could be made available for reuse, especially considering that human excreta and manure from husbandry play an essential role in building healthy soils and are providing valuable nutrients for plants. While conventional sanitation restricts health security to the in-house environment and sometimes leads to a disastrous situation in the neighbourhood or the receiving water body, the new approach is aiming at sanitizing the products instead of exporting problems and apply a health oriented multi-barrier concept of treatment, crop-restriction and exposure control.

This approach, mostly addressed as “ecological sanitation” or ecosan offers an alternative to conventional sanitation. It is based on an overall view of material flows as part of an ecologically and economically sustainable sanitation system tailored to the needs of the users and to specific local conditions. It does not favour or promote a specific sanitation technology, but is rather a new philosophy in handling substances that have so far been seen merely as wastewater and water-carried waste for disposal. It carries with it a new approach to sanitation education, a new discourse, and a new way of managing knowledge.

Ecosan systems restore a remarkable natural balance between the quantity of nutrients excreted by one person in one year and that required to produce their food (7.5 kg nitrate, phosphorous and potassium to produce 250 kg of grain) and therefore can greatly help in saving limited resources. This is particularly urgent with regard to fresh water and mineral resources – for example current estimates for phosphorus state that economically extractable reserves risk to be exhausted in the foreseeable future. Ecosan does not favour a particular technology but is rather a philosophy in recycling oriented resource management and offers modern, convenient, gender friendly and desirable solutions, in accordance with the Bellagio Principles as formulated by the WSSCC (Water Supply and Sanitation Collaborative Council) (SANDEC/WSSCC 2000a).

The core principle of ecosan is to close the loop between sanitation and agriculture, enabling and bringing about “agricultural reuse”, along with other means of closing flow cycles.

Box 3: What is “agricultural reuse” in ecologically sustainable sanitation?

Ecosan approaches uniformly strive to close the nutrient loop between sanitation and agriculture, enabling an almost complete recovery of the nutrients, organic material and water discharegd in conventional sanitation systems. Closing nutrient loops and recycling organic material contributes to safeguarding soil fertility and improving its structure and water retention capacity, while providing a natural alternative to chemical fertilisers.

In ecosan, the term “agricultural reuse” refers to a wide range of productive, ecosystem oriented, reuse options. This includes reuse in what could be considered traditional agriculture, i.e. on farmers fields where crops such as cereals are grown, but also in silvaculture (forestry), aquaculture, market gardening, horticulture, etc. It also includes the reuse not only of nutrients but also of grey water, the organic content of wastewater and energy.

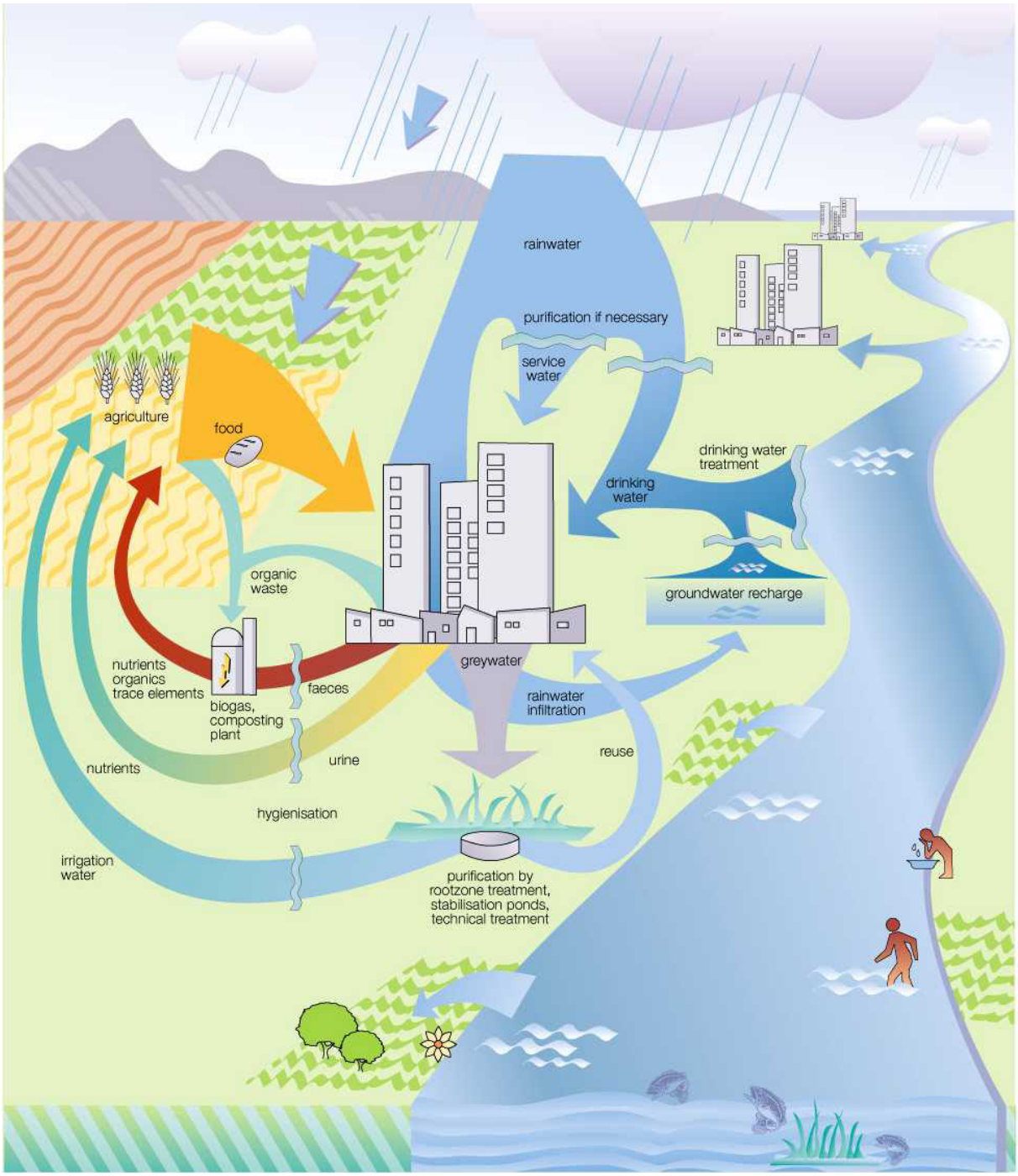


Figure 3: Schematic illustration of the main advantages of ecological sanitation systems (GTZ)

Ecological sanitation systems

In general, sanitation service systems identify several stages in the management of the flow of materials, in which appropriate sanitising and handling of the materials throughout the entire system is essential. Each of these stages can be considered as a specific tactic to deal with specific materials after they have been consumed. Which tactic is applied depends on the requirements needed to fulfil the function of each element in a specific situation. Ecological sanitation systems include the collection – storage – transfer & transport – treatment – and the resource management & reuse stage.

In practice a frequently applied strategy in ecological sanitation management services is to separately collect and treat faeces, urine and grey water, which minimises the volume of valuable drinking water needed to flush away excreta. This has other important advantages as the different fractions have different characteristics and can be treated more easily according to the specific reuse requirements (see Figure 4). Although the recovered material from human excreta is predominantly used in agriculture, urine as direct fertiliser and faeces as organic matter for soil improvement, the reuse options within ecological sanitation are not limited to agriculture only, especially considering grey water. Other reuse options include the domestic reuse of grey water, following suitable treatment, for example for flushing toilets, or possibly its use as service water in industry, or its use to recharge groundwater. Rainwater use could also be incorporated into this, with rainwater possibly being treated and being used for drinking water. Organic material can also be recovered to generate biogas, or perhaps even as a general soil amendment. Biogas production allows to recuperate the energy contained in liquid and solid household wastes, and to put it to an array of uses, such as cooking, electricity generation, heating purposes or even for industrial use.

Considering resource management, the ‘market’ is the major player in the design of the reuse stage. Taking into account this ‘market’ affects the whole design of a sanitation system and means e.g. that there is a need for a product with certain characteristics in terms of chemical and hygienic quality, concentration, volume, liquid or dry status, etc.

Concluding, the split-stream collection, treatment and reuse of different waste(water) flows often offers new possibilities for more specific and cost-efficient solutions and enables a more active involvement of the solid sanitation sector, where there is already a great deal of experience in the logistics, treatment and marketing of discarded resources. However, as stated above: Ecological sanitation does not favour a particular technology but is rather a philosophy in recycling oriented resource management and offers modern, convenient, gender friendly and desirable solutions for all.

3.2 Material cycles in ecological sanitation (ecosan)

Closing local nutrient cycles by recovering and using the nitrogen, phosphorus, potassium, micro nutrients and organic components contained in excrement is important not only because it can help minimise the energy and resource intensive production of mineral fertilisers, but also because it makes such agricultural inputs available even to the poorest farmer. Mineral fertilisers are often too expensive in many parts of the world or are simply unavailable to local farmers, who often turn to using the untreated contents of toilet pits or septic tanks on their crops. The long-term effects of mineral fertilisers on soil and food quality are also in dispute.

Whilst often making treatment easier and less expensive, the separate collection and treatment of the flow stream is however not a prerequisite in ecosan systems, and ecological sanitation is also possible in centralised and combined flow systems.

Separated waste (water) flows can be characterised as follows:

- black water - a mixture of faeces and urine with or without flushing water
- yellow water - urine only or mixed with flushing water
- brown water - black water without urine, with flushing water
- grey water - domestic water without toilet wastewater

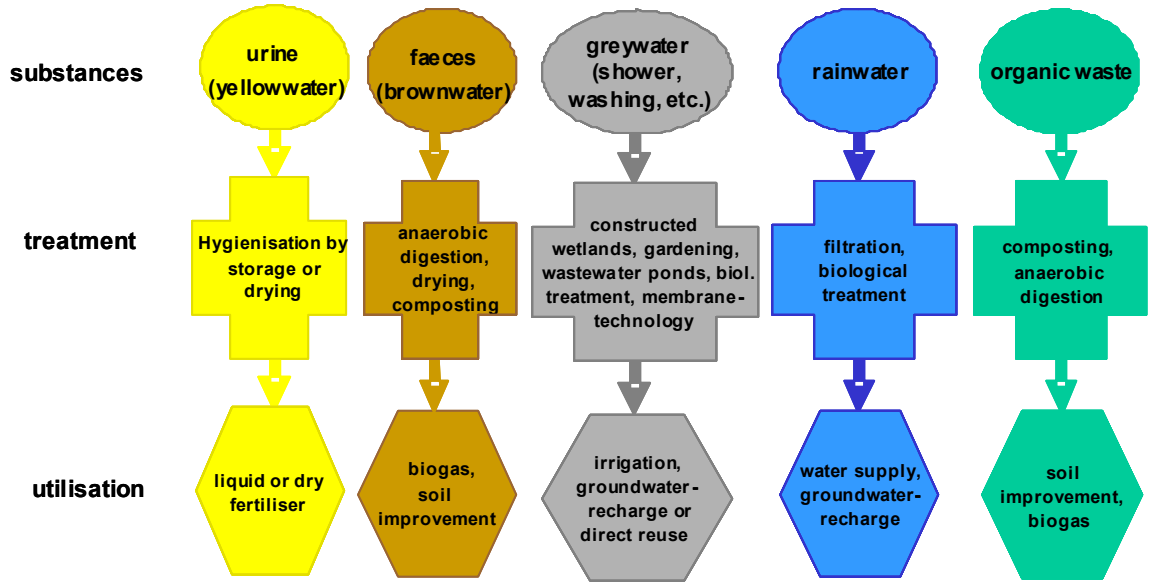


Figure 4: Separation of substances and examples of possible ecosan elements (GTZ)

Ideally, ecosan systems enable an almost complete recovery of all nutrients, trace elements and energy contained in household wastewater and organic waste and their reuse in agriculture. An essential step in this process is the appropriate treatment and handling of materials during the entire treatment and reuse process to ensure a sufficient sanitisation of the excrement and the protection of the public health. Therefore, ecosan systems not only control the direct hygienic risks to the population but also protect the natural environment.

It is the enormous economic potential which makes ecosan so attractive, particularly with respect to the water and energy balance.´

Human faeces obtained after separation, show valuable soil improvement qualities (particular improving the structure of the soil and raising its water retention capacity). If required, they can be treated together with the organic fraction of solid waste and/or animal manure and in a way suited to local conditions (climate, power demand, socio-cultural acceptance etc.) using the processes of aerobic composting, dehydration, stabilisation, or anaerobic digestion. This allows the organics and nutrients contained in faeces to be used in a concentrated and hygienically safe form as a dry fertiliser, compost or a fluid fertiliser. Depending on the type of treatment energy can be produced if necessary in the form of biogas after anaerobic digestion.

Urine, the yellow water, contains approximately 90% of the total nitrogen, 55% of the total phosphorus and a substantial portion of the potassium contained in human excrement. These nutrients are in a form directly available to plants, and can be used as effectively as some mineral fertilisers. A partial flow separation and use of urine is advisable due to its low volume and the high concentration of nutrients in it. In order to obtain the yellow water fraction devices such as urine diversion toilets or waterless urinals can be used.

The water used for domestic purposes such as washing clothes, or from showers is known as grey water. This makes up the largest proportion of the total wastewater flow from homes, but has only a very low nutrient content. It can therefore be fairly easily treated to a high quality using simple techniques such as constructed wetlands, ponds, bio-films or activated sludge processes. For high-tech applications more sophisticated treatments, such as membrane filtration or activated carbon filters, may eventually be added. Treated grey water can be put to particularly good use for agricultural irrigation (especially in water scarce regions), but may also be used for groundwater recharge, industrial or urban reuse or discharged into surrounding watercourses.

Table 1: Characteristics of flow streams

Fraction	General characteristics
1. faeces	• hygienically critical, potentially containing a series/array of pathogens, leading to water-borne diseases (e.g. bacteria, viruses, protozoa, nematodes, worm-eggs) • consists of organics, nutrients and trace elements • improves soil quality and increase its water retention capacity • average production ca. 50 kg/cap/a • consists mainly of organics submitted to decomposition processes and a minor proportion of nutrients
2. urine	• hygienically uncritical • contains the largest proportion of nutrients available to plants • may contain hormones or medical residues • average production ca. 500 l/cap/a • consists mainly of nutrients available to plants and very little organics, therefore no need for stabilisation
3. grey water	• usually of no major hygienic concern • volumetrically the largest portion of wastewater • contains usually almost no nutrients (simplified treatment) • may contain a vast range of various substances • average production 25 – 100 m³/cap/a

Diverse technologies can therefore be used in ecological sanitation systems, from quite simple low-tech to sophisticated high-tech solutions. These currently range from compost toilets or urine-diverting dry toilets, to water-saving vacuum sewage systems, possibly with separate collection and subsequent treatment of urine, faeces and grey water through to membrane technology for material separation and decontamination. Generally, in ecosan systems precedence is given to appropriate modular and decentralised facilities, although in very densely populated areas centralised systems may still be needed.

The essential advantage of the modular components is their flexibility allowing an optimal adaptation to the local social, economic, ecological and climate conditions. As a result, they offer a more rapidly realisable and economic alternative to conventional systems. Another advantage is, that even simple dry ecosan toilets can be constructed directly indoors in very poor areas. These toilets do not require a pit and so do not endanger the stability of the house, and have neither flies nor odour when well managed. Indoor toilets contribute to the security of the user, particularly women and girls who use the toilet at night. They also save a good deal of time, as adults, normally women, can help children, sick, elderly or disabled people to the toilet with only a minimal delay in other activities.

Of particular importance in ecosan approaches are innovative institutional arrangements, financial mechanisms, and logistics to return the nutrients to farmland, marketing strategies for the recovered nutrients and directions for their safe application in agriculture. New ecosan schemes may also entail setting up service enterprises and hence kick starting income generating measures for the construction and easy and safe operation of the installations as well as the collection, treatment and marketing of the recyclates.

3.3 Technologies in ecosan

The technology in ecosan is not necessarily characterised by the development of completely new elements, but by their use in other contexts and functions. The designer of medium and larger scale systems is recommended to make use of existing standardised elements such as pumps, armatures etc. It should be recalled that many parts of ecosan components, although field-tested in pilot projects and described in literature are far from standardisation in their new context. For example in vacuum toilets and vacuum sewers there is a long experience gained from the use of these components in ships and aircrafts. However they have to be adapted for the large-scale use in urban conurbations.

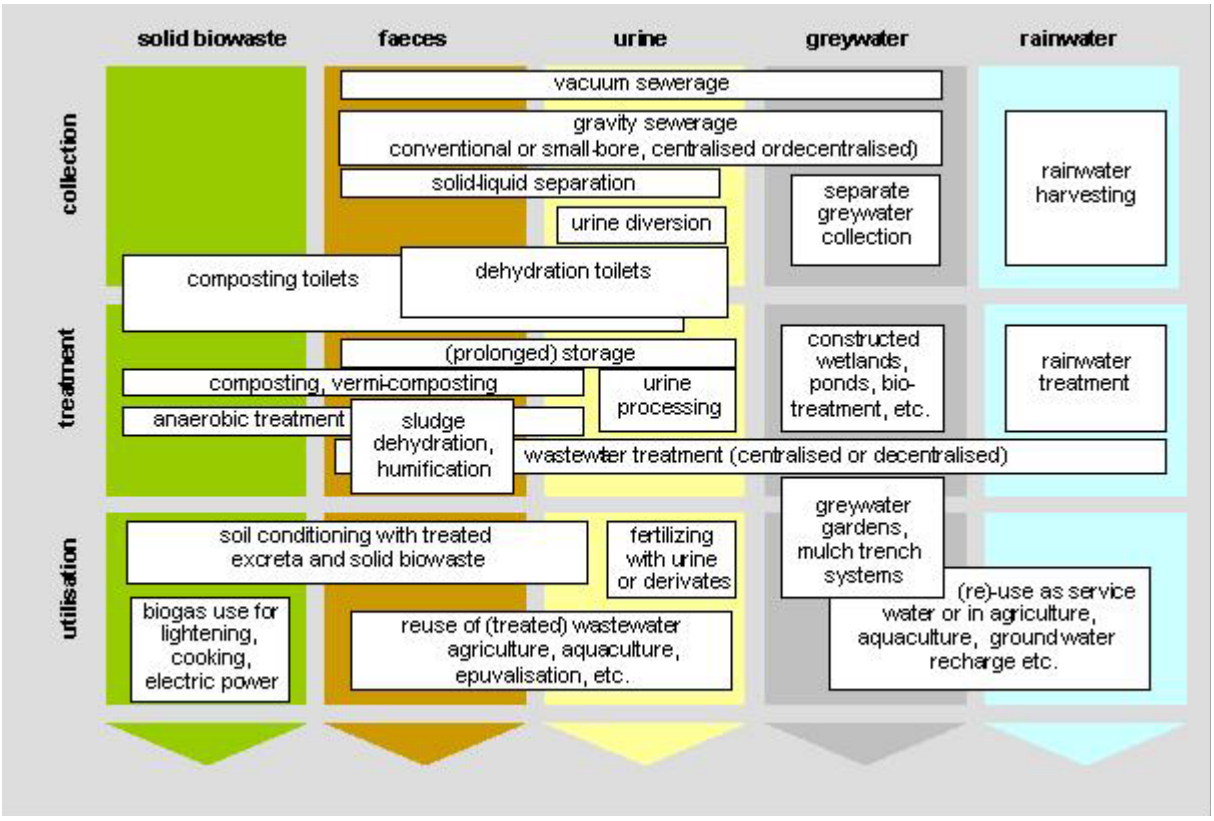


Figure 5: Essential technological components used in ecosan (GTZ)

The GTZ-ecosan sectoral project has started to develop “technical data sheets” as well as “project data sheets”. These contribute to a standardised knowledge management and allow collecting first standard information on components, systems and projects. This shall form the basis for future research on components and systems to get a state-of-the-art design with well defined and reliable parameters (GTZ –technical data sheets 2005, GTZ –project data sheets 2005).

3.4 Tools for the planning and implementation of sustainable sanitation projects

To date most participatory approaches applied in sanitation projects have been developed mainly with a rural context in mind, with similar tools for densely populated urban areas still lacking. As these approaches were developed for, or adapted to, programmes dealing with conventional systems of water supply and sanitation, they require adaptation in order to adequately address issues which are of vital importance in ecosan programmes, such as the hygienically sound reuse of recyclates from household sewage in agriculture, and the needs of the user of the recyclates. In an urban environment one of the few publications dealing directly with participatory approaches are the "Tools to Support Participatory Urban Decision Making", from the United Nations Centre for Human Settlement (UN-Habitat 2001).

While lacking ecosan specific elements, these participatory tools have in many cases shown a great deal of success in water supply and sanitation programmes. They therefore have a proven track record that should not be neglected. These tools should be adapted wherever possible to the specific needs of ecosan programmes enabling them to address the philosophy of a closed loop approach to sanitation.

A relatively new tool for environmental sanitation is seen as being almost ideal for ecosan projects. This is the Household Centred Environmental Sanitation Approach (HCES), a new approach for planning environmental sanitation services, with the promise of correcting current unsustainable practices in planning and resource management by concentrating on the below given two main components (Eawag 2005).

Box 4: The two main components of the HCES

(1) The focal point of environmental sanitation planning should be the household, reversing the customary order of centralised top-down planning. The user of the services should have a deciding voice in their design, and sanitation issues should be dealt with as close as possible to the site where they occur. With the household as the key stakeholder women are provided with a strong voice in the planning process, and the government's role changes from that of provider to that of enabler;

(2) A Circular System of Resource Management should be used emphasising the conservation, recycling and reuse of resources, in contrast to the current linear sanitation service system.

First, planning with a household or neighbourhood-centred approach places the user at the core of the planning process. The HCES responds to the knowledge, needs and demands of the users.

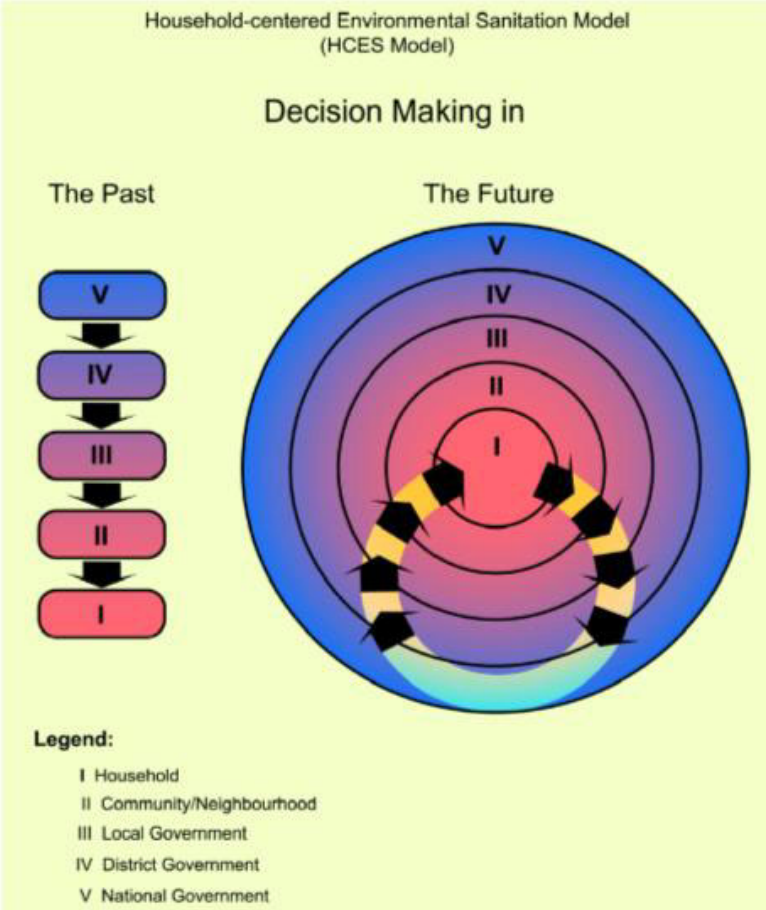


Figure 6: Decision making in the past and in the future according to the HCES (Eawag 2005)

The above figure presents the radical re-think of current planning practices, proposed by the HCES. This approach attempts to avoid the problems resulting from either “top-down” or “bottom-up” planning approaches, by employing both within an integrated framework.

Secondly, HCES is suggesting to minimise the transfer of waste across circle boundaries by reducing waste producing inputs (e.g. water) and by maximising reuse and recycling activities. Ecosan projects are obviously promoting and applying this concept in a very systematic way. The HCES approach refers to the Bellagio principles, but not specifically to the ecosan philosophy. However, the HCES and the Bellagio principles are both fully compatible with the ecosan philosophy. The draft of a guideline for implementation of projects in line with the HCES approach is available now (Eawag 2005). Field testing of the guideline and the collection of feedback are foreseen as the next phase.

A specific adaptation of the HCES for ecosan projects was established in the GTZ ecosan source book (Werner et al. 2003a). As discussed there, certain key tasks and moments in the course of an ecosan project may determine whether and how the programme will continue. The simplified flowchart of the process (see figure below) shows these key moments as being either workshops or reports, although in reality a wide range of different tools and methods could possibly replace them. In our view this flowchart and description of these key moments is useful as it transforms the theoretical steps into an idealised practical example.

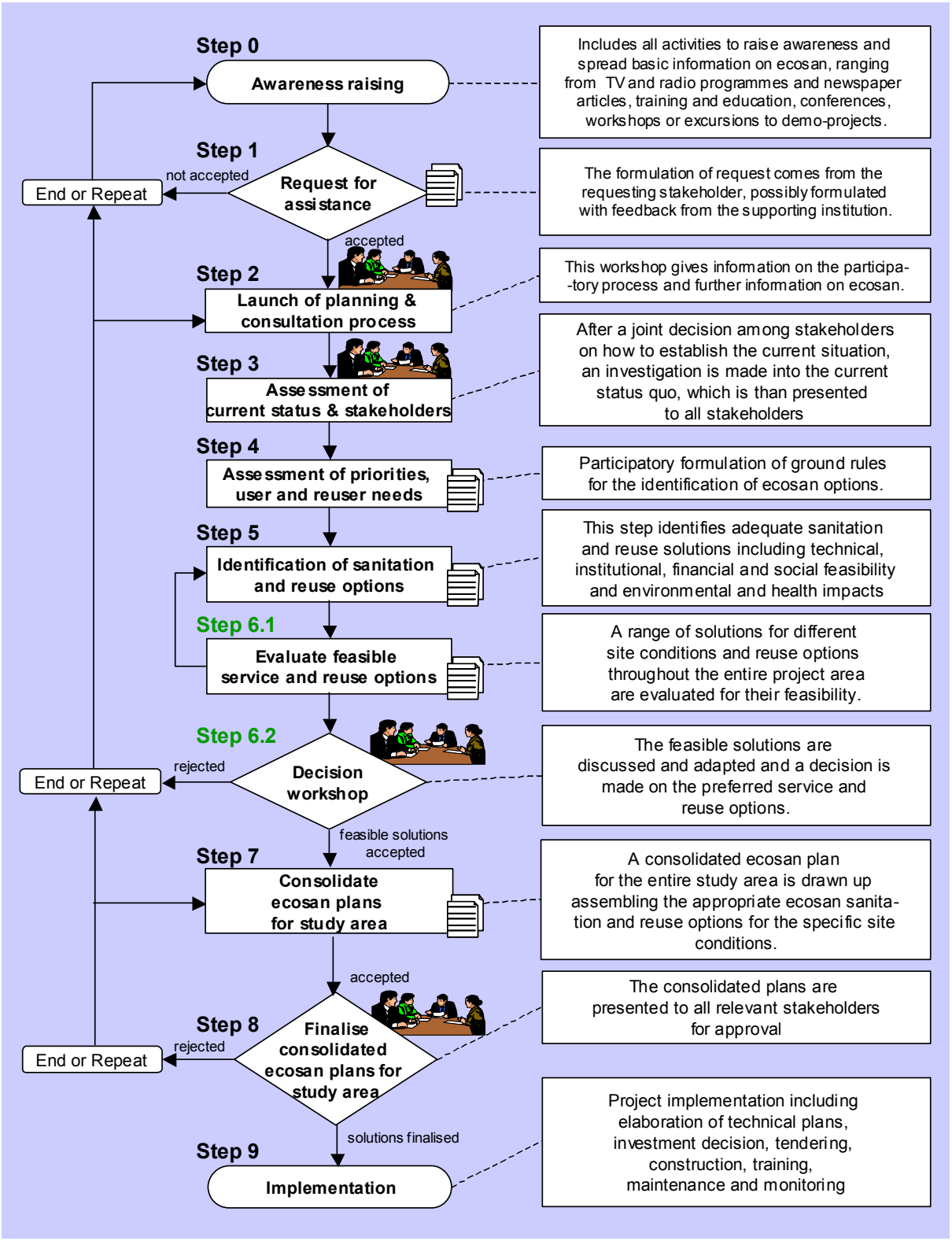


Figure 7: The "ecosan project steps" – key moments, necessary activities and expected results (GTZ)

3.5 Types of ecosan projects and stakeholders involved

Ecosan projects have proven themselves around the world in a rich variety of applications. Environmentally friendly settlements in the temperate climates of northern Europe have employed closed-loop sanitation systems, treating their grey water locally and providing agriculture with fertiliser from urine diversion or from the sludge of biogas plants, as can be seen, for example, in Germany, Norway and Sweden. In China, the combined treatment of human excreta and animal manure in small scale bio-gas plants is common and from 1997 to 2005 around 1.000.000 urine diverting dry toilets have been constructed in a project that started in Guanxi province (Liu and Mi 2003, GTZ –project data sheets 2005-005).

Project Box 2: Urine diverting dehydration toilets in China (GTZ –project data sheets 2005-005)

The "Urine diverting dehydration toilet dissemination programme, Guanxi province, China" was initiated in 1997 by the Chinese Government in co-operation with Sida and UNICEF. The initial demonstration project began with just 70 toilets. There are now more than 1 million installed double vault urine diverting dehydration toilets spread across several provinces.

Figure 8: ecosan urine diversion squatting pan (left); ecosan in-house toilets (middle and right) (SIDA)

A plastic urine-diverting squatting pan is produced locally for approximately 8 EUR.

To improve the dehydration and sanitisation of the faeces, a shovel full of ash is thrown onto the faeces chamber after defecation. When the first chamber of the double vault is full, the squatting pan is turned round, and the second chamber is used. The dried faeces from the vault are removed once or twice a year, depending on the chamber filling cycle. They are applied by digging them into the roots of plants. Urine is collected once or twice a week and applied directly to crops.

The basis of the success and acceptance of this system is the traditional use of urine and excreta in agriculture in China, and the absence of prejudices and questioning of their agricultural value. Other advantages noted by the users include: the system is simple and easy to construct, can be easily adapted to local needs and is affordable. In addition water consumption is reduced, the toilets are clean, do not smell, and have no flies. This allows the toilet to be directly constructed inside homes, making them more comfortable, convenient and safe for families to use, particularly for women and children, and resulting in savings for the construction of an external superstructure, and in a better operation and maintenance.

At present a dry urine diverting system is being installed for 7.000 people in Erdos City in inner Mongolia, whilst in Mexico an ecosan programme began in 2002 to address the sanitation needs of the population of Tepoztlán, an urban centre with approximately 40.000 inhabitants just south of Mexico City. In southern Africa, pre-fabricated dehydration toilets have been available on the local market since 1994, with over 18.000 of this type of decentralised units installed world-wide. Each one of these projects employs a different technology, tailored to the needs of the user and the local market.

Project Box 3: TepozEco municipal ecosan pilot programme, Mexico (GTZ –project data sheets 2005-012)

The town of Tepoztlán, located within a national park in Mexico, has an enormous contrast between poor, indigenous areas and luxurious weekend homes. It also has a special history of environmental activism and has become an important tourism destination.

The objective of the TepozEco project is to establish a functioning example of urban ecological sanitation, including household eco-toilets, a system of communal collection of organic refuse, greywater and organic solid waste management, eco-stations for the secondary treatment of toilet output (urine and dehydrated faeces), and recycling of nutrients for urban agriculture.

The technologies, which have been applied in the project, include urine-diverting dehydration toilets with a dehydrating chamber with two large plastic recipients, a urine collecting container, a vent pipe and fly trap.

Figure 9: Dehydrating chamber with 2 containers and urine collection (left); organoponics (right) (TepozEco)

Low cost shallow pit composting sanitation system prototypes were also installed for poor peri-urban and rural populations (using the arborloo and fossa alterna systems pioneered initially in southern Africa) as well as public and institutional waterless male and female urinals. Reed-bed or mulch greywater filtering systems for mechanical and biological treatment, and rainwater harvesting and filtering systems with sedimentation and volcanic gravel filtration were constructed. To promote urban agriculture and nutrient recycling, a cultivation technique called organoponics was introduced. It works in any type of container or garden bed, which is mostly filled with compacted dry leaves, soaked with fermented human urine, and topped with a layer of soil to produce vegetables and aromatic plants.

The introduction of a reuse system of organic residues in the urban context of Tepoztlán is seen as a strategy for recovering and recycling valuable nutrients to support local agricultural production and to stimulate self-reliance. An additional aim is to conserve water, considering the increasing amount of tourism in the municipality.

The work of the TepozEco project to date has in many cases resulted in the integration of dry toilets into households and a demystification of human waste for use as a fertiliser.

The mix of different framework conditions, technical options, stakeholders involved and motivations, serves to ensure that no two ecosan projects are alike. For the moment therefore, there is no such thing as a typical ecosan project. However, on the basis of experience gained, it is possible to broadly identify four basic types of ecosan projects, and give a general description of the stakeholders involved, their degree of participation in the process, and the activities to be undertaken. This helps with the identification of the tools and instruments that may be necessary, and who may need them, at different stages throughout the project.

The four broad categories of ecosan projects given here are quite general in their description. Projects in reality may not fit so neatly into one of the categories and individual projects may lie somewhere in between two types. The four basic types are therefore mainly intended to provoke reflection on who the stakeholders in a project might be, what their roles and information needs could be, and what tools should be foreseen to encourage their participation.

3.5.1 The 4 basic types of ecosan projects

Project type A (rural upgrade) corresponds to what could be considered as the "classic" ecosan-project. Farming households, in rural areas, receive support to establish ecological sanitation systems either on their compounds or in their houses. The farming households are usually responsible for the handling of the recyclates (most often only urine and faeces), using them on their own fields as fertiliser and soil conditioner. Grey water treatment and reuse, rainwater harvesting, and organic waste management can be integrated into the system, although this is rarely practised in this type of project.

The decision to implement ecosan may result from the initiative of a local NGO or CBO engaged in ecological development. The organisation may start their activities by contacting local opinion leaders, informing them of the ecosan approach and asking for their support. It is hoped that once these people have accepted the system, a broader introduction among the farming households will be facilitated and accelerated.

The decision can also however be made at the political macro-level, for example within the framework of a rural development programme. This would involve a large number of farming households in the project, enabling economies of scale to be made, but possibly complicating the participation process. In this case, information structures (public/private) and appropriate financing methods would generally be provided by the government.

Project type B (peri-urban and urban upgrade) corresponds to ecosan projects implemented in all existing urban or peri-urban areas of cities and towns in the course of renovation or rehabilitation work. Here more or less well functioning existing sanitation systems are converted to closed loop systems. This therefore applies to all areas, from informal settlements to luxury multi-storey apartment or office blocks, where the existing infrastructure is to be upgraded to ecosan systems. The implementation of such projects generally tends to be much more complex than those in areas of new development, for several reasons. The use of the existing infrastructure may still be foreseen in the project, which means that ecosan solutions must be built around this system, which may cause a considerable degree of technical difficulty. Private households may also only reluctantly agree to convert their sanitary facilities to ecosan, as they will most likely have to foot the bill for the change over. Private investors may also not be willing to participate in such projects as there is a considerably smaller opportunity for them to make a profit. Additionally, these built-up areas may have very little space for the installation of decentralised solutions. Projects in this context may therefore have to adopt a long term approach to the completion of an ecosan system, with innovations being introduced gradually over many years.

The ultimate handling and reuse of the recyclates (faeces, urine, grey water, rain water, storm water, organic waste and energy) is carried out, either only partially or for a particular recyclate, by the householders themselves in an urban context (in vegetable gardens, urban agriculture, for toilet flushing etc.). More usually, however, the households may not have the opportunity, or the need, to use the recyclates themselves. In such cases external service providers, working either privately or for the municipality, can be charged with collecting, treating, storing and marketing the recyclates, eventually transporting them to a reuse site, for example in urban parks or to farmers cultivating on the outskirts of the town, for energy production or for producing service water for private or public users.

The initiative for projects of this type can come from a variety of sources. The households concerned may themselves initiate the project on a local level, but it can also come from the macro-level, for example in the case of improvement projects for informal settlements implemented by the municipality or the government. The projects in this case address a large number of households, with the degree of support from the authorities (government/ municipality) being considerably stronger (regulation, financial support) than from local micro-initiatives.

Project Box 4: Gebers collective housing project Sweden (GTZ -project-data sheets 2005-008)

The Gebers collective housing project is located near a nature reserve in Orhem, a suburb of Stockholm. It was promoted by a network of friends and neighbours, who converted a deserted and vandalized building complex into 32 apartments with a total of 80 inhabitants. With the installation of a closed-loop system for toilet- and organic waste, the project contributes to the environmental protection of the reserve.

Figure 10: Gebers apartment building (left); composting of faeces and organic waste (middle); urine application on a barley field (right) (VERNA)

Urine-diverting toilets were installed to separate urine and faeces, which is then further treated before reuse. The urine is flushed with water and piped to polypropylene collection tanks under the house. The faeces are collected without flushing water and fall straight into individual ordinary plastic bins in the cellar. The plastic bins are housed in a special compartment which is constantly under negative pressure through ventilation. This improves dehydration of the faeces and prevents odours from entering homes. The urine tanks are emptied about twice a year by a tanker truck and the treated urine is used as fertiliser in agriculture.

The faeces are composted together with other organic household wastes. The resulting compost has a soil-like appearance. It is planned to use it as a soil conditioner in agriculture to produce horse feed.

Generally the project highlights how motivated the users are able to implement appropriate solutions for a more sustainable lifestyle.

Project type C (new development) is to be found when new dwellings or development areas are being constructed either by the authorities (national, regional or local government) or by private developers (these are normally private businesses, but may sometimes also include citizens groups who wish to build their own homes in an ecological way). The dwellings come equipped with ecosan systems, and these systems are therefore considered from early on in the planning stage, facilitating considerably the consideration of all relevant aspects of town planning, land use, (urban) agriculture, water management and so on, as well as their rapid and comprehensive introduction. They are often sold or rented to a relatively well-off section of the population, if the developers themselves do not occupy them. There is however also the possibility of new development areas with closed-loop ecological sanitation systems being constructed specifically for low-income households. Because of the urban location and the favourable planning conditions, all the treatable resources (urine, faeces, grey water, rain water, storm water and organic waste) may be integrated into these sanitation systems.

Depending on the social status and activities of the users of the sanitary facilities, the handling and reuse of the recyclates may proceed in two ways: (1) they could be collected and treated by a service provider (either private or from the municipality) at a certain cost to the users. The products are then used by a third party (e.g. farmers, city parks etc.) who may have to buy and transport the products or (2) the households themselves collect and reuse the recyclates on their own plots of land (gardens / urban agriculture).

In projects of type C, the initiative to opt for an ecosan system often comes directly from the investors (i.e. the private developers or citizens group) or the local, regional or national government and their respective planners. Householders then first come into contact with the system when they move into

their bought or rented property. They should, at the latest, be informed at this point of the principles and operation of their ecosan system.

Basic types of ecosan-projects

Project-type / Characteristics	A	B	C	D
	 rural upgrading	 urban upgrading	 new development areas	 non-residential (schools, offices ..)
• User of sanitation facilities	household	household / neigbourhood	household / neigbourhood	tourists, employees, pupils ...
• User of the end products (Range: in house / other)	household	household (partly) / farmer, external user (partly)	household (partly) / farmer, external user (partly)	user-institution (partly) / farmer, external user (partly)
• Level of initiative and Decision (min / max)	micro / macro	micro / macro	macro	micro / macro
• Considered resources (minimum / optimum)	faeces + urine only / plus greywater, rainwater harvesting, organic waste	faeces + urine + greywater only / plus rainwater harvesting, stormwater management, organic waste	faeces + urine + greywater + stormwater-manage-ment / plus rainwater harvesting, organic waste	faeces + urine + greywater + stormwater-manage-ment / plus rainwater harvesting, organic waste
• Service provision for operation, transport, treatment and marketing (Range: in house / other)	household	household / public/ private service provider	household / public/ private service provider	user institution / public/ private service provider

Figure 11: The characteristics of the 4 basic types of ecosan projects (GTZ)

Project type D (non-residential) covers all ecosan applications in buildings and areas that are not intended for normal residential use. Examples of these include public institutions, such as schools or hospitals, private establishments, such as banks or offices, as well as hotels or holiday lodges situated in sensitive areas (e.g. in national parks or on islands), or in regions that are not being served by the public sewer network. Projects of this type may address the upgrading or rehabilitation of an existing conventional sanitation system to ecosan or the construction of a new building with a closed-loop sanitation system. Depending on the circumstances, upgrade or new construction, different levels of technical difficulty may be encountered.

All recycling options are possible in such projects, with the integration of grey water, rainwater and organic waste into the system along with the use of faeces and urine. The handling of the recyclates can be carried out either by the users of the building (e.g. employees, pupils etc.) or service providers are engaged, requiring a marketing and transport of the recyclates to the end users.
The decision to use an ecosan system in this case can be taken at the micro level, if the owners of an individual building, for example a hotel, voluntarily opt for closed-loop sanitation. Alternatively, macro level decisions, for example that all schools should implement ecosan or that certain natural resources in a region must be protected, can be taken at governmental level.

3.5.2 Stakeholders in ecosan projects

In general stakeholders are those groups of individuals or organisations who have an interest in the outcome of a particular process. They can range from households and community based organisations to local, regional and national government, and can also include private sector institutions, social services, such as health and education, national and international donor institutions

and civil society at all levels. Relevant stakeholders are those who should be involved in a particular process, as well as those who are mainly affected by it or involved in the related decision making process. The relevant stakeholders in ecosan projects are described below. However, the relevance of a certain stakeholder is dependent on both the type of ecosan project as well as on the project phase, with their roles and tasks varying. Therefore, not all the stakeholders presented in the following stakeholder analysis will always need to participate in the programme.

The number of different stakeholders that may be involved in a project can be quite large, depending on its type and scale, and will include very different individuals, groups, institutions, etc. Even within stakeholder groups there may be smaller sub-groups, who may in turn be sub-divided into even smaller groups. For example a community based organisation may be considered as representing a stakeholder community, however this community consists of different interest groups such as men, women, the elderly, the young, the poor, the wealthy, etc. who may also consist of other small sub-groupings. It is therefore extremely difficult to directly address the needs and concerns of all stakeholders. However, a detailed stakeholder analysis should be carried out at the start of an ecosan project in order to identify who are the individuals, groups or institutions that will be relevant to the process and to work out ways in which large stakeholder groups may be effectively addressed and represented in the process.

The stakeholder analysis given below, aims to give an overview on the possible types of stakeholders who may be involved in a project. This list aims to assist reflection on who the stakeholders might be, by providing a general overview of the types of stakeholder.

- **(I) Users of sanitation facilities:** In many cases the user of the sanitary facilities can be considered as the individual households. In the context of most sanitation projects the term household is generally applied to describe the smallest user unit, composed of different individuals (e.g. women, men, children, the elderly, handicapped people, the rich, the poor, etc.) each with perhaps their own needs and expectations with respect to levels of comfort, hygiene, privacy, ease of use and maintenance, construction and maintenance costs, etc.. Due to the wide range of household types and their different expectations, the role of the household in an ecosan programme varies enormously. In projects of type A (rural upgrading) the households are usually the final decision makers and are often responsible for the construction and maintenance, as well as the collection and treatment of the recyclates, whereas in projects of type B, the households may be only very marginally involved in these processes, with service providers collecting the recyclates, possibly for further treatment, generally against payment. In practice it is often necessary to determine if the user of the facilities in a house is also the homeowner as this may have a decisive impact on the decision to invest in an ecosan system. In urban areas the household may prove to be too small a unit to work with (for example in a large apartment block or neighbourhood). In such cases it may make more sense to consider all the people living in a building or settlement as a single unit and to work with a neighbourhood group.
- **(II) Users of the recyclates:** In some cases, these may be the users of the sanitation facilities (e.g. the households) themselves. In urban areas, the users of the sanitation facilities **may** not be able to fully reuse the recyclates due to their particular situation (confined space, no gardens etc.) and may only be able to partially reuse the different flow-streams (e.g. using of rainwater for washing, grey water for toilet flushing, energy for cooking etc.). Here the majority of the recycled organic material and nutrients will be reused outside of the urban area by external users such as farmers or foresters. They may also be used within the town in urban agriculture, by market gardeners, municipal parks etc. who receive the recyclates from a service provider or directly from the households. Recycled water (including grey water and rainwater) may be used as service water by industry or small businesses, or to irrigate recreational areas, or even in aquaculture.
- **(III) CBOs and self-help groups** are generally formed by user-groups. These organisations may already be in existence before the introduction of ecosan or may be created in response to an ecosan project. CBOs and neighbourhood groups provide the households or other users involved, the opportunity to **exchange** experiences and to obtain advice from their peers. These groups may also support their members to organise the delivery of the different services needed (maintenance, collection, treatment etc.) and the use of the produced fertiliser at the level of the CBO/ neighbourhood-groups. In an ecosan programme CBOs may eventually develop into (market-oriented) service providers (maintenance, collection, treatment etc.)

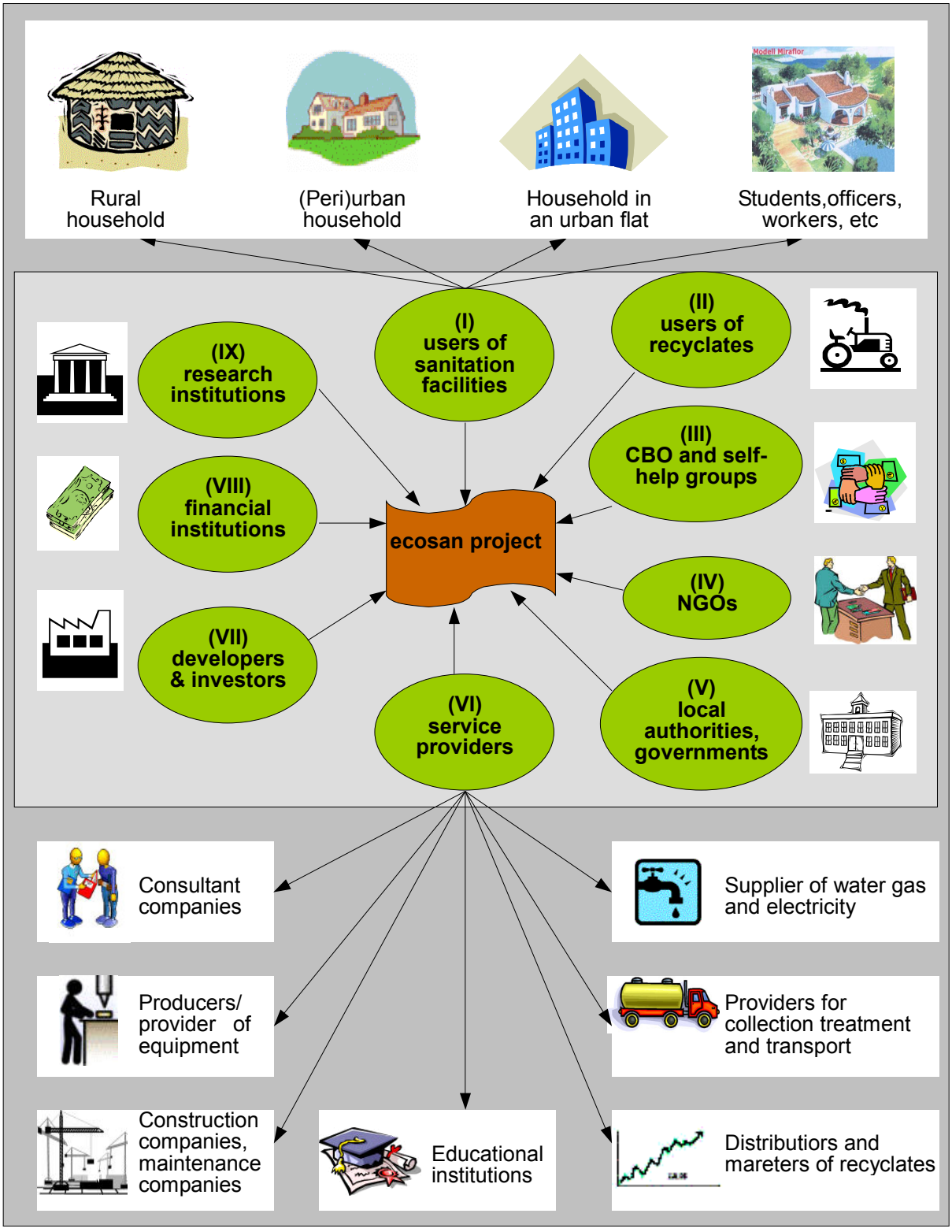


Figure 12: Principal stakeholders in participatory ecosan projects (GTZ)

- **(IV) NGOs** are generally of great importance regarding information and awareness raising among potential users. They also often support the households in forming CBOs and neighbourhood-groups and advising them on the use of eco-sanitation systems, and support (poor) households by connecting them to financing institutions, municipalities, producers of ecosan equipment (bulk-buying) etc.
- **(V) Local authorities** and governmental institutions are responsible for establishing the framework conditions for the implementation of ecosan systems. They can however also be directly involved, for example by initiating local or regional sanitation programmes promoting or even requiring ecosan, providing subsidies to households, collecting user-fees and disseminating information to potential user households. Governments are also responsible for ensuring the creation of a legislative enabling environment making it possible to install and use ecosan systems to their full potential.
- **(VI) Service providers** is a term that encompasses a wide range of diverse stakeholders, engaged in public or private market oriented activities of service provision, for situations where user households are either not willing or unable to carry our certain activities on their own. In an ecosan programme these could include planners, consultants, equipment producers / suppliers, construction companies, academic institutions, utilities providers, and companies involved in recyclate collection, transport, treatment, packaging and marketing services. Service providers carry out their different tasks against payment. Along with being users of the recyclates, farmers could also act as service providers in ecosan projects by collecting and treating excreta from the users of the sanitary facilities.
- **(VII) Developers and investors:** These can be either private or public investors, who initiate the construction of residential units to be sold or rented. The introduction of ecosan is thus tightly related to the demand for houses / flats with such systems anticipated by these investors. In these cases, the developers themselves may be very actively involved in the planning and implementation process of the entire programme.
- **(VIII) Financial institutions:** The introduction of new infrastructure generally requires that the investment and operation costs are secured. Initially in conventional sanitation systems, investment costs for public sewer systems and treatment plants are generally initially covered by local authorities. The costs for both the public part of the system and its operation are however later recovered from the users through fee collection. The private owners of the buildings have to provide the investment and operation costs for the in-house installations and on-plot part of the system (bathroom equipment, house installations, branch and house drains, or on-plot treatment). With the introduction of ecosan, it is assumed, that the total costs of the system (i.e. of the private and public parts together) will be considerably reduced, however the costs to be borne by the private householders may possibly increase (on the other hand, if one were to take into account the initial cost to connect to a conventional sewerage network into the private costs of conventional systems, it quickly becomes apparent that this is also a considerable sum to be covered by private money and ecosan systems may also be cheaper in this regard). In any case, new financing instruments may have to be developed in ecosan projects in order to support these private investments as only a small part of the user households may be able to pay these costs immediately, at the time of the installation of the sanitation system. Large scale application of ecosan sanitation systems may therefore necessitate the introduction of corresponding subsidy or credit schemes, and thus the involvement of financial institutions, such as local or international banks or donor agencies. During the piloting and development stage of new ecosan-systems, additional funds are also needed for the start-up phases of projects, the development and introduction of new technologies, technical, agricultural, environmental and social research, and the market introduction of hardware producers or service providers.
- **(IX) Research institutions:** These may be universities or other research oriented institutions or organisations. They can fulfil different tasks by providing advice to programme initiators, such as developers, municipalities and NGOs. Universities and research institutions can also initiate ecosan programmes for research purposes, usually with external financial assistance. They also have the important role of providing research results regarding their research, which can then be disseminated and used for information, advocacy and lobbying activities among the different stakeholders.

The table below (Table 2) presents some of the factors that may either encourage (motivating factors) or discourage (constraints) different stakeholders to opt for ecosan solutions. The table does not present an exhaustive list of all the motivating and constraining factors all the stakeholders may have, but should serve to provoke thought on what these factors may be. In many cases the motivating factors represent expectations of the stakeholders involved, while the constraints represent their fears. It is important that all stakeholder groups are well informed of how an ecosan system could work for them to avoid unrealistic expectations and groundless fears.

Table 2: Factors motivating and constraining stakeholders to participate in an ecosan programme

Principal stakeholders	Examples of motivating factors	Examples of constraints
I. Users of sanitation facilities households, neighbourhoods tourists, pupils employees, …	• hygiene improvement, • structural stability, • local physical factors (high groundwater table, rocky ground…) • reduced costs, • increased comfort, • improvement of quality of life, • greater security, • interest in recyclates, • prestige, • ecological reasons, • water scarcity, • unreliable water supply, • …	• culture, habits, taboos, • hygiene concerns, • unfamiliarity, • fear of loss of comfort, • unavailability of structural elements, • legislative restrictions, • economic factors (e.g. for start-up etc.), • …
II. User of recyclates	• economic reasons, • local and reliable availability of agricultural inputs (water, nutrients, organics), • increase of crop yields for either the market or for family needs, • improvement of self sufficiency, • ecological reasons, • …	• culture, habits, taboos, • lack of logistics, • fear of negative consumer perception, • fear of negative long term effects on soil, • …
III. CBOs and self-help groups	• failure of conventional / existing sanitation system, • local improvement of quality of life, • Agenda 21, • interest in recyclates, • reduced costs, • local physical factors (high groundwater table, rocky ground…)	• culture, habits, taboos, • lack of information, • insufficient financing, • inappropriate legislation, • influence of interest groups, • hygienic concerns, • …
IV. NGOs	• failure of conventional / existing sanitation systems, • economic reasons, • ecological reasons, • agricultural reuse of recyclates • improve quality of life, • …	• culture, habits, taboos, • lack of information, • insufficient financing, • inappropriate legislation, • influence of interest groups, • hygienic concerns, • …

(continued …)

(…continued)

V. Local authorities, governmental institutions	• political reasons, • economic reasons, • ecological reasons, • Agenda 21, • failure of conventional / existing sanitation system, • possibility of financial support, • sustainability of system, • support regional self-sufficiency, • promotion of (urban) agriculture, • job (and income) creation, • long-term security of social services (water supply etc.), • …	• culture, habits, taboos, • lack of information, • lack of start-up funds / insufficient financing, • monitoring of treatment / handling etc. more difficult for decentralised system, • distrust of alternative systems, • not recognised as state of the art technology, • reluctance to change status quo, • contradiction of existing legal framework / long term plans, • powerful lobby from conventional centralised sanitation industry, • corruption, …
VI. Service providers Planners / consultants; constructors (builders); maintenance service providers; producers of equipment; providers of collection, treatment, transport and marketing of the recyclates	• increase profit, • opening up of a potentially huge new market, • request / need for particular product, • further develop their own know-how, • ethical / ecological reasons • …	• absence of technical knowledge, • absence of products, • inappropriate legislation, • lack of suitable tools, • economic interest of (waste) water monopolies, • fear of failure (economic risk), • not yet recognised as state of the art, • reluctance to make the necessary increase in effort, • lack of experience in decentralised planning / participation, • lack of start-up funds, • fear of reduced profit margins in smaller / decentralised projects, • regulatory obstacles; • …
VII. Developers & Investors	• increase attractiveness of developments (eco-label), • safe and secure “disposal” (especially in tourist areas), • user satisfaction, • economic reasons, • legal requirements, • …	• absence of service logistic, • culture, habits, taboos, • lack of information, • lack of start-up funds, • monitoring of treatment / handling etc. more difficult for decentralised system, • distrust of alternative systems, • not recognised as state of the art technology, • reluctance to change status quo, • contradiction of existing legal framework / long term plans, • powerful lobby from conventional centralised sanitation industry, • corruption, • less«commission»for ecosan projects, • …
VIII. Financial Institutions	• economic reasons, • failure of existing / conventional systems, • improving sustainability, • guarantee repayment of credit, • …	• absence of specific financing instruments, • not recognised as state of the art technology, • need for research and development, • …
IX. Research Institutions	• Need for research and development, • availability of research funds, • ecological reasons, • …	• availability of research funds, • prestige, • …

Both the motivating factors and the constraints of the stakeholders can vary enormously and may not always be obvious to outsiders. It is therefore important in a participatory approach that the stakeholders have the possibility to voice their motivating factors and the reservations they may have about the programme. When these are known for all stakeholders it may then be possible to tailor the ecosan programme to their needs and to adequately address their concerns. It is important and very useful to continually refer to the motivating factors and to confirm that they will be addressed by the project. Equally important is to check that the constraints have been convincingly dealt with. To map the motivations and constraints is therefore an important prerequisite, which should be adapted during the course of the project, becoming increasingly specific.

Most stakeholders will be relatively new to the ecosan approach in the beginning of a programme and will almost certainly require a degree of training in order to familiarise them with it and enable them to complete their task and fulfil their responsibilities. Such training may include the following: instructing the users of the sanitation facilities on the correct use and maintenance of their facilities, informing the users of the recyclates of the correct and safe use of the recyclates, possibly with the aid of agricultural extension agents, training CBOs and NGOs to provide their members or partners with the necessary information for the programme to function correctly, capacity building measures in local and regional authorities governmental institutions to support inter-ministerial and inter-sectoral co-operation and co-ordination, a wide range of training measures for the service providers (including technical training for technicians, such as plumbers, or construction companies), informing developers and investors of the opportunities offered by ecosan systems and their particularities, introducing financial institutions to ecosystem based sanitation and their long-term financial sustainability and highlighting the need for start-up funds and new financing mechanisms for such systems, and informing research institutions of the current state of the art on an international level and the need for locally relevant research.

4 Capacity building - education and training in ecological sanitation

4.1 Purpose of this chapter

The role of this chapter is twofold:

1. to discuss specific aspects of education and training in the field of ecological sanitation as a part of capacity building activities; and

2. to begin to formulate strategies for education and training people in this area.

In this chapter, emphasis will be placed on the methodologies for transferring the paradigm shift in sanitation to the people who need to know about it. Equally important is to transfer that knowledge to the people who will implement the technologies and systems. Special attention will also be given to defining the relevant target groups who are likely to embrace the ecological sanitation concept. These people will have different roles to play in the implementation process: (i) to plan and enable implementation, (ii) to establish the necessary framework (political, social, economic) and (iii) to use these facilities. This publication is designed to assist all these groups and furthermore to be used by professional educators and trainers who will assist in knowledge transfer to all of the above training target groups.

Although this publication is primarily geared towards professionals who would be in charge of implementation of ecological sanitation education and training, it should also prove useful to a broader audience. Indeed a broad audience for this publication is desirable as the concept of ecological sanitation has yet to find its place in the curricula of many different disciplines, levels and forms of education and training, including:

- formal education at the secondary and university level; and
- continuing education and vocational training of special target groups in the form of specialised courses and other means of training and capacity building.

In presenting and promoting the educational concept of ecological sanitation, in this chapter, we do not discuss technical issues, but refer to the technical material presented in the other chapters of this publication.

4.2 The unique challenge

Many of the required measures to integrate ecosan into education and training programmes and curricula can be achieved relatively easily. Several forward looking educational establishments have in fact already started to do this, for example at the UNESCO IHE or in several universities in Sweden, Norway and Germany. However in order to achieve a complete integration of eco-sanitation into curricula and training programmes there are several challenges that need to be overcome. These challenges include:

The highly inter-disciplinary character of ecological sanitation, requiring it to be integrated in curricula not only for engineers and natural scientists but also for many other professions.

- The relative novelty of the closed-loop approach to sanitation is implying that education for ecosan should be a mixture of teaching and promotion at all levels (advocacy). An additional challenge caused by the relative novelty of the approach is that for many contexts every-day practical experience is lacking from which direct lessons can be drawn.
- The majority of practical examples have been implemented on a relatively small scale and there are only a limited number of large-scale examples.

- The existing instruments for design, feasibility assessment, monitoring / performance assessment of sanitation have not yet been adapted to the new paradigm.

As with many new paradigms, education for ecological sanitation should serve as a model for the kinds of processes which are to be encouraged in this new approach to sanitation. Ecological sanitation calls for participatory planning, so education should also be participatory. Ecological sanitation gives special attention to users, as active participants rather than passive recipients in a planning process. So students should also become active players rather than objects of the educational process. This change of attitudes between teacher and pupil is desirable in any case, but of particular importance in topics as complex as ecosan. This places rather challenging demands on the educational system, forcing the educational institution, in effect, to move into a new educational paradigm in order to support the new paradigm in sanitation.

The inter-disciplinary nature of ecological sanitation is depicted in Figure 13. Ecological sanitation draws on a wide range of expertise, including:

- Integrated water management and other natural resources
- Resources protection and recycling
- Sustainable agriculture, soil conditioning and replacement of fertilisers
- Public health enhancement and reduction of children mortality
- Food security
- Job creation and unemployment reduction
- Climate change and variability
- Flood control and management

Changing the conventional sanitation mindset and creating a favourable environment for the implementation of ecological sanitation will not be an easy task. It will require time and will not happen overnight. In order to increases the success rate of ecological sanitation projects and to generate a more positive perception amongst its future users, education and training in all of its aspects must reach a wide range of society members.

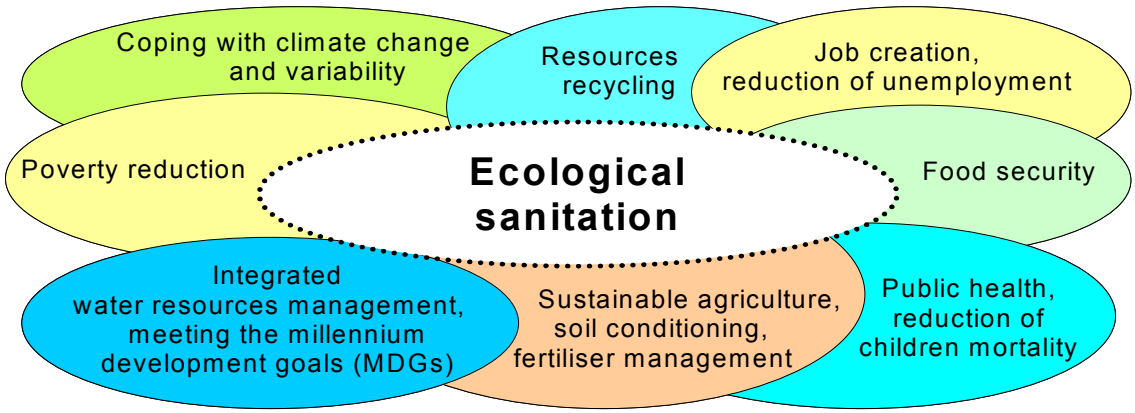


Figure 13: Ecological sanitation is an inter-disciplinary field and is related to many aspects of modern societies in both developed and developing world (GTZ)

The authors believe that here is a growing need and pressure to provide sound educational tools in order to encourage capacity building and to support the world-wide implementation of ecological sanitation. There is also a need for a broad analysis of existing curricula and education systems in both formal education at all levels and continuing education in water and environment related disciplines, with a view to introducing the holistic concept of ecological sanitation.

In the developed world the role of ecological sanitation education and training is to contribute to broader application of its concept, especially in areas where the advantages are directly obvious (e.g.

individual homes or groups of houses in areas where there is no sewer network, in small communities, vacation areas and in other similar contexts).

In developing countries and countries in transition, ecological sanitation education and training is even more important and urgent, especially in the context of achieving the Millennium Development Goals for sanitation and environmental sustainability (see UN Millenium Project 2005).

4.3 Overview of the new training and education content that needs to be conveyed

As has been stated previously the basic principle of ecological sanitation is to close the loop between sanitation and agriculture, enabling reuse and recycling rather than disposal. Therefore, a wider range of disciplines need to be included in education about planning techniques and processes, when compared to planning processes in conventional sanitation. Included in these are, for example, training in techniques for the assessment of the current agricultural situation with respect to soil quality, types of crops cultivated, agricultural practices, water and fertiliser needs, practices concerning the treatment and reuse of manure and so on.

As ecological sanitation solutions also aim at reducing water consumption for sanitation (e.g. by integrating rainwater harvesting systems along with grey water treatment and reuse), water supply systems may often have to be reviewed and modified within an ecological sanitation project. Hence, it is important that teaching integrates sanitation with issues of water supply, water efficiency, and water productivity.

Ecological sanitation solutions ideally lead to the closing of material flow cycles on the minimum practical level (i.e. reuse close to the point of generation of excreta or wastewater). We therefore need to consider aspects of urban planning (e.g. in order to provide space for the integration of a constructed wetland in an urban park, to support urban agriculture or to provide small scale service providers with an area for the treatment and storage of ecological sanitation products in the neighbourhood). Ecological sanitation education therefore should include the methods and theory of integrating the various sectors in urban environmental planning and practice.

The materials that can be recovered in an ecological sanitation system may have a high nitrate concentration and therefore lend themselves to integrated management of water and waste: They can be treated together with the organic kitchen, garden, and animal wastes from households and even paper and cardboard from households, institutions, and businesses. For this reason, it is important to teach the integration of sanitation with certain aspects of solid waste management (especially organic solid waste treatment).

The educational systems need to broaden their content to include a mix of centralised and decentralised, conventional and closed-loop, high-tech and low-tech, traditional and innovative, separate-stream technical solutions. The curriculum for both formal and continuing education needs to be developed so that it familiarises students not only with technical approaches, but also with the corresponding institutional and management solutions. In practice, the huge variety of different technical and operational combinations may represent a considerable challenge for educators.

The consideration of appropriate sanitation solutions (i.e. technology and management system choice) in an ecological sanitation approach will require that students acquire more varied know-how and experience than is currently the case. They should then be able to consider a larger range of technical and service options, rather than focussing the planning process on a narrow range of commonly implemented systems (e.g. sewer networks or pit toilets). Hence, we need to teach methodologies that encourage inclusion of a broad range of sanitation solutions in all planning, feasibility, design, and construction phases of projects.

Classical evaluation criteria currently taught in sanitation curricula also tend to bias the results of decision making processes towards conventional sanitation systems. For example, the criteria for the limiting parameters for discharge into receiving water bodies are no longer applicable in sanitation options based on ecological sanitation techniques, where in many cases, discharge is either zero or

close to it. Therefore, new criteria have to be developed, analysed, field tested and then integrated into curricula for planners and sanitary engineers.

The new evaluation criteria need to adopt a much broader approach to carefully account for all the potential impacts of the sanitation system. Examples of what the new criteria need to consider include access to resources, water reuse efficiency, system energy demand and energy efficiency, resources recovery rates, public health risks [1] (both in ecological sanitation and conventional systems), environmental risks, lifecycle analysis, self-help criteria. Ecological sanitation education hence needs to include the application of new, wide-ranging evaluation criteria for water supply and sanitation services.

Another issue is that students must understand that an entirely different approach will be necessary to supply the relevant information to stakeholders so that they can make an "informed choice". Sanitation professionals of the future need to understand the necessity to focus on the needs of the users of the sanitary facilities and other relevant stakeholders of the sanitation system (particularly the service providers and the end users of the recyclates). On the other hand, of course they also need to have knowledge of the techniques for doing so. This implies creating knowledge on the potential subordination of technical criteria to participatory project preparation and implementation processes.

Students will need to learn how to analyse the context specific options, to provide unbiased performance indicators and to propose viable solutions. We therefore need to teach them about promoting the consideration of smaller planning units and a greater number of decentralised options.

Finally, the requirements of the project preparation and planning process in ecological sanitation as a part of integrated urban water management are comparatively much more demanding than those of conventional sanitation projects. Several guidelines are currently being prepared by various organisations each addressing some of the above mentioned aspects (Eawag 2005, Kvarnstroem and Petersens 2004, Werner et al. 2003a). Students have to learn about the integration of educational, institutional, and capacity building aspects into planning instruments.

4.4 Who needs to be reached?

An ecological sanitation focus in education and training systems produces responsible, realistic professionals whose work supports sustainable sanitation solutions. Such an educational system is focused on creating intellectual and social capacity in relation to the integration of reuse aspects in the assessment of the current sanitary situation and in all the relevant planning activities and conceptual work. Thus, it is aimed at a broad spectrum of individuals and at various groups of stakeholders (described in the Section 3.5). They should have a vested interest in raising the awareness and competence level of various target groups that they deal with so that they can pursue ecological sanitation projects together.

4.4.1 Stakeholders

The educational system, if effective, will change the view or perception towards sanitation amongst the wide range of target groups, which are part of or under the sphere of interest of stakeholders discussed in Section 3.5. Although the principles of ecological sanitation are "universal" (in that they apply to all projects), different stakeholders work with various target groups that have different backgrounds, priorities and abilities to accept the "new paradigm" of ecological sanitation. Accordingly, the stakeholders should encourage, organise and/or endorse education and training programmes in ecological sanitation.

Educators thus need to prepare, for each of the target groups a different educational strategy and a different (target group specific) implementation methodology to be used in this endeavour. Some stakeholders are highly knowledgeable of the ecological sanitation, whilst others would benefit from attending some of the course on the specific topics. Most of the stakeholders likely to undergo the

[1] Public health risks with regards to: in-house hygiene, hygiene of neighbourhood and impacts on receiving water bodies, hygienic aspects of the handling, processing and reuse of the products etc.

education and training process will belong to one of the target group shown in Table 3, so the training programme will be specifically designed with these target groups in mind. However, some new subgroups may emerge in the future.

4.4.2 Target groups

In order to support changes in formal education and training to include ecological sanitation in mainstream curricula, it is necessary to know who the education is for. In Table 3 we identify and describe the major characteristics and features of the six major target groups, each having very specific education and training needs. The boundaries between the target groups are not fixed, and there is therefore a degree of overlapping.

Some of these target groups will be receiving the information for the first time, thus making the design of curricula relatively easy. Others, especially the first two groups, need to understand the critique of conventional sanitation so that they can “unlearn” a great deal, before they are ready to accept the new technology. The target group of professionals (planners and designers with the expertise in conventional sanitation) also requires special attention and “re-training”. Only then will they open themselves up to accept new information (the first stage), accept to treat alternative sanitation options as “equal opportunity options” (the second stage) and to become an active promoter and “implementer” of this approach (the third stage).

With respect to target group 4, the Professional Practitioners, it should be pointed out that it may not always be easy to motivate practising sanitary engineers to attend further training in ecological sanitation. Some individuals or organisations in this group may have a strong bias in favour of conventional water-borne sanitation which they may not readily give up or modify. The institutions which are addressed in this publication could possibly achieve a part of this re-training via their active alumni communities. A variety of “marketing” approaches is needed to invite these practitioners to further their knowledge and at least consider (if not embrace) the alternative approach of ecological sanitation. Again, this will not happen overnight, but is a process that should be set in motion now.

Failures of some pilot systems may also serve to block some stakeholders from accepting the eco-sanitation approach. It will therefore be necessary for educators to analyse the exact causes for these failures and to integrate the lessons learned into their teaching programme, thus acknowledging that closed-loop sanitation systems are, like many other innovative approaches, in need of further optimising. Stakeholders who have already experienced unsuccessful projects will have different issues, and additional effort has to be made in analysing the specific causes of the failure (learning from the past errors) before they are convinced to try it once again.

Table 3: Target groups for education and training in ecological sanitation

Target group	Example	Comments regarding training needs and strategies
Group 1a: **Existing users of the sanitation facilities and general public.** For example this group could include users who have an access to these facilities, are taking part in a demonstration project or a full-scale implementation of ecological sanitation technologies. With respect to the general public, it is included because members may be exposed to an ecological sanitation-compatible toilet if these are incorporated into public toilet blocks for example.	Mr. Smith who has a urine-diversion toilet at his house. After initial teething difficulties with the device it is now functioning perfectly, however he now has difficulties in training his visitors to correctly use it.	**Training needs:** Current users' needs. Existing users have to be given support in the correct use of the toilets facilities and possibly in the collection, treatment and safe use of the products if they are to e used "on-site". Future user's needs: Future clients have to be "educated" in advance. **Training strategy:** should be organised to cover both informing the users of the existing facilities ("making best out of it") and disseminating information on the options and benefits among the potential users and those who are yet to be convinced on the potential benefits.
Group 1b: **Students, and pupils in formal education at primary, secondary or university level (future users of sanitation facilities).** Obviously the teaching methods are going to be very different for the different age groups (teaching children, young adults or adults). Also, the younger children will need more guidance, whereas students can use self-study methods. They will also have more choices in choosing the topic of their future study (with more or less "ecological sanitation content").	A 12-years old girl at primary school who leads a local action to improve sanitation conditions in their school.	Teaching young people about the ecological sanitation paradigms will prepare them for a changing world, where water-borne sanitation will no longer be the scenario that everybody aspires to. Training needs: The needs are big at all levels in all educational institutions in the world, especially in developing countries. **Training strategy:** Use the existing channels for vocational training
Group 2: **Markets and end-users of the recyclates,** e.g. farmers who are using ecological sanitation products as fertilisers on their land.	Mrs. Myambelo owns an organic food production farm and a farm guest house. She is refurbishing her farm house, to introduce eco-sanitation to attract more eco- movements visitors to her "integrated eco-farm" with healthy organic food.	People in this group will mainly be interested in the safety aspects of handling ecological sanitation products and using them in food production and in economic benefits. There is overlap with Group 4 (e.g. agricultural specialist), but Group 2 is meant to be mostly people without a university degree. The consumers of products that have been fertilised with ecological sanitation products are not meant to be part of this group, but rather part of Group 1a (i.e. general public). **Potential needs:** Case by case analysis of the needs to cover all users who are spatially disperses.
Group 3: **CBOs and self-help groups representing users, NGOs**	Church in Kibera Slum in Nairobi. They have a complex challenge of providing advice and support to low income communities. However, they have potential of relying on the access to small international grants and community support in project implementation.	**Training needs:** need to select and train local champions need to train future users of the facilities **Strategy:** Provide the concept of integrated clean-up programmes and decompose it into parts (action plans) that include ecological sanitation.

Target group	Example	Comments regarding training needs and strategies
Group 4: **Professional practitioners: engineers, sociologists, other scientists, and other professionals** who are currently working in the fields of water, environment, civil engineering or related disciplines. To give some general examples, Group 4 would include: Water and environmental specialists (hydrologists, treatment specialists, sanitary-public health engineers, designers, contractors and developers) Planners, landscape architects, biologists, municipal officers Agriculture specialists Researchers and MSc and PhD students[2] Professionals interested in starting-up or upgrading their businesses in the ecological sector	An environmental chief engineer working for an environmental consultancy firm which just got an ecological sanitation project and all his team's past experience was based on the "conventional" technologies.	This is an important target group because they can both promote implementation or create obstacles to implementation of these facilities. For example, consultants might be asked to develop sanitation alternatives but if they have no knowledge of these technologies, they will not offer, or they will oppose, alternatives along these lines. This group would also include "newcomers" i.e. professionals which traditionally had "nothing to do with sanitation" but have realised that time has come when it is important to raise their "green credentials". One of the most important aspects for this group is that the awareness of the ecological sanitation approach needs to be created, because it is likely that during their university studies, they have not been exposed to it to the degree that would guarantee their full commitment to this concept. It is one of the aims of this publication to change this situation and ensure that in the future ecological sanitation gradually becomes a part of the regular curricula in water and environment related study areas. Additionally, there is the need to increase their awareness of the multi-disciplinary nature of ecosan. Particularly the importance of the socio-cultural aspects of sanitation that may have a primary role in the failure of a sanitation system. **Potential needs:** Not continuous, concerted action through professional associations could be helpful. **Strategy:** Short courses should be run frequently, publications
Group 5: **National, provincial and local authorities, top-level decision makers** (managers, politicians, civil servants in leading positions, etc.)	A Minister of Agriculture or Ms Pinzon (medical doctor) Deputy minister or public health. None of them had time to be briefed about ecological sanitation but are ready to give a speech on the topic.	This group does not have much time to undergo lengthy training courses. Therefore, short briefing sessions need to be arranged for them. When planning training sessions or briefings for this group one should also bear in mind that there are laws and regulations by health authorities, which may (unintentionally) limit the use of technologies based on ecological sanitation. **Potential needs:** Deal with the education in the post-election period.
Group 6: Service Providers, MSEs, labourers, technicians and general staff who are in daily contact with installation, operation and management of ecological sanitation-related facilities.	This could be people who build composting toilets, collect faecal matter for processing off-site, manage public toilets, market urine-diversion toilets etc.	This group is also thought to include people working in small to medium enterprises (SME's) who are creating a business in and around the "ecological sanitation market". **Training needs:** There is a need to do search in order to identify the local needs on the case by case basis

[2] Undergraduate students, on the other hand, are thought to be part of Group 1b.

4.5 Education and training methodology

The technical material presented in chapters 1 to 3 of this publication can serve as background literature introducing the basic ecological sanitation concept. However for an in-depth studying of the matter, more comprehensive sources are needed. How the content and methodology of a training course should be tailored to the specific target groups is described below.

4.5.1 Preparatory activities

Any education or training programme has to be carefully planned by knowledgeable people (i.e. the teacher[3]) or by a qualified Education Development Body (e.g. a task force for preparation of the educational material), which is authorised for such activities. Systematic preparations are required to be undertaken, followed by selection of the didactical methodology, teaching/training material, adjusted to the particular target audience and circumstances. At this point, one needs to distinguish between training and education, for which the preparatory activities are described separately as follows:

Preparation for training programmes

In this context, a "training course" is a course that teaches specific aspects of ecological sanitation during a period of several days up to several weeks only. The course duration typically being 1-3 weeks, but possibly spread out over a longer time period if the trainees are studying at their own pace, e.g. the literature provided or some form of distance-learning.

It should be pointed out here that this document is not limited to serve institutions of higher learning. Indeed, there are many technical training and vocational schools for technicians and practitioners who do not aspire to provide university-level courses, but will in fact train the majority of the people "on the ground" who will implement ecological sanitation. This results in a wide variety of needs and level of knowledge of the participants in the training programme.

Preparations for running training programmes may differ from one case to the other, but generally it has to take into account the local socio-economical situation, availability of suitable case studies, availability of qualified trainers, technology level, and public perception. During the preparation, some or all of the following activities have to be carried out:

[3] The word "teacher" is used in what follows, and is understood to be synonymous with "trainer" or "educator".

- Assessment of training needs
- Definition of the training objectives
- Decision on length of programme
- Selection of candidates (if appropriate)
- Planning for provision of resources such as human (lecturers and supporting staff), financial, logistic
- Evaluation of education level of the target audience, i.e. how much prior knowledge exists, and what pace and method of teaching / training would be appropriate
- Design of the curriculum (e.g. selection of content according to the identified level of the students and the assessed training needs)
- Include social and cultural aspects (consult the specialist if needed) to address the local area specific issues
- Selection of training method(s), e.g. up-front teaching, hands-on training, field trips for on-site training, workshops, excursions, discussion fora or other methods
- Relevant content preparation
- Preparation of training material and production of handouts for the participants
- Preparation of rooms, computers, projectors, copiers
- Preparation of field trips, access to the site, local champions, transportation, accommodation and subsistence
- Provision of the safety and hygiene at work
- Preparation for reporting, evaluation, post-training follow-up
- Planning of promotional activities and publishing (if appropriate) and analysis of the feedback

Preparation for educational programmes

Education, in contrast to training, refers less to passing on concrete knowledge (although this is also part of education), but more to teaching people how to think critically and analytically. This is mainly done in formal education institutions, such as schools, colleges, universities. It is about conveying concepts, attitudes and learning methods. It is not advocated here that a separate educational programme for ecological sanitation be created but rather that the closed-loop paradigm is included into the relevant existing educational programmes at all levels of formal education.

Modifying curricula and syllabi is a long process which usually has to be approved by the appropriate governmental institution (university council, ministry of education or equivalent). Accreditation procedures may also slow down the process. Hence, the preparation activities for educational programmes are more difficult to define and carry out than for training programmes. To be implemented they have to be initiated at the appropriate instance and a broader consensus has to be achieved among the members of the initiating body.

4.5.2 Selection of relevant subject areas

Depending on the target audience and the specific circumstances, the teacher should make a careful selection from the following broad range of subjects (see also the following section, which shows a matrix of target groups and subjects to be taught):

Table 4: Range of subjects to be taught in ecological sanitation training and education

1. Introduction to ecological sanitation
Paradigm shift and ancient technologies revisited (source separation) Basic principles, biological, chemical and physical processes involved Benefits to be achieved by ecological sanitation and integrated solutions Advantages and disadvantages of ecological sanitation vs. conventional sanitation systems Resources needs and availability
2. Technologies applied in ecological sanitation
Potential for co-management of liquid and solid waste flows from households; separation at the source Relevant toilet types (e.g. dry/wet sanitation, urine separation, vacuum toilets) Sanitisation of faeces or black water (e.g. anaerobic digestion, composting, dehydration) Storm water management including rain water harvesting, flood management Water saving and water reuse principles and technologies Balance of resources (including energy efficiency)
3. Resources recovery and agricultural reuse (nutrients, organics, water and energy)
Principles and prerequisites Technologies and selection principles Wastewater reuse (principles, technologies, health and safety) Bio-solids, e.g. organic kitchen wastes (recovery, application, disposal) Food safety Energy recovery (small scale – decentralised vs. centralised facilities) Climate and factors affecting suitability and efficiency Marketing of the recyclates in agriculture or other areas
4. Implementation, operation and maintenance management
5. Practical skills for operation and maintenance
6. Environmental and health aspects
Interactions of ecological sanitation with the broader environment Health and safety, including performance verification Hygiene education
7. Economic and financial aspects
Full cost comparison between different ecosan / conventional options; influence of system boundaries, Impact of health related costs, private versus national economy, shadow prices, Micro credit financing schemes, impact on job creation, small scale enterprises, Role of the private sector, potential for cost recovery, infrastructure ownership, fees and charges
8. Social and cultural aspects
Social perception, motivation and obstacles for broader application Cultural issues Gender: sanitation and men, women and children
9. Policy and Legal aspects
Local legal framework affecting implementation of ecological sanitation and reuse Building codes and permits Strategies for the future
10. Institutional and organisational aspects
Institutional framework (stakeholders, relationships, decision making) User management, monitoring, evaluation Participatory principles (with respect to users of services) Implications for bureaucratic attitude towards sanitation New roles for formal institutions
11. Case studies: successes and failures
12. Enabling search for up-to-date information on ecological sanitation (e.g. internet)
13. Interactions of ecological sanitation projects with existing infrastructure
14. Evaluation criteria for sanitation systems
15. Promotion and public awareness

4.5.3 Matrix of subjects and target groups

The following table attempts to select relevant subjects for the six target audience groups defined earlier. This should be seen a guide only. Final selection and shaping of the training programme should be based on a case-by-case investigation taking local conditions into account.

Table 5: Matrix of relevance of subjects for different target groups

Subject	**Group 1a and 1b** Users of facilities and students	**Group 2** Farmers / users of ecological sanitation products	**Group 3** CBOs and NGOs	**Group 4** Profess-ionals	**Group 5** Decision makers	**Group 6** Service providers
1. Introduction to ecological sanitation	■	■	■	■	■	■
2. Technologies applied in ecological sanitation	■	■	■	■	■	
3. Resources recovery and agricultural reuse (nutrients, organics, water and energy)		■	■	■	■	
4. Implementation, operation and maintenance management				■	■	■
5. Practical skills for operation and maintenance						■
6. Environmental and health aspects	■	■	■	■		■
7. Economic and financial aspects	■	■	■	■	■	
8. Social and cultural aspects	■	■	■	■	■	■
9. Policy and legal aspects		■	■	■	■	
10. Institutional and organisational aspects			■	■	■	
11. Case studies: successes and failures	■	■	■	■	■	■
12. Enabling search for up-to-date information on ecosan		■	■	■		
13. Interactions of ecosan projects with existing infrastructure				■		■
14. Evaluation criteria for sanitation systems			■	■		
15. Promotion and public awareness			■	■	■	

4.5.4 Available and emerging education and training tools

The teacher can make use of existing tools, both relating to content and didactical methods, which will enable an "active learning"[4] environment. The resources available to teachers with regards to the content include:

- Conventional educational material such as books, brochures, guidelines, leaflets, posters etc.
- Educational material in electronic (multimedia) form such as text in PDF and Word format, Power Point presentations, video clips etc. Selected sample material that belongs to this group is available on the "ecosan resource CD" (GTZ 2006) and from the organisations mentioned in chapter 8.2 and their webpages.
- Web based material and other on-line training courses and materials (e.g. SDC/myNetworks 2003; EMWater 2005; UNESCO-UWETTT training material [in prep.]).

Possible didactical tools to enable an active learning environment include:

- Lectures / classroom sessions, or briefing sessions with up-front teaching
- Individual or group assignments
- Field trips
- Work with local champions
- Work with local users of the facilities and with local stakeholders' groups
- Case studies - learning by doing (analysis of successes and failures of existing ecological sanitation projects; analysis of interactions with other infrastructure projects)
- Practical workshops
- Role playing games
- Analysis of interactions with other infrastructure projects
- Group work, e.g. technology selection, analysis of sustainability and risks
- Tutorials for preparations for pre-feasibility and feasibility studies

As mentioned before each of the target groups requires the appropriate set of contents and didactical tools to be tailored taking into account local technical, socio-economic and cultural conditions.

4.6 Proposed implementation strategy for modernising the educational and training system in sanitation

Knowledge of ecosan-related issues has increased considerably over the last decade, as has the number of ecosan pilot projects. This period can be seen as a phase of primary advocacy which now needs to move towards a phase of wider dissemination of the latest scientific research results, capacity building and training for a new generation of professionals to prepare them for jobs in the sustainable sanitation sector.

Whilst the academic resource base is currently very limited around the world, it can still be geared towards an effective leverage function for sustainable sanitation activities in institutions in both industrial and developing countries. The academic and professional resource base should focus on inspiring local and national authorities, institutions and other interested parties in both the North and the South to engage in training and research, involving itself intensely with research collaboration and providing inputs to training given by these institutions.

Several international organisations have already begun working in this direction, illustrated by the two examples below:

[4] "Active learning" refers to a mode of learning where the student takes an active role in acquiring the knowledge (See for example http://edweb.sdsu.edu/people/bdodge/Active/ActiveLearning.html)

(1) North-South: Research Partnerships for Mitigating Syndromes of Global Change
Within the framework of the "Swiss National Centre of Competence in Research (NCCR) North-South: Research Partnerships for Mitigating Syndromes of Global Change" which is co-funded by the Swiss Agency for Development and Cooperation (SDC) and the Swiss National Science Foundation, a project on environmental sanitation is managed by Eawag-Sandec. The overall aim of this NCCR is to enhance sustainable development in selected contexts through research partnerships involving institutions within Switzerland as well as their partners in developing countries. Interdisciplinary exchange and transdisciplinary integration and dialogue is promoted in nine geographical Joint Areas of Case Studies (JACS), where concrete efforts are undertaken jointly with local partner institutions. Sandec's Project aims at enhancing knowledge and contribute to the scientific basis for improving environmental sanitation in developing countries, with particular emphasis on the situation of the most vulnerable populations in urban and peri-urban areas. (Morel, Zurbruegg and Schertenleib 2005).

(2) Regional Nodal Development
The second phase of the EcoSanRes Programme, which started in January 2006 will emphasise capacity building and knowledge management through the development of regional nodes in the South. This means working with a series of dynamic institutions that have good regional networks that can provide support in training, research and development, knowledge management, demonstration and pilot projects in order to build regional capacity. The EcoSanRes Programme will provide leadership and stimulate this development in collaboration with several other actors in the North and South. An International Board and Review Panel will provide governance. A global fund for local and regional initiatives is in place, and a series of international Thematic Working Groups ensure that cutting edge knowledge is properly shared among leading specialists and institutions involved in capacity building. (EcosanRes 2006)

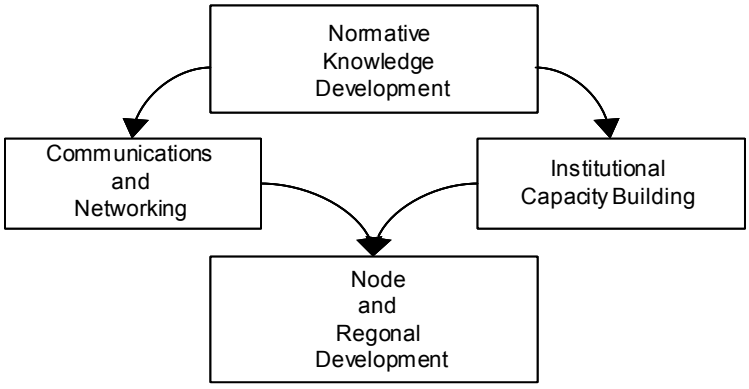


Figure 14: Modus operandi in Nodal Development. (EcoSanRes 2006)

How to accelerate ecological sanitation education and training?
The implementation strategy for ecological sanitation education and training will involve extensive and intensive work with educational and training institutions. The lack of capacity is presently considered as a crucial limiting factor in meeting the increased demand for implementation of ecological sanitation. All actions aimed at encouraging regional, national and local institutions are however limited by this lack of capacity.

In an ad hoc meeting on "Ecological Sanitation Capacity Building" held during the 3rd International Ecological Sanitation Conference in Durban, South Africa (24 May, 2005) it was suggested to establish an international network of interested organisations and training institutions, in order to accelerate the formation of a capacity building initiative for ecological sanitation.

Some institutes have already included or are planning to include ecological sanitation in their regular educational programmes. A non-exhaustive list of examples is given below:

- Sida/EcosanRes (Sweden): Annual course for professionals in two regions alternating between Latin American countries, Africa and Asia
- Norwegian University of Life Sciences: Summer school and courses for students and professionals
- Technical University of Hamburg-Harburg (Germany): ecosan integrated in university degrees
- CREPA: Training courses for sanitary professionals in the West Africa Region
- My Networks: Internet courses on ecosan
- UNESCO-IHE (The Netherlands): Integrated into MSc programmes, e.g. Municipal Water Infrastructure MSc programme (in preparation)
- UNESCO endorsed network of centres for urban drainage / urban water (IRTCID/CUW network)
- German Water Association (DWA): Training courses for professionals (in preparation)
- Order of Syrian Engineers and Architects (OSEA): creating an inter-institutional professional network (IPN) on ecosan for the advancement and dissemination of knowledge and training
- Indian Innovative Ecological Sanitation Network: Regular capacity building workshops and joint pilot case studies
- Centre for Science and Environment, India: Training on water pollution & water-waste management
- Philippines Ecological Sanitation Network: Regular capacity building workshops and joint pilot case studies (e.g. Center for Advanced Philippine Studies: Capacity building and training with Ecosan pilot projects and research; University of the Philippines / Philippine Women's University: Integrated of ecosan into an MSc programme on Enviromental Engineering / Management).
- GTZ-ecosan project (Germany): Local capacity building workshops in the start-up phase of ecological sanitation projects for decision makers, professionals and other stakeholders
- WASTE (The Netherlands): Local capacity building workshops in the start-up phase of ecologicalsanitation projects for decision makers, professionals and other stakeholders
- World Toilet Organisation / World Toilet College: Training of trainers in ecological sanitation

Box 5: Example for a funding programme to strengthen ecosan research capacity

A Funding programme for ecosan related research was started in 2005 by the Swedish International Development Cooperation Agency (Sida), the Stockholm Environment Institute (SEI) and the International Foundation for Science (IFS). (IFS 2005)

In the programme up to US$ 12,000 (EUR 9,600) are being offered in research support for projects on Sustainable Sanitation and Grey-Water Reuse. Grants are intended for citizens of developing countries carrying out research in a developing country, attached to a university or non-profit making research institution in a developing country. The age limit for this programme is 40 (for Chinese applicants 30, for applicants from Sub-Saharan Africa 45).

The topics funded are: (1) Ecological Sanitation

- monitoring the reduction of environmental impact;
- pathogen destruction;
- secondary treatment of excreta and organic waste;
- safe agricultural reuse;
- identification of pollutants (e.g. pharmaceuticals);
- perceptions/attitudes related to excreta reuse in food production;
- economic value of nutrients and humus.
- Other forms of sustainable sanitation
- development of other sustainable sanitation methods;
- monitoring the reduction of environmental impact.

(2) Reuse of grey-water for irrigation

- monitoring improved availability of water for agriculture;
- identification of geographical areas where re-use of grey-water is feasible;
- development of treatment systems;
- identification and reduction of pollutants (e.g. detergents, pesticides, pharmaceuticals);
- public acceptance and management of systems.

One important way to increase capacity is to develop funding programms for research in the new field. A funding programme for ecosan related research has been started in 2005 by the Swedish International Development Cooperation Agency (Sida), the Stockholm Environment Institute (SEI) and the International Foundation for Science (IFS). Its design, topics, and target group of researchers are given in Box 5 above. The funding programme shows what are currently seen as the promising fields for young ecosan researchers in southern countries.

Training of Trainers with a partly e-based approach is needed
Whilst these initiatives are to be welcomed and further encouraged, it is also clear that alone they will not be able to meet demand as long as they continue to reach only a fixed number of participants (e.g. reaching several hundred people per year and courses). An exponential increase in capacity is now required, with training being aimed at trainers, who in turn can pass their knowledge on, establishing a large network for capacity building.

An important target group should therefore be trainers at professional training institutions such as schools of public health, departments of water and sanitation for civil engineers, agriculture and horticulture training institutions, schools of architecture, university departments for social and economic development, etc.

This new direction of capacity building activity requires well designed materials for the training of professionals and students soon to become professionals.

Some material has already been developed for such courses, as can be seen from the examples given in Chapter 7. Most of these materials are to some extent e-based, and many of the courses are divided into two, with one section done by the students in their home countries (preparatory activities, case studies, collection of local background data, introduction into the topic) and another section being carried out with the trainer in a face to face situation (including discussions of the case studies, group work, etc.).

E-based Learning Materials are suitable for ToT-schemes
E-based learning material has particular advantages when being used in Training of Trainer (ToT) schemes: It can be made informative, up-to-date, and presented in a way that catches the teachers' interests. It can include "Power Point" presentations with accompanying text / instruction, film clips, video-taped interviews and lectures, and an extensive reference list. E-learning material can be made available on the web or on a CD for teachers and instructors in recognised institutions for training of professionals in various ecosan-related subjects. Teachers are free to choose the sections which he or she deems relevant for courses they are conducting. The material is thus easy to adapt to the needs of the individual teacher, from a full course to parts to be included in some lectures. The CD / website is easy to update on a periodic basis.

E-learning material is already available that covers the major ecosan management issues, policy, household routines, hygiene and sanitation systems, primary treatment/handling, secondary treatment, reuse in agriculture and energy generation, selection criteria for sanitation systems and systems analysis. It can also include suggestions on how to use the material in learning and gives examples of syllabi for a variety of courses.

Starting a knowledge base for ecosan training and education
As a contribution to the currently available e-learning resources and ecosan knowledge dissemination, GTZ together with several other organisations have collected, assembled and made available published material relevant for education and training purposes on a "ecosan resource CD" (GTZ 2006), which either accompanies this publication, or is also available from ecosan@gtz.de . This CD will be useful for interested teachers to develop their own teaching material. The content of the CD comprises:

- Basic ecological sanitation literature (e.g. the new edition of the EcoSanRes book on ecological sanitation from Winblad and Simpson-Hébert (2004)
- Guidelines (e.g. for the reuse of excreta and grey water, and for project planning)
- Proceedings of ecological sanitation conferences
- Project data sheets and technical data sheets
- Example curricula and Power Point presentations used in existing university courses on ecosan
- Concepts for local capacity building workshops

This CD is seen as the core of the current ecological sanitation knowledge base, and may be used as a starting point for a web-site on education and training material for ecological sanitation capacity building. Further activities in this respect may comprise the exchange of information on ongoing training activities, resource experts, development of a joint e-learning courses etc.

To provide inspiration for the development of your own ecological sanitation courses, a range of samples of ecological sanitation syllabi and workshop contents and an awareness raising presentation are given in Chapter 7 of this publication.

Learning material from all sources shall be used in a joint effort to develop a comprehensive capacity building programme to support sustainable sanitation. This certainly will contribute to the task over the next 10 years to meet the Millennium Development Goals.

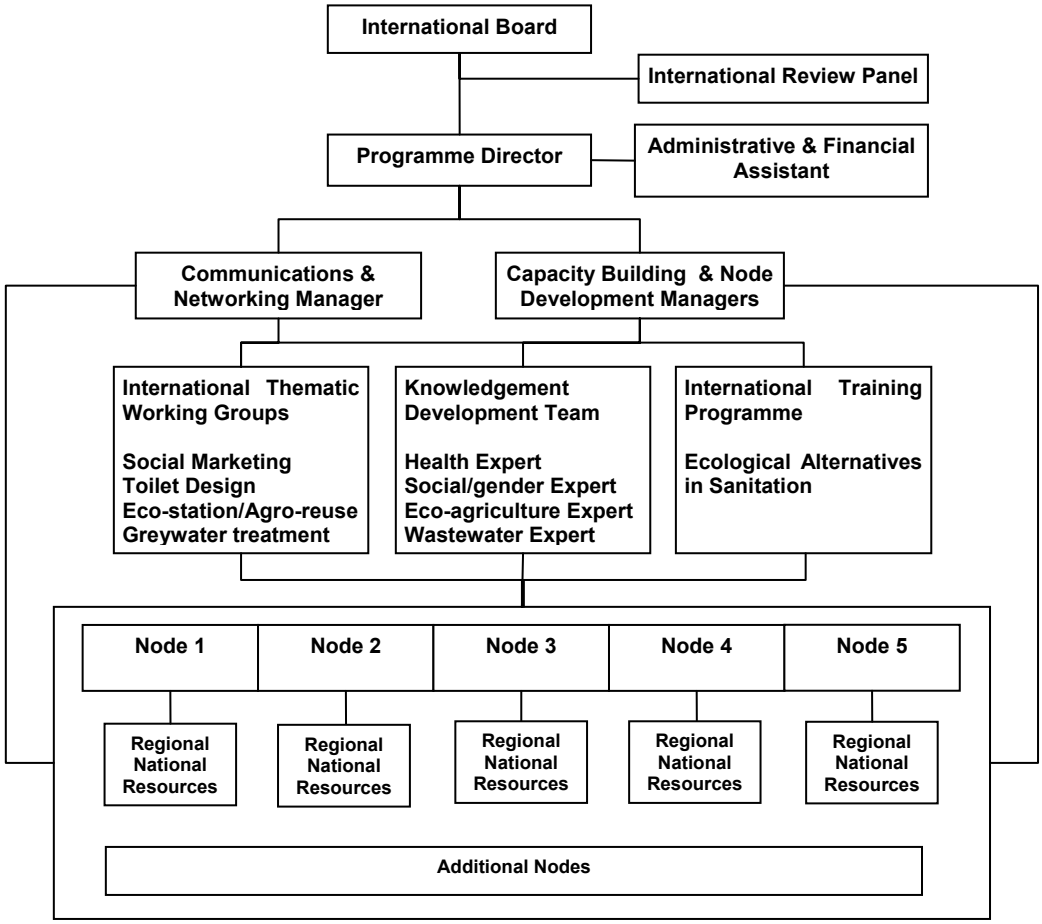


Figure 15: The organisational structure of the "nodal concept for capacity building", as suggested for the EcoSanRes Programme Projectphase 2. (EcoSanRes 2006)

5 Knowledge management, research and development for sustainable sanitation: the need for a change

Many successful, individual examples of ecological sanitation systems can be found in various countries. However there is still a great deal of research and development work needed before ecologically sustainable sanitation systems are broadly accepted and implemented internationally as state of the art solutions. Most of the systems installed to date have been in rural areas, whereas experience in urban and peri-urban areas remains limited. However, faced with rapid urbanisation world-wide there is a pressing need for practicable sanitation solutions in such densely populated areas.

If the Milennium Developments Goals are to be reached, a dramatic acceleration in the rate of progress in sanitation coverage is necessary. If they are to be reached sustainably, knowledge management, research and further development of sustainable sanitation systems with a proven track record and a large potential for multiplication are urgently required. This can be best achieved through a combination of demonstration projects and action research, the development of field-tested standardised systems and the compilation of a broad knowledge base on innovative and sustainable sanitation solutions. Demonstration projects are also needed to illustrate how robust, sustainable ecological sanitation systems can be provided at a high enough rate to make the sanitation targets of the MDGs achievable.

The holistic approach needed for knowledge management, research and development for sustainable sanitation solutions should be multi-facetted. It needs to comprise not only traditional water supply and sanitation issues, but also other disciplines such as agriculture, town planning, public health, environmental protection, resources management, economics, marketing, and sustainability assessment. At the same time the development of sanitation systems should adopt a life-cycle approach. This should be applied to the material flows that enter the system and must subsequently be managed or reused, as well as to the infrastructure itself.

It will not be enough to simply change the topics being researched. The way in which sanitation research is carried will also have to change to an extent, making better use of “learning alliances”, and “action research”. The bridge between academia and practice, or formal and practical knowledge in sanitation also needs to be improved, taking behavioural and cultural aspects and the actual needs of the stakeholders into consideration.

5.1 Historical perspective on sanitation knowledge and experimentation

Most old agricultural societies practised use of night-soil, and lived for centuries in closed loop systems, where the nutrients from liquid and solid household wastes were reused as fertiliser. Using this practice, China managed to keep the soil fertile for several millennia, despite having a relatively high population density. This knowledge however was not based on scientific research, but was rather culturally codified and traditional practical knowledge. In general, historical descriptions on this theme are sparse.

This practical knowledge has been used for water saving, greywater recycling and the reuse of nutrients from excreta. In Yemen, for instance, the separation of urine and excreta was common practice for many centuries resulting in a sanitation system, which required very little water, with the dried faeces eventually being burned. In modern times this traditional sanitation system has been changed with the introduction of water-flush toilets, which appeared to offer a more convenient and “modern” solution. However this has lead to water shortages and a dramatically falling water table in the area of the Yemeni capital city of Sana’a, and to structural damages of the existing multi-storey clay-buildings (Winblad and Simpson-Hébert 2004). In Central Europe human excreta were commonly used together with animal manure in agriculture as a source of nutrients. In many places, including colonial America, fruit trees were planted when an outdoor latrine was moved, and the trees were fertilised by the excreta.

Over the last centuries however, traditional reuse practices have been abandoned, due to the reasons discussed below. Today however, in view of the degrading quality and fertility of our soils, the limited availability of mineral phosphorous reserves and the high energy demands to produce fertiliser, and the need to protect our freshwater reserves, the recognition of excreta and greywater as resources should again be reinforced and systematically implemented, using modern technological and operational solutions, and ensuring maximum health protection.

The practice of using the nutrients in excreta for agriculture was prevalent in Europe until the middle of the 19th Century, and the marketing of fertiliser derived from excreta and organic waste was a thriving small scale business. Farmers were eager to get these fertilisers to increase their yields and the value of human waste was clearly recognised.
In Paris for example, in 1850 urban agriculture was practised on 15% of the citys area and Paris was exporting vegetables, compost and fertiliser from pits to the surrounding regions (Illich 1987, Lange 2002). With the introduction of flush-toilets, the system was no longer able to manage the increased amount of liquid waste leading to overflowing pits and a rise in pollution of the inner cities, and exceeded the transport capacity of the traditional night soil management systems. In addition the dilution of human excreta with flush water decreased the nutrient concentration and thereby the market value of the wastes and the invention of artificial fertilisers finally introduced a cheaper alternative into the market.
All this led to the increased use of existing storm water drains to transport liquid waste out of the city. The concept of the water-borne sewer system quickly became the standard approach to solve the sanitation problems in urban areas of industrialised countries during the second half of the 19th century (van Zon 1986).

With the widespread introduction of flush-toilets and water-borne sewers however, pathogen laden black water entered rivers, lakes, and other surface waters. This pollution problem got worse with increasing population density and the number of inhabitants and industries connected to the sewer system. Consequently these sewage disposal systems had to be successively upgraded with additional sewage treatment plants, increasing investment and operation and maintenance costs.

Waste-water treatment technology has been further refined over the years, targeting different substances and using a variety of physical, biological, mechanical and chemical water treatment technologies. As knowledge of environmental science increased, the aim of these treatment steps has evolved from the simple removal of larger solids to the elimination of oxygen-consuming organic substances, and later the removal of nutrients. Today the need to degrade or remove micro-pollutants, such as hormones and medical residues, is being discussed as a further treatment step. It has taken about a generation to research, invent, develop, test, up-scale, and institutionalise each additional major waste water treatment step.

The refined treatment processes however, resulted in the production of larger quantities of sewage sludge, which again posed problems of handling and disposal. With the replacement of the traditional reuse oriented dry sanitation systems through sewer systems and wastewater treatment plants, the recycling of nutrients now was limited to the small insoluble fraction contained in the sewage sludge, whilst the soluble fraction was either discharged into the water bodies or degraded into volatile substances in energy intensive processes. Making the issue more complicated was the fact that sewage sludge from large centralised systems often were contaminated with toxic substances (e.g. from industries), and therefore had to be disposed of in landfills instead of being reused.

The abandoning of reuse oriented sanitation systems lead to an increased use of mineral fertilisers to maintain soil fertility (although their long-term effects on the soil and on the quality of the food produced are still being debated). Where finances have been limited, for example in developing countries, soil quality and fertility has degraded dramatically, while the misuse of water bodies as a sink for human waste reduces their quality and causes severe hygienic and environmental problems. In addition the consumption of limited natural resources for the production of artificial fertilisers (especially phosphorous) led to a new debate on sustainable reuse oriented sanitation concepts.

After water-borne sanitation became the prevalent approach in the 20th century, the search for efficient reuse-oriented sanitation in industrialised nations basically came to a standstill until the 1970s,

when mainly Scandinavian research on ecological sanitation started with projects on composting toilets, urine separation and reuse (compare figure below). The widespread acceptance and promotion of water-borne systems can be mainly attributed to the following:

- The availability of cheap artificial fertiliser ensured there was no market for the products of human excreta
- Large centralised sewer systems and treatment plants were seen as the state of the art and as the unquestioned modern solution
- Environmental problems had been recognised, but were not perceived with the urgency they are recognised today. One reasen is that the global population and urbanisation were less, and so were the resulting problems.
- Mineral fertilisers were seen as a panacea for soil fertility problems, with the problems that it can cause, (for example the depletion of micro nutrients and organic material from the soil or the contamination of phosphorous fertiliser cadmium and uranium) not being widely known
- The displacement of nutrients and organic material from the soil-sphere to the water bodies was not recognised as a problem
- The discussion on the limitation of natural resources (such as oil and phosphorus) and on the sustainability of our way of life only arose in the 1970s

In many ways development studies and the investigation of failures of the European models in the South have revitalised the interest in alternative solutions to the conventional sanitation approach. Sewered sanitation and centralised waste water treatment were regarded for several decades, and indeed still are by many people, as the most appropriate solution to solve sanitary problems world wide, with the main difficulty being how to finance the required investment. This was followed by the realisation that the implementation and operation of these systems was only possible in rich countries and in high income areas of developing countries, and still required huge subsidies by governments, and resulted in the poor being left to fend for themselves.

Today with greater population pressure and scarce water resources this human waste disposal system is no longer able to meet needs.

In recognition of these shortcomings, a movement towards developing and providing appropriate alternative sanitation began some decades ago. The movement was largely driven by the realisation that the health of unserved, unconnected populations was in dire need of improvement and that these improvements were unlikely to be come through conventional sewerage. It thus became a priority to:

- Identify appropriate simple, affordable decentralised dry and wet sanitation systems, such as VIP-latrines or pond systems and promote their adoption
- Implement appropriate technologies with the participation of the communities to be served, and
- Focus on health and hygiene education so that physical facilities would be properly used and maintained, and that hygienic behaviour would support the improvements brought about by the infrastructure.

Progress in the adoption of appropriate technology was initially slow as it required nothing less than a paradigm shift away from the traditional technology fix to one based on the participation of the intended beneficiaries assisted by multidisciplinary teams of professionals.

Over the years, it became clear, that this health and hygiene driven paradigm shift was incomplete: In practice faecal sludge management problems where often overlooked, as were negative downstream effects. Protection of the environment, resource conservation and waste reuse remained secondary concerns at best, or were neglected entirely, and operational problems reduced the health impact of these technologies.

For many practitioners and researchers this lead to a revival of interest in the reuse of excreta and urine that had been ignored by mainstream research.

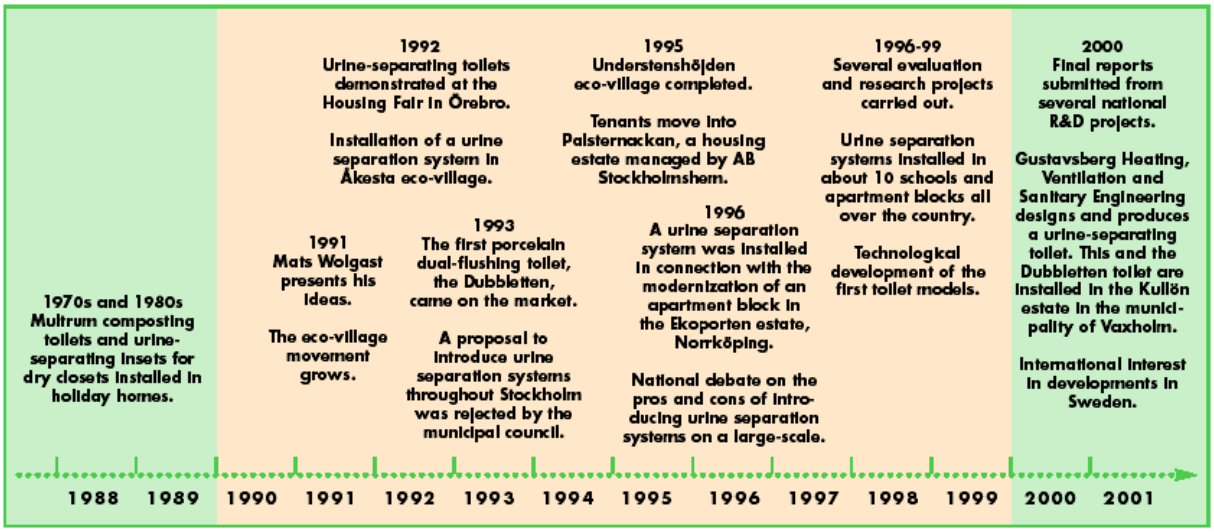


Figure 16: Swedish research on urine separation and reuse in the end of the 20th century (Johansson et al. 2000)

Figure 16 illustrates the increasing number of research and demonstration projects for excreta reuse carried out in Sweden from the 1980s to the early 21st century aimed at developing hygienically safe closed-loop sanitation systems. Similar lines of research began elsewhere, for example in North America (del Porto and Steinfeld 1999), in Africa (Morgan 2005), in the Netherlands (Zeeman and Lettinga 1999, Lettinga 1996), Norway (Jenssen et al. 2004) and Germany (Wilderer et al. 1997, Wilderer, Schroeder and Kopp 2004).

These closed-loop sanitation systems became popular under the name “ecosan”, “dewats”, “desar”, and other abbreviations. They placed their emphasis on the hygenisation of the contaminated flow streams, and shifted the concept from waste disposal to resource conservation and safe reuse.

In addition to paying great attention to the health aspects at the household level they also emphasised:

- The destruction of pathogens through flow stream separation, containment and specific treatment.
- Resource conservation through reducing the use of potable water as a transport medium for human waste and by using wastewater for irrigation
- The elimination or at least the reduction of wastewater discharge to the environment
- The need to close the resource loops through the productive use of the nutrients contained in excreta

The modern ecosan concept thus represents the culmination of the paradigm shift initiated in response to satisfying the health needs of unserved, mostly poor population groups. Ecosan adds resource conservation and waste reuse to improve both the economic conditions and the health of the population served. These two issues are linked, as health is a prerequisite for human productivity, and productivity determines economic well-being. The ecosan paradigm shift thus uniquely contributes to several objectives: the improvement in human health, poverty reduction in developing countries, the conservation of natural resources and sustainable water and sanitation management systems in both, industrialised and developing countries.

Examples for early alternative sanitation initiatives

Historical research on the urbanisation of 19th century Europe sheds some light on the driving forces behind sewered, water-borne sanitation, and end-of-pipe treatment systems in Europe. The historical research of Lange (2002) and some earlier work of van Zon (1986) are useful to help us understand the alternatives that have been discussed and tested, and to gain some preliminary insight as to why these were ultimately rejected or accepted on only a small scale.

Vacuum technology, currently used for sanitation systems in ships, aircraft and trains, as well as in hospitals where patients are exposed to radioactivity, was a major contender to become the sanitation system of choice in Europe in the 20th century. The advantage of vacuum systems is that they use very little water, so that the concentration of organic matter in black water is high enough to allow fermentation and bio-gas production. The low pipe diameter and water volumes also ensure more modest construction and maintenance costs.

Urine diversion and collection was common practice in many cultures and has a long history. For example in Roman times urinals were put up in alleys by laundry services who collected the urine and used it in washing clothes.

In the second half of the 19th century special urinals were developed for saving water, but also for extracting phosphates and nitrates, which were used as fertilisers or for the production as gunpowder and could be sold well until in the 20th century, when saltpetre (an alternative source for nitrates) was discovered in Chile.

Box 6: Urine separation and reuse technology in the 19th century

A patent for waterless urinals was given in 1885 to the Company BEETS from Vienna. In Vienna, as in several other cities, the water consumption of public urinals was too high to be provided with an adequate public supply (over 100 Litres per single urinal stand and hour). Beets' idea was a siphon in which a liquid lighter than urine (oil) formed a layer on top of the urine thus preventing its evaporation and stopping smells. The design of the siphon has since been further developed. In the last 40 years more than 200 000 waterless urinals have been sold, mainly in Switzerland, by the successor of the Beetz Company, which is the Company Ernst. (Lange 2002; Lange and Otterpohl 2000; GTZ-technical data sheets 2005)

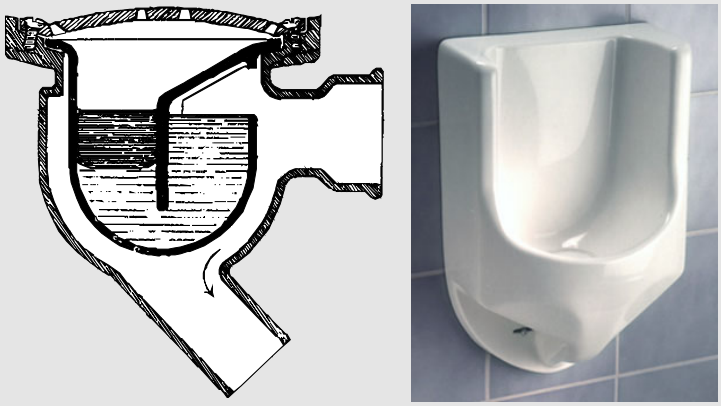


Figure 17: Siphon for waterless urinals invented by Beets, 1885: Oil forms a layer on top of the urine and stops smells (left) (Lange 2002). Modern waterless urinal (right). (GTZ–technical data sheets 2005-01.B2).

Box 7 : Vacuum technology in the 19th century

In 1865, Prince Heinrich der Niederlande had asked T. Charles Lienur to remove the sewage from Castle Luxembourg without polluting the River Elz and without using wagons. The introduction of sewer systems in the second half of the 19th century had provoked hefty discussions on their pros and cons, as treatment plants were not existent (the first German treatment plant was build in 1887 in Frankfurt-Niederrad) and they were resulting in an increasing pollution of surface water bodies.

The system developed by Lienur consisted of two pipes. One carried rainwater, greywater, and industrial water, while the other was what could be considered the ancestor of modern vacuum sanitation systems, and was used to transport blackwater and water from stables and slaughter houses. The vacuum toilets required very little water and the blackwater collected was used to produce “poudrette” (French for dried natural fertiliser from dung or compost).

At that time the industrial production of mineral fertiliser had not yet started (the first factories were built in 1870) and the price for fertiliser was high enough to allow the production and successful marketing of “poudrette”.

In developing areas of Amsterdam in 1906 more than 4 500 vacuum toilets where connected to a Lienur-system. Soon however the production of poudrette was seen as being too costly as prices for industrial mineral fertiliser decreased.

Although some information on Lienurs system is available, a thorough investigation of why the system could not compete with central sewer systems in urban areas, particularly under the specific and very difficult conditions in a city like Amsterdam, has not been carried out (Lange and Otterpohl 2000, Lange 2002).

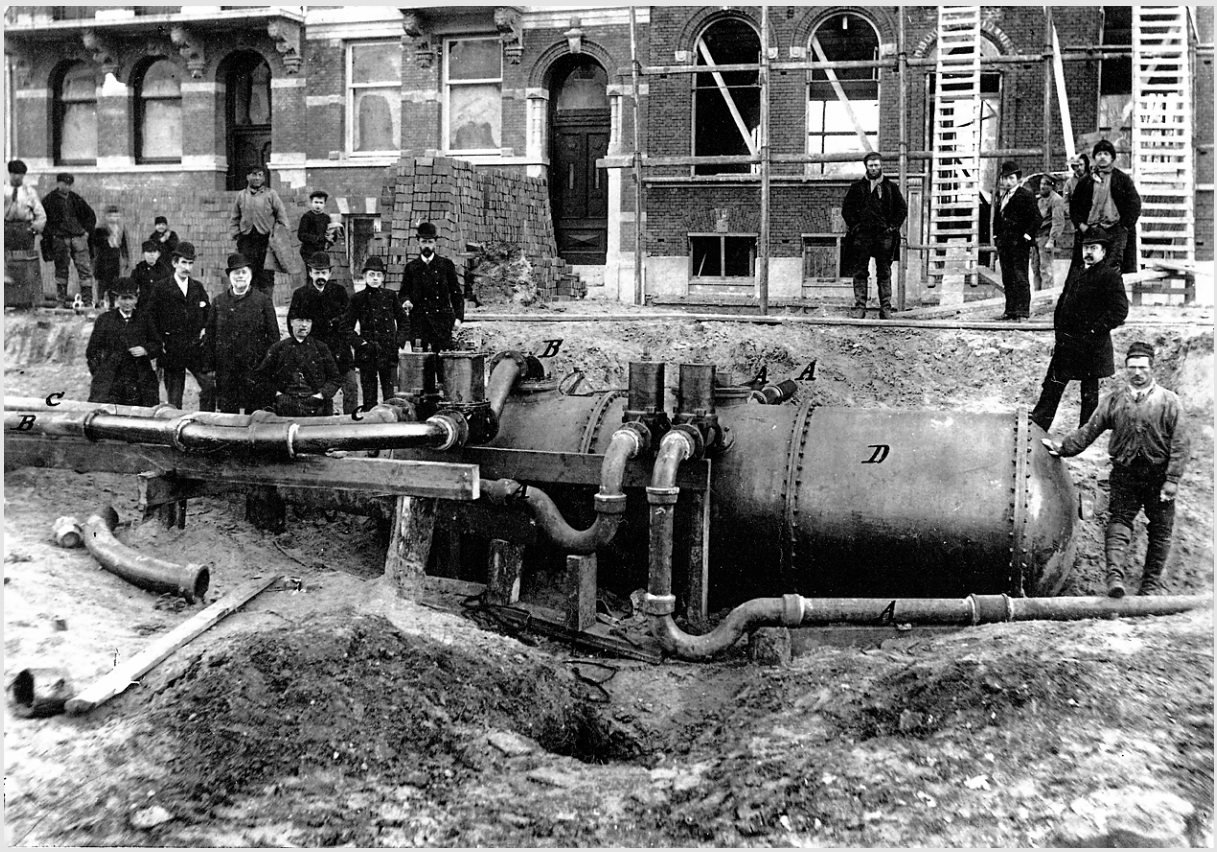


Figure 18: In Amsterdam in 1906 more than 4.500 vacuum toilets were connected to a vacuum based Lienur-system (Lange 2002). (Foto Roediger)

Recent renewed designs

Today vacuum technology, waterless urinals and urine diverting toilets belong to the many technologies available as components of innovative eco-system oriented sanitation systems. Examples for vacuum based ecosan projects include the headquarters of the KFW-Bank in Frankfurt, Germany (comp Box 5 below), or the Building Initiative "Wohnen & Arbeiten", Freiburg, Germany (Panesar and Lange 2004). Waterless urinals are becoming increasingly common in Europe and can be found in many public buildings today. In the new GTZ-Headquarters in Eschborn, near Frankfurt, Germany (comp Box 6 below) for example, waterless urinals are used together with urine diverting toilets for a urine separation and reuse demonstration and research project (GTZ –technical data sheets 2005).

Project Box 5: Vacuum sewerage and greywater recycling at the KfW office building, Germany (GTZ-project data sheets 2005-001)

A recent extension of the headquarters of the KfW Bankengruppe, in Frankfurt, Germany, offers space for around 300 workplaces and has 13 apartments on its two top floors. In the building an innovative water and wastewater management system has been installed that includes vacuum technology and meets economic and ecological requirements.

Figure 19: KfW office building "Ostarkade" (left); Vacuum toilet and pumping unit (right) (KfW)

Office areas and apartments are equipped with vacuum toilets and vacuum urinals which are connected to the central vacuum pumping station in the basement by a vacuum pipe system. Blackwater from toilets and urinals is currently discharged to the communal sewerage system. However it is planned to include on-site anaerobic treatment of the blackwater in the next phase of the project.

Greywater from hand washing, cleaning and kitchens is collected in a separate gravity pipe system. It is treated using compact activate sludge reactors, membrane filtration and UV-light. The treatment guarantees pathogen free water for reuse. The treated greywater is used for toilet flushing and for cleaning.

The innovative sanitation concept is currently repeated in other extensions of the KfW office complex.

Project Box 6: Urine separation and reuse at the GTZ-Headquarters inGermany (GTZ - project-data sheets 2005-016)

During the renovation of the main GTZ office building in Eschborn, a modern, ecologically sustainable concept for the management of the wastewater from toilets is being installed. The main building will be equipped with waterless urinals and water flushed urine diversion (UD) toilets. Through the separate, undiluted collection of urine, the water demand for flushing toilets will be significantly reduced. With this concept, the GTZ not only saves 900 m³ of water per year, but also the load of substances and nutrients from the urine on the water treatment facilities is reduced.



Figure 20: The main building of the GTZ headquarters (left - ttsp-HWP-Seidel); urine diversion toilet (middle - ROEDIGER) and waterless urinal (right; Keramag)

After treatment the urine will be used in agricultural tests carried out as part of a research project. The information collected from the project will also help to improve agricultural production with fertiliser originating from urine. When finished, the system will serve as a model for similar facilities, also in countries where water is scarce and fertiliser is needed in local agriculture. As the bulding recieves thousands of overseas visitors per year from developing countries, a large public relations impact is expected.

For the treatment and reuse of the brownwater originating from the UD-toilets an additional research component is foreseen. Treatment with an activated sludge reactor, followed by membrane filtration, is currently being discussed as one possible technological option.

5.2 Evaluating sustainability in sanitation systems

Overall sustainability has been largely overlooked in decision making processes and in planning and implementation of sanitation systems. Many systems have failed to provide sustainable services with regard to their social, economic and ecological impact, and in their operation. As a recent unofficial figure from the World Bank highlights, currently only 25% of all centralised wastewater treatment plants built in developing countries actually function correctly, as the sustainable operation of these cost intensive facilities is often not feasible. In terms of the social, economic and ecological sustainability and in protecting human health, these systems are failing in most cases.

Current legislation, norms, standards and decision-making procedures for choosing sanitation systems are determined by conventional thinking toward end-of-pipe solutions. They focus on the quality requirements of treatment plant effluent, which initially have been set for not polluting the receiving water bodies beyond their so called self-purification capacities. The decision-making is based largely on the net present value of investment, operation and maintenance cost of the system. However, if a sustainable operation of the system is to be achieved, a more holistic planning and decision making process is needed, geared towards finding sustainable systems. Sanitation decisions therefore need to be made on the basis of a much broader range of criteria than at present. They should include

social, ecological, technical, and economic and health aspects, and respond to long term sustainable resources management needs.

This is an urgent requirement given the current global sanitary crisis and the international commitment to address this, particularly the plan of action to reach the Millennium Development Goals. With this pressing need for action to meet the MDG sanitation target however, there is a huge risk that in developing countries the focus will fall simply on the provision of toilets and sewer connections, overlooking what is needed for a sanitation system and the related services to be sustainable from an overall perspective. That these conventional solutions usually are a subsidy for the rich, leaving the poor without service, was expressed by Sunita Narain, the director of the Indian Centre for Science and environment (CSE) (Narain 2004) (see Box 8).

There is therefore a need to integrate the more holistic considerations of sustainability into current decision making processes for sanitation, from the micro to the macro level.

Box 8: Conventional sewerage leaves the poor unserved

In her key-note speech at the international symposium on ecological sanitation “ecosan - closing the loop” in Luebeck 2003 Sunita Narain, the director of the Indian Centre for Science and environment (CSE) said:

“The political economy of sewers is extremely atrocious in poor developing countries. Hardly any poor city is able to recover its investments in sewer systems. As a result the users of these sewer systems get a subsidy. But almost all users in poor cities are the rich. Thus, sewers only lead to a subsidy for the rich to excrete in convenience. The poor always remain the `unserved´ in this waste disposal paradigm.” (Narain 2004)

One way of guiding decision making processes towards social, economic and ecological sustainability is to use sustainability oriented criteria when comparing and choosing sanitary systems. Such criteria should be used across the entire range of planning, implementation and operation levels – from the macro to the micro level. Developing and using a context-specific list of criteria to indicate the overall sustainability of a sanitation system therefore helps gearing the decision making process towards the issues relevant to the different stakeholders, and away from basic economic and techno-centric discussions. This allows more room for the implementation of innovative sanitation solutions that are tailored to the needs of the system users (Tischner and Schmidt-Bleek 1993).

The use of criteria in order to assess sustainability of sanitation systems has been suggested by several researchers. Larsen and Gujer (1997) underlined the need to focus on the functions the urban water management system should provide in order to be sustainable. Computer-based multi-criteria analysis tools to assess sanitation systems have been proposed by different actors, including the Swedish water and sanitation research group “Urban Water” (Urban Water 2004) and the Dutch researcher van der Vleuten-Balkema (2003).

However, despite this work, the use and usefulness of sustainability criteria in sanitation decision making remains largely unrecognised in real-life project planning and implementation. This may be due to the fact that much of this work has so far been mainly the domain of a relatively small circle of academics. The use of abstract theories and complex computer models may actually be serving to discourage practitioners from using sustainability criteria in their decision making processes.

In literature, many references to sustainable sanitation can be found without any accompanying definition of what this term might actually imply. To identify criteria that can be used to assess the sustainability of sanitary systems, a definition of sustainability with regard to sanitation is needed. However in order to do this, clear boundaries defining the limits of a sanitation system are a prerequisite

These should comprise from the cradle to the final destination all parts of the sanitation system, including: the users and other stakeholders demands and needs, collection, transport, treatment, reuse or final disposal of human excreta and domestic wastewater, organic household wastes, with option to include as well industrial wastewater, storm water, solid waste, animal manure or other agricultural wastes.

This broad definition explicitly recognises that sanitation is more than simply an element contained entirely within the water cycle. These boundary conditions also deliberately include the social aspect of sanitation, the economic and logistical side, and the idea of resource management, as well as any indirect impacts, costs or benefits of the system. Setting the boundaries of the sanitation system sets the basis for the comparison of entire systems, rather than simply comparing different technical elements of the system.

The list of criteria presented below is based on the understanding that a sanitation system that is sustainable, protects and promotes human health, does not contribute to environmental degradation or depletion of the resource base, is technically and institutionally appropriate, economically viable and socially acceptable.

The sustainability assessment of different sanitation systems is a holistic way of comparing systems with regard to their ecological, economic, organisational and societal impacts. This important method to compare conventional and ecosan systems constitutes a research field for itself.

Criteria for comparative sustainability assessment

An example of a general list of sustainability criteria that could be of importance in the assessment of the sustainability of sanitation systems, can be seen in Table 6. This list was first presented by Bracken et al. (2005) and is based to a large extent on criteria/functions/indicators outlined in the literature (van der Vleuten-Balkema 2003; Hellström, Jeppsson and Kärrman 2000; Larsen and Gujer 1997; Larsen and Lienert 2003; Lennartsson 2004, Urban Water 2004).
The criteria in the list are grouped into categories which are an expansion of the conventional triple bottom line usually accepted as the three pillars of sustainability – economy, society and the environment. This table contains five main categories; health, environment, economy, socio-culture, and the technical function. The protection of human health was and is the main aim of providing sanitation. To stress this fact, health has been taken as a category in itself and not as an element of environmental or social considerations. The technical function of the system was also considered an important criteria for sustainable operation, and this could not be satisfactorily addressed under the triple bottom line. The categories are described in more detail after the table.

Table 6: Examples of general sustainability criteria for the evaluation of sanitation systems (modified from Bracken et al. 2005). The contents of this table is intended to assist planners, decision makers and other stakeholders to identify their own context specific sustainability indicators, and not to serve directly as a general checklist for sustainability.

Criteria	Indicators
Health	
Exposure to pathogens and risk of infection related to all system elements including collection, treatment reuse and final destination of products / wastes	Risk assessment or qualitative
Risk of exposure to hazardous substances: heavy metals, medical residues, organic compounds	Risk assessment or qualitative
Health benefits due to improved hygiene, food production, nutrition status, livelihood	Risk assessment or qualitative
Environmental	
Use of natural resources, construction and O&M	
Land (investment, constr. and O&M)	m^2/pe
Energy (constr. and O&M)	MJ/pe
Construction material (constr.)	Type and volume
Chemicals (constr. and O&M)	Type and volume
Fresh water (O&M)	
Discharge to water bodies	
BOD/COD	g/pe/yr
Impact on eutrophication	g/pe/yr of N and P
Hazardous substances: heavy metals, persistent organic compounds, antibiotics/medical residues, hormones	mg/pe/yr
Air emissions	
Contribution to global warming	kg of CO_2 equivalent/yr
Odour	Qualitative
Resources recovered	
Nutrients	% of incoming to the system
Energy	% of the consumption within the system
Organic material	% of incoming to the system
Water	% of incoming to the system
Quality of recycled product (released to soil)	
Hazardous substances: heavy metals, persistent organic compounds, antibiotics/medical residues, hormones	mg/unit
Economic	
Annual costs, including capital and maintenance costs	Cost/pe/yr
Ability to pay – user (% of available income)	Disposable income/pe
Environmental and health costs	Cost/pe/yr or qualitative
Benefits from reuse	Generated income/pe/yr
Local development, business and income-generation effects	Qualitative
Socio-cultural (including user, institutional and policy asepcts)	

Criteria	Indicators
Acceptance by the users and willingness to contribute through work and or money for sanitation services (% of available income)	Reasonable % of time or income – defined by users
Convenience (comfort, personal security, smell, noise, attractiveness, adaptability to different age, gender, and income groups)	Qualitative
Current legal acceptability and institutional compatibility	Qualitative
Appropriateness to current local cultural context (acceptable to use and maintain)	Qualitative
System perception (complexity, compatibility, observability – including aspects of reuse)	Qualitative
Ability to address awareness and information needs	Qualitative
Technical	
System robustness: risk of failure, effect of failure, structural stability,	Qualitative
Robustness against extreme conditions	Qualitative
Robustness of use of system: shock loads, abuse of system	Qualitative
Possibility to use local competence for construction and O&M	Qualitative
Ease of system monitoring	Qualitative
Durability / Lifetime	Qualitative
Complexity of construction and O&M	Qualitative
Compatibility with existing systems	Qualitative
Flexibility / adaptability (to user needs and existing environmental conditions – high groundwater level, geology etc.)	Qualitative

Health
The entire sanitary system should minimise risks and safeguard public health. This covers the use of the sanitary installation, collection, transport, treatment and destination of the treated products. For instance, the risk of being infected through ground water or surface waters, contaminated from leaking sewers, pit toilets, or wastewater disposal should also be considered, as well as the risk of being infected when consuming vegetables from fields irrigated with insufficiently treated wastewater and bathing in lakes or the sea near overflows or waste water treatment plant outlets.

Environment
In many industrialised countries sanitation systems have been further developed to protect the environment against possible detrimental effects of the discharge. When considering the environmental sustainability both emissions to different recipients (water, soil, and air), as well as resource use by different sanitation systems during the construction and operation phase must be accounted for. Moreover it is important to consider the suitability of the treated product for possible reuse in agriculture or aquaculture.

Economy
The ability to pay for sanitation is clearly a decisive factor in choosing the system. Among the users, the ability to pay is an important criterion for sustainability. However in the end it may be their willingness to pay that will define within what range the costs (both for construction and O&M) can vary and services be sustained financially by the population. Some experts argue that the other criteria may eventually be reducible to purely economic considerations. Considerations such as the impact on local development (e.g. local private sector), health benefits etc. might be expressible in monetary terms. However, this reduction of criteria to their estimated economic value is probably not sufficient to allow a thorough consideration of all of the aspects.

Socio-culture
Clearly the objectives of sanitation are to protect human health and the environment, however, sustainability in sanitation cannot be based only on these objectives. There is an obvious need to

include social criteria as they are crucial to the sustainability of the use and the services provided by the system. It is possible to distinguish at least three very different types of important criteria within this category, namely cultural acceptance, institutional requirements, and perceptions of sanitation. Society is more dynamic and flexible than criteria such as human health and the environment and therefore the socio-cultural criteria are subject to a more dynamic change with time than human health and the environmental criteria. How the system is perceived, legislated for and accepted is therefore changeable with time. Although improving human health and protecting the environment are the main objectives for planners and politicians, this might not be enough to sell the sanitation concept to future users. It is also important to recognize that the prime driver for sanitation might be security and status rather than health and environment as recent studies have shown (Holden 2003, Kgomotso et al. 2004). Another sanitation driver could be the possibility of increased food security if the sanitation solution can provide hygienically safe fertilisers.

Technical function
The technical reliability and performance of the system is key to its success and ultimately its sustainability. One of the more important sub-criteria under this category is probably robustness and flexibility, both within the system (to be able to receive varying loads) and externally (to be able to withstand varying extreme environmental conditions as well as user abuse). The technical functioning of the system is seen as perhaps the most flexible group of criteria. In this regard, it is important to adapt technologies to the needs of the situation rather than trying to make a situation comply with the demands of a favoured technology. It is also much easier to adapt a technology to what people need than to adapt people to what a technology requires.

The list of criteria presented here is intended to provide inspiration when trying to identify context specific sustainability criteria. The requirements of sustainability are dictated by context, and can change with time. This list should serve to inspire sanitation planners on all levels to include the concept of sustainability criteria in their planning processes, and to actually define, in a participatory manner with the relevant stakeholders, what criteria their planned sanitation system should fulfil in order to optimise sustainability in the given context. The list presented here should provide certain “core” considerations of sustainability, which should be considered as a minimum in any basic list to assess a sanitation system.

One way in which the criteria may be used would be as the focal point of a multiple criteria decision making process. There is a broad range of techniques which can be employed for this. This does not need to be an extremely complicated process and methods are available that could facilitate this when working with grass roots level groups. In such cases it is often considered appropriate to allot agreed weights to the criteria identified, relative to their importance to the stakeholders, and to use these weighted versions when deciding. Each stakeholder group may have criteria which are of particular importance to them, and different criteria may be of greater relevance at different times in the decision making process.

5.3 Development and field testing of sustainable sanitation systems in the urban context

5.3.1 The need for large series of pilot research and demonstration projects

The highest research priority for sustainable sanitation is to gain experience of implementing innovative, sustainable sanitation systems on small, medium and large scales, in industrialised and developing countries and in countries in transition.

A large series of research and demonstration projects are therefore needed which can serve to further develop and field-test a broad variety of technical and operational sanitation systems in a range of climatic, social, cultural, economic and geo-morphological conditions. In short: pilot systems are needed to develop a series of model solutions to cover the entire range of sanitation needs.

The research needs cover all the following key aspects for the sustainable operation of a sanitation system:

- technical and performance issues
- environmental and health aspects
- financial and economic aspects
- institutional and organisational aspects
- socio-cultural aspects
- policy and legal aspects

Research needs to seriously address:

- technologies for the collection, treatment, storage, transport and use of excreta and greywater
- logistical and operational concepts
- capacity building issues for decision makers, planners, technicians, users and other stakeholders
- development of local service providers to plan, install, operate and maintain the systems and to market the products
- identification of different reuse options
- market analysis for the complete range of products that the system can be recovered
- development of planning, capacity building and management tools
- development and field testing of different financial instruments and models
- assessments of health and environmental impacts
- full cost-benefit analyses of all types of sanitary systems

A great challenge for ecosan research and development is the introduction of reuse systems in urban areas, where the production of excreta or greywater, their treatment and their reuse can rarely occur in the same location and cannot be carried out by the same person. In introducing ecological sanitation in urban areas, it is therefore necessary that research does not only concentrate on purely technical “hardware” issues. Logistical and institutional issues must also be given a high research priority to encourage the development of more sophisticated logistical arrangements by service providers for the collection, transport, and treatment of excreta. Even more critical is economic and health research in the marketing of these products, leading to an increase in their potential for agricultural use, and social acceptance in cultures where the use of treated excreta is not currently considered appropriate for the food chain.

Technical research is of course also needed. System components that have proven successful on a small scale (for example vacuum sewers) need to be up-scaled and new technical components are needed to ensure that eco-sanitation services can be provided in a variety of demographic and geographic settings.

Project Box 7: China-Sweden project of Erdos eco-town in China (Rosemarin et al. 2004)

Erdos is a cluster of cities in a coal mining belt of Inner Mongolia, where a new eco-town is being developed in a suburban area a few kilometres from the city centre of Dong Sheng.

New houses for 7.000 peoples in the eco-town are being equipped with modern porcelain urine-diverting dry toilets. Toilets and related equipment and fixtures are being developed and manufactured in China.

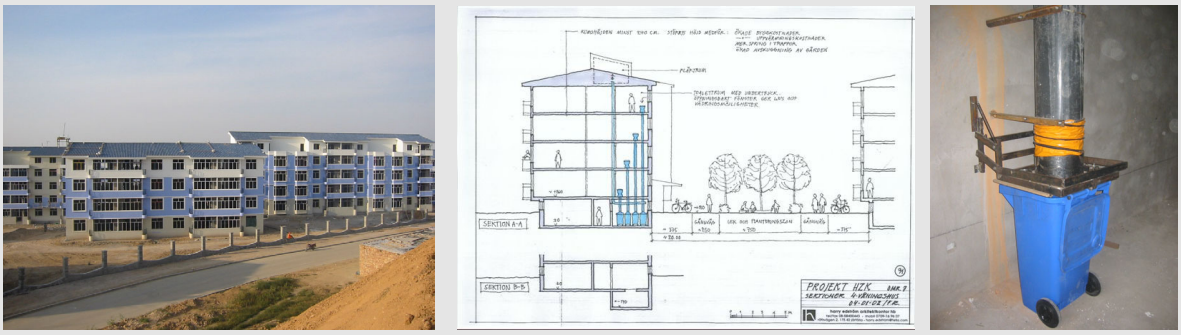


Figure 21: Front view of the apartment buildings (left); straight drop urine diversion toilet design (middle); collection of faeces in cellar containers (right). (EcoSanRes)

Faecal material will be collected in dry form in cellar containers, which will be regularly emptied. The faeces will then be composted together with household organic wastes and used as a soil conditioner. Urine will be collected on site in tanks and used in local agriculture.

Greywater will be collected and treated on site in small aeration and filtration treatment facilities. Organic and other solid wastes will be sorted and collected in eco-stations. Storm water will be collected separately using drains.

The project will undergo a period of development and testing prior to its full-scale implementation. Once in operation the model town will be the object of further performance studies by water and sanitation specialists, urban planners, urban agriculturalists and others.

Urine

Research into the technical and logistical aspect of urine separation in an urban context and the associated management of transport services to return the nutrients to agriculture have been carried out in Sweden. One result of this research was that for a given context, the transport of urine was economically and ecologically sustainable for distances of up to 120 km (Johansson et al. 2000). The institutional and commercial basis for doing this, however, remains largely unexplored, and represents an important challenge.

Rainwater

There are many successful examples for the integration of rainwater management in urban planning, with significant implications for domestic water use, or ground water recharge. Zero run-off concepts and rainwater-collection can make an important contribution to water supply, the replenishment of falling groundwater levels, flood protection and the reduction of costs for storm-water sewers. Green roofs, ponds, and infiltration ditches have a positive impact on the local climate, reduce run-off, and their integration into urban environments can contribute to improving the quality of life for the population.These examples illustrate clearly that rainwater management must be an integral element of urban water and sanitation management systems.

Greywater

The technical and social base for the reuse oriented management of greywater appears to be even more favourable since it can easily be treated and then reused to a large extent near the point of generation, within the same house or housing complex for toilet flushing, irrigation, or groundwater recharge. The municipality of Hamburg is promoting grey water reuse in a pilot programme with the argument that it reduces the consumption of high quality drinking water, and that the innovative treatment system may prove to be a technology ideal for export (comp. Box below).

Box 9: Grey becomes clear: Hamburg, Germany, promotes greywater recycling

"Greywater" is water from showers, wash basins and bathtubs. The most modern recycling technology for this wastewater is smaller than a wardrobe. The treatment and reuse of this water can reduce consumption by approximately 30% and the treated water is of a high enough quality to be used for swimming, bathing, flushing toilets, watering gardens and for washing clothes.

The municipality of Hamburg now provides subsidises of 1 500 Euro per treatment plant, and can subsidise up to 30 plants. "We are doing this for two reasons: (1) Drinking water in Hamburg is of excellent quality and too precious to use as a transport medium for excreta, and (2) Greywater recycling is an innovative approach which could become an important export technology, for example for water scarce regions in the south." said Dr. Herlinde Gundelach, a member of the Hamburg state parliament during a presentation of this new environmental programme – the first one of its kind in Germany. (Stadt Hamburg 2004)

Faeces and blackwater

Large scale experience in the use of urine diverting toilets and the anaerobic digestion of black-water (most usually combined with pig slurry) has been gained in China. In rural and peri-urban of China around 700.000 urine diverting dehydration toilets were installed between 1997 and 2004, and over 10 million of the biogas generating 4-in-1- and 3-in-1- models have been installed (Zhou et al. 2004). These systems have been designed to recover and use the materials at or very close to the point where they have been generated (in agriculture or gardening), and whilst highlighting clearly that ecosan systems can provide sanitation to large numbers of people, they have not provided a great deal of experience with regard to the development of the logistics and infrastructure necessary when ecosan is applied in areas where the materials cannot be directly used.

In the development of this infrastructure efforts should be made to ensure that they enable material flow cycles to be closed on the minimum practical level (i.e. that use can occur close to the point of generation), thus ensuring that transport requirements are minimised, and that any possible export of problems associated with the use of treated excreta and greywater is avoided. This clearly requires urban planners to be involved in the development of the system, and to avail of practical knowledge to enable them to plan appropriately.(e.g. in order to provide space for the integration of a constructed wetland in an urban park, to support urban agriculture or to provide small scale service providers with an area for the treatment and storage of ecosan products in neighbourhoods). In contrast to infrastructure development for conventional, centralised sanitation systems, the required infrastructure for ecosan systems may include the possibility of using smaller planning units and of a greater number of decentralised systems.

The installation of such service structures, and of creating appropriate financing mechanisms to ensure their sustainability, is crucial for the introduction of ecological sanitation in urban areas. This clearly still requires a good degree of research and development to optimise new technical and management solutions.

Research needs to particularly focus on decentralised solutions and systems as integral parts of larger sanitation systems. These systems may consist of combinations of different technologies with services for the transport, storage, distribution, marketing, and safe and sustainable use of the produced materials. Large scale pilot projects are therefore urgently needed, allowing applied research on their performance under different circumstances.

5.3.2 The transition from conventional to closed-loop sanitation systems

The introduction of closed loop concepts in central systems will most probably begin in small pockets, for example in new development areas, where the sanitary system can be designed from scratch and implemented comparatively easily using material flow cycle principles. Such systems provide alternative solutions, which can quickly be used for the sanitation solutions in fast growing cities in developing countries. However, in industrialised nations, where vast sums of money have been invested in centralised water-borne-systems over many years, the transition to closed loop systems will be a much more demanding task. Nevertheless this transition is equally required, probably best being realised during the renovation of the existing infrastructure. For both the installation of new, and the upgrading of existing infrastructure, a step-wise approach will most often offer the best solution. In a first step a series of generic pilot projects can be implemented in a range of typical urban and / or rural settings. These should be both tested in, and adapted to local conditions. In a second step this experience can be repeated and scaled up to eventually cover the whole settled area.

So far very little experience of the transition from end-of-pipe towards closed loop approaches is available. In Europe massive investments have been made in centralised sewers and waste water treatment plants, and a move away from these end-of-pipe systems will prove extremely difficult, as sewers are designed and built to last for several decades. Here, transition towards ecosan solutions will be a slow process, requiring perhaps several generations.

However, in countries where these investments have not yet been made, there is the possibility to avoid the mistakes of the end-of-pipe approach. It will therefore be essential to make any investment decision here on the basis of sustainability, using suitable, context relevant criteria in selecting a sanitation system.

The step-wise transformation of an existing end-of-pipe system will have to take into account the existing structures and making best use of what is available. An example for this approach with a vision for closing the nutrient cycle in an existing central system was developed and described by the Novaquatis –research project, carried out at EAWAG, Zurich, Switzerland (Larsen and Gujer 1996). One of the concepts developed here was to separately collect urine from individual households, and to conveying it to a central collection point using the central system at a specific schedule at night, on dry days, when the system is usually not being used by anybody else.
In the framework of the AKWA 2100 research project, Hiessl and co-workers (2003) developed a series of scenarios for future central, semi-central and decentralised sanitation solutions in an urban context, analysing them both from an economic and a sustainability perspective. In a follow up to this research project it is planned to outline how the transition from the existing situation to the desired future situation can be addressed.

Box 10: Urban ecosan pilot project for 100 new urban houses in southern Germany

In the construction of around 100 new residential buildings in Römerhof, near Knittlingen, southern Germany, a unique form of community water management will be implemented. Advanced technologies will be used, ensuring a sustainable and affordable operation of the entire water infrastructure, supported with 2 Million Euro from the German Federal Ministry for Education and Research.

The project, led by the Stuttgart Fraunhofer Institute for Interfacial Engineering and Biotechnology (IGB), plans to recycle rainwater and nutrients from household wastewater. The black water will be collected by vacuum sewer and transported to a central biological treatment reactor with integrated membrane technology. In this process organic material will be fermented, producing methane ,and phosphorus and nitrogen salts will be converted into agricultural fertiliser. The bio-gas generated will be used to provide the plant with electricity and heat, with surplus electricity being fed into the national grid. The treatment technique is designed to produce minimal volumes of sludge and after treatment the water can simply be infiltrated into the ground.

(IGB 2004)

5.4 Research and development of tools and instruments for sustainable sanitation

As a complex, holistic, and innovative approach, involving disciplines from engineering to public health, and the social sciences, research fields for eco-sanitation are extremely broad and this publication can only try to highlight some of the more pertinent areas where research is needed. Identifying knowledge gaps and posing the appropriate questions to fill them will remain a major task for interdisciplinary research teams in the future.

Research and development is needed within, between and across many different disciplines, addressing topics such as the fertiliser value of the recycled nutrients or the degradation rates of micro pollutants, as well as practice oriented tools and instruments for planning, implementation and operation of reuse-oriented sustainable sanitation systems and marketing strategies for ecosan products.

Some specific areas where there is a need for additional research and development of tools, or instruments related to sanitation planning, implementation and operation are discussed below.

5.4.1 Financial and economic feasibility of sustainable sanitation

One of the difficulties in considering economic aspects in decision making for ecological sanitation systems is that very few economic studies have been carried out so far. The information available is mostly anecdotal or gathered from pilot or demonstration projects, which are notoriously unreliable for cost analysis related to economy of scale (Anschütz, Ijgosse, and Scheinberg 2004). Pilot and demonstration projects generally have unusual expenses, such as those for technology introduction, limited, small scale production of system elements, or initial awareness raising activities. Most existing studies also tend to consider only a particular aspect of the system rather than adopting a holistic analysis. However, first results indicate that; even within studies which have only considered investment, reinvestment and operation and maintenance costs, closed-loop systems have an economic advantage over more conventional systems (see comparative investigation examples in the Boxes 11 and 12 below).

In order to make a fair comparison between the full investment, operation and maintenance costs, there is a need for a comprehensive, dynamic, integrated, cost/benefit or multi-criteria analyses of different types of systems to be performed over life cycles or planning periods.

This will establish the investment, operation and maintenance cost, as well as additional benefits such as improved public health, the fertiliser value of recovered material, the value of improved agricultural production, the energy generated, etc., that are all a result of using the system.

A difficulty with traditional economic appraisals for sanitation is that the setting of the boundaries of the system often leads to many important external costs, or even benefits of the system being overlooked completely. An example of how far these externalities actually reach can be seen by taking a brief look at externalities in relation to centralised wastewater treatment and an ecosan system.

Conventional water-borne sanitation relies on disposing treated wastewater to a surface water body. In addition to the investment, reinvestment and operation and maintenance costs of the sewer network and plant, and the expected health benefits, the environmental externalities arising in the receiving water must be considered, as should the social loss of a recreational area, the possible effect on subsequent drinking water treatment, the loss of natural habitats and effects on coastal areas, the effect of medical residues (hormones, antibiotics etc.) which pass through the treatment works virtually intact, the eventual rehabilitation costs, the impoverishment of soils as a result of nutrient loss, and the costs of using high quality drinking water to flush the system. Each one of these external costs in turn may incur further costs.

Project Box 8: Sanitation for a rural school in Uganda (EcoSan Club, www.ecosan.at)

Kalungu Girls Secondary School, an all girl boarding school with about 350 pupils is nestled in the hilly landscape of Southern Uganda (in Masaka District). A typical problem of this region is that although water is plentiful, water quality is poor. Problems with the water quality led the school administration to ask for support to improve the situation. Due to the shallow ground water level and the location of the soak pits and pit latrines directly upstream of the schools and the nearby villages' water sources the situation was clearly unsatisfactory and potentially dangerous. Additionally the pit latrines were smelled badly and were unhygienic. There was no further wastewater treatment.

The project was implemented in 2003 with 45 dry urine diversion toilets being built for the pupils (mainly outdoor but additionally 2 indoor dry toilets for each dormitory to avoid the pupils having to go out during the night), with treated urine and faces being used in the schools agricultural activities. Additionally a constructed wetland was installed for the biological treatment of greywater, and a dry toilet demonstration unit for teachers and visitors (with a urinal) was constructed.

A special focus was put on training the students, teachers and the O&M personal, to ensure that the newly constructed toilets would not end up in the same state as the old latrines. A main concern was the involvement of the teaching personal, especially the ones responsible for health issues. The design of the demonstration unit was carried out in a participatory way: the details of the unit were developed together with the teachers to create a feeling of ownership and responsibility. The contractor who installed the system was responsible for the education of the students and O&M personal, with a special focus on involving the local technicians from the beginning of the planning/construction process.

Figure 22: Training of students (left); dry toilets with wooden containers for collecting the separated faecal material (middle - view from the back) and demonstration toilet (right). (EcoSan Club)

The toilets are a great success and delegations from all over the country and from abroad come to visit the school toilets. The pupils and the teachers are proud of their well working toilets which are kept clean and well maintained. Since this was such a successful project, visits or families are picking the idea and requests are increasing.

For ecosan systems these external costs may include the necessary transformation costs to adapt the existing sanitary infrastructure, additional awareness raising activities, and the need for continued research and development of different parts of the system.

In contrast to conventional systems, however, ecosan systems offer significant external benefits, which ordinary appraisal tools also fail to capture. These include securing the drinking water supply, through the use of treated greywater and by reducing the discharge of effluent to potential drinking water sources; the improvement of soil structure and fertility; increased access to fertilising agents and phosphates, particularly for poor and for subsistence farmers; reduced energy consumption in the treatment works, and during fertiliser production; nutrient and resource conservation; and the potential for energy production. In order to account for all these externalities the boundaries for evaluating sanitary systems are significantly expanded, and the tools for appraisal need to be expanded accordingly.

Box 11: Examples of cost comparisons - Uganda

School Sanitation in Uganda

In Kalungu Girls Secondary School in Uganda poor sanitation facilities was putting groundwater at risk. This served as the main source of potable water. From February to December 2003, a project was implemented to renew and improve both water supply and sanitation facilities. Additionally a training programme aimed on ensuring an understanding and proper use of the facilities installed.

Prior to deciding on the sanitation scheme to be installed a detailed comparison of costs was conducted and served as one instrument among others in the decision making progress. Two alternative sanitary solutions were compared:

Option 1: Source separation concept: dry urine diversion toilets, sewer line for greywater and a horizontal subsurface flow constructed wetland.

Option 2: Conventional concept: flush toilets for the students, separate sewer system for black water, mechanical pre-treatment, pumping station and a vertical subsurface flow constructed wetland. (EcoSanClub 2004)

The comparison considered investment and reinvestment and operating costs. The calculation was carried out over a 50 year time frame, with reinvestments depending on individual system parts and an interest rate of 8% p.a.(EcoSanClub 2004).

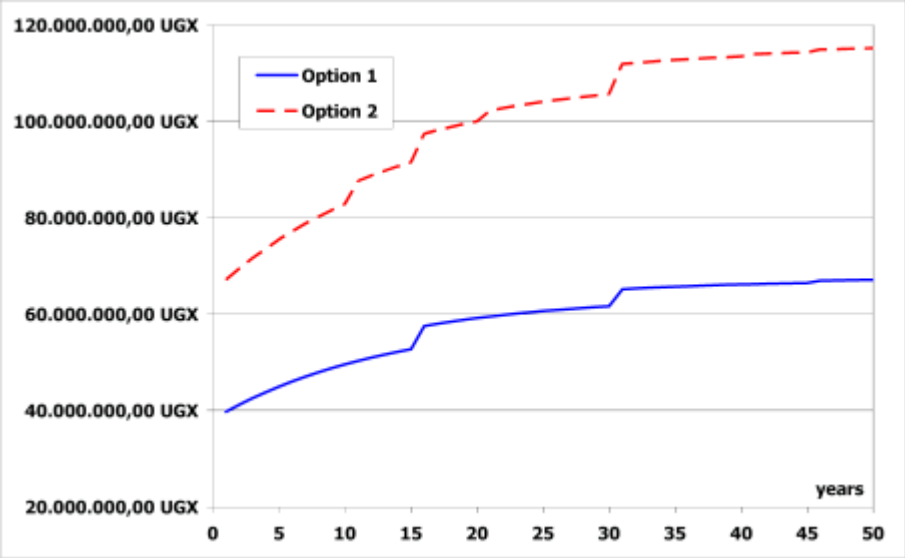


Figure 23: Cost comparison for the installation, operation and maintenance of the two systems for the school (EcoSanClub 2004)

Research is therefore needed to identify and test methods and approaches that can be used in economic analyses to ensure that its boundaries are set wide enough to account for all the expected positive and negative effects of a sanitation system.

The cost comparison in the example from Uganda clearly shows that the safe use option is significantly less expensive. The main difference results from the significantly smaller wastewater treatment system for this option and the pumping station additionally required for the conventional option (EcoSanClub 2004).

Box 12: Examples of cost comparisons – Berlin Brandenburg

New housing estate in Berlin Brandenburg Germany

In Brandenburg near Berlin, Germany, cost comparisons have been made for three different sanitation concepts for a planned new housing estate, where the population is expected to increase from 672 to 5,000 inhabitants within 10 years. The three systems were:

Gravity sewer system (conventional): Flush toilets, normal gravity sewer system, pumping station with transport sewer to the existing sewer network, system operated by the public supplier.

Source separation concept I (gravity, composting of faeces): Gravity separation toilets, collection and storage of urine, transport and agricultural use on a nearby farm, faeces transported in gravity sewer with aerobic treatment in a compost separator, utilisation of compost in horticulture, transport of greywater in gravity sewer system, treatment in a constructed wetland, transport to the receiving water.

Source separation concept II (vacuum, digestion of faeces): Vacuum separation toilets, gravity urine transport, storage of the urine transport and agricultural use on a nearby farm, faeces transported by vacuum sewerage, common treatment with organic waste in a biogas plant, biogas used to produce energy, transport of the digested sludge to the farmer nearby and utilisation in the agriculture, transport of greywater in gravity sewer system, treatment in a constructed wetland, transport to the receiving water.

The three systems were calculated over a lifetime of 50 years, with an annual interest rate of 3.5% p.a. . The results of this cost comparison can be clearly seen in figure 1, for the situation where 5000 inhabitants are served and the local Berlin water company are responsible for the operation of the system. Other service scenarios have been calculated with different population numbers and operational models which also revealed a significant price advantage for the closed-loop systems over the system lifetime. (Peter-Fröhlich et al. 2004).

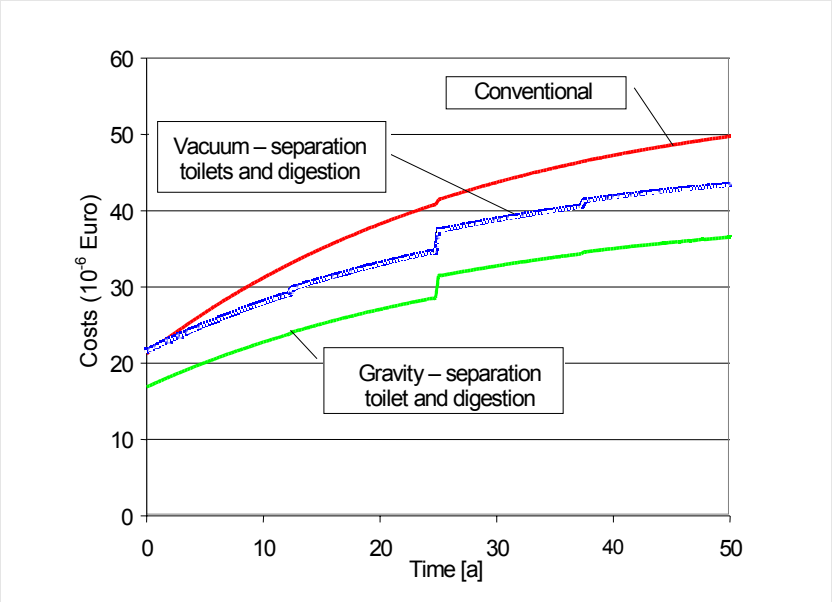


Figure 24: Cost comparison for the installation, operation and maintenance of the three systems for a population of 5000 (Peter-Fröhlich et al. 2003)

Excreta and greywater use projects strongly influence the individual as well as the national economic well-being, since proper management and treatment of excreta and greywater reduces health risks and associated costs for medical care. On the individual (household) level the time gained through reduced illness can be used for education or income generating activities. On the national level monetary and professional resources are relieved from cases of faeco-oral diseases and can be concentrated in other areas. Some of the tools needed to measure these effects are available and

transferable from related disciplines, but require a certain degree of adaptation to sanitation system planning, whilst others need to be developed.

Economic appraisals should also recognise that the real cost or value of an item to a country's economy is not always the same as the price paid for it. For example, foreign exchange may be more valuable than the formal, controlled exchange rate would suggest. On the other hand, the labour of workers who would otherwise be unemployed costs less to the economy than their wages, since no production is lost elsewhere by offering them a job. Economists use a "shadow price" to approximate the "real" value of an item to the national economy. Thus the shadow price of foreign exchange is usually higher, and that of unskilled labour lower, than the rate actually paid for it.

The proper use of shadow prices in this context may also be a relevant research subject. It is thought that reuse oriented systems will perform better than conventional systems when shadow prices are considered for at least two reasons:

- The construction of the system such schemes can most often be carried out using locally available skills, and tradesmen, and using locally available material and thus requires less imported equipment than other processes; at shadow prices, it is more likely to be cheaper.
- The prices of many of the products grown for local consumption are often held below the world market price (if one exists). Whether they are grown for export or for import substitution, a shadow price for foreign exchange will show their true value to the economy.

This however needs research and verification.

Financing mechanisms

Research has a large role to play in developing appropriate financing instruments, putting particular emphasis on the possibility to finance the users' investment for on-site and neighbourhood systems, and recognising that systems to recover and use excreta and greywater have a different cost structure from conventional sanitation systems. This can result in the total costs of the system being less than that of end-of-pipe systems, but the costs that the private households themselves have to pay can increase (see below). Innovative financing alternatives including start-up funds, community based finance programmes, micro-credit programmes and cost recovery mechanisms may therefore be required.

In researching financing mechanisms, allowances should be made not only for the investment, reinvestment, and operation and maintenance of the system but also for the opportunity and environmental costs as well as the systems external impacts on individuals and communities (Cardone and Fonseca 2003). Allowances should also be made for the financing of institutional capacity building and skills training, monitoring and assessment, and policy and the development of an enabling environment for sanitation. The latter includes awareness raising campaigns, hygiene promotion etc. Most of these activities are of a public nature with both the broader community and the individual households benefiting. Financing for sanitation however mainly comes from two sources: the individual or household, and an external source such as government (Evans 2001). Trying to mobilise individual household financial resources for activities targeted to the broader community has however proven difficult. This raises one of the main challenges in developing financing mechanisms for sanitation: How can the needs, interests and finances of individuals and households be effectively co-ordinated and reconciled with those at the community / national level? Ideally this should be achieved in a way to recover costs, but also to ensure equitable access to sanitation, particularly to poorer members of society. This represents quite a challenge to researchers.

Sanitation systems that recover and use excreta and greywater, generally have a different cost structure than conventional systems. This needs to be recognised and practice oriented research should focus on developing appropriate financing mechanisms to support private households in their decision to install them. As shown in Figure 25, the total costs to install such systems tends to be lower than some other for more conventional sanitation systems. This is mainly due to the decentralised, modular nature of source separating systems, which do not require large sanitary infrastructure, such as centralised treatment works, sewerage, or pump stations. In comparison to traditional decentralised sanitation (such as pit latrines or VIPs), they normally provide permanent solutions, and thus do not have to be replaced when full, representing a significant saving over time.

However, although the overall costs are less, those to be covered by the private household may very well increase be higher as a result of having to replace or transform domestic sanitary facilities (for example by installing a urine diversion toilet).

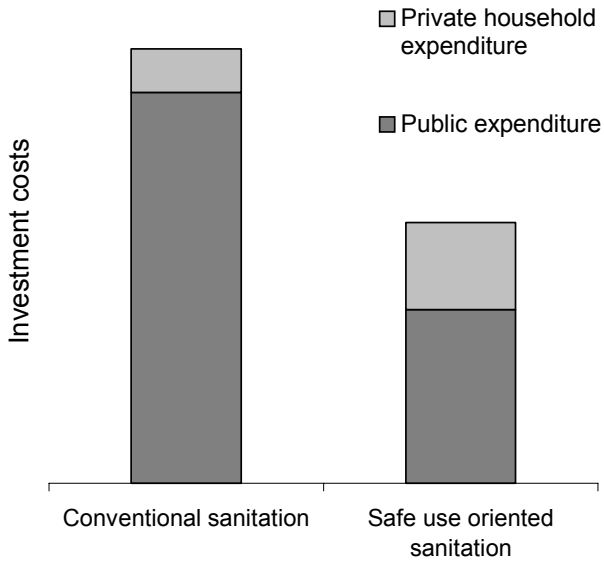


Figure 25: The cost structures of conventional and safe use oriented sanitation systems (GTZ)

Research also needs to examine the possibilities of integrating the local private sector into sanitation provision. The introduction of innovative systems to the market have to be field tested and evaluated.

Further research and demonstration projects are needed in order to develop a variety of viable solutions for densely populated urban areas and obtain results concerning the costs and performances of different systems in both industrialised and developing nations. Generally, for cost and ease of management reasons, a commonly accepted solution must be found based on a participatory planning approach as it is suggested e.g. in the Household-centred Environmental Sanitation approach (Eawag 2005) and taking into account the specific local socio-economic conditions.

Recent international research on the relation between poverty and sanitation indicates that investments in sanitation have a huge positive impact on the national economy, with relatively high cost-benefit ratios, averaging 5.5 for all targeted regions (SEI 2005). The fact that money put into sanitation provides a huge return on investment has also been stressed recently in the joint monitoring report from the WHO / UNICEF MDG Joint Monitoring Programme, where they point out that “access to safe drinking water and basic sanitation will bring dividend many times larger than the investment required.” (WHO/UNICEF JMP 2005)

Meeting the sanitation Millennium Development Goal (MDG) target (halving the proportion of the world’s population in 1990 lacking basic sanitation services by the year 2015) is estimated to cost between US$ 9 billion (Evans 2001) and US$ 15 billion (SEI 2005), but the payback would be an injection of between an extra US$ 65 billion (Evans 2005) and US$ 84 billion (EUR 69.4 billion - WHO/UNICEF JMP (2005)) per year into developing economies – money saved by averted deaths, lower health care costs and productivity gains. Improved water supplies and basic toilets generate returns ranging from 3 to 34 times the original investment, depending on the type of investment and the country, the report says (WHO/UNICEF JMP 2005).

For closed loop sanitation systems the return on investment is expected to be even higher. A recent debate in the magazine of the International Water Magazine, WATER21, on the economics of urine

diverting double vault dehydration toilets with reuse highlighted that such systems not only cover the extra costs that may occur, but that the total investment for the system could be amortised over a ten year period. (Jönsson et al. 2005 ; as part of the discussion on ecosan in Water21 in 2005, see also: McCann 2005, Mara 2005a, Ashworth 2005, Otterpohl 2005 and Mara 2005b)

Further cost comparisons between conventional and eco-sanitation systems have been made and are presented in the table below.

Table 7: Sanitation cost ladder for conventional and ecological sanitation methods (including initial capital cost and O&M for the first year of operation) (SEI 2005)

	Conventional Sanitation (sourced from UN Millennium Project, 2005; original source UNEP, 2004)		**Ecological Sanitation** (various sources see below)	
	Method	Estimated cost per person (USD) incl. operation and maintenance	Estimated actual initial capital cost per person (USD) and household incl. operation and maintenance (hh size is 4.5 unless otherwise given)	Method
Mainly urban	Tertiary wastewater treatment	**800**	340 (1190 per hh) (China, hh size 3.5)* (source: Dong Sheng EcoSanRes Programme)	Urine-diverting high standard porcelain dry toilet (indoor and multistory); piped urine system, dry fecal collection and composting, decentralised piped grey water treated using septic tank, and aeration treatment; local collection and transportation costs included
	Sewer connection and secondary wastewater treatment	**450**	330 (1500 per hh) (Sarawak)* (source: Mamit et al, 2005)	Conventional indoor toilet with sealed conservancy tank, black water collection by truck; local biogas digester; decentralised piped greywater treated using septic tank and vertical biofilm filter technique
	Connection to conventional sewer (assumed without treatment)	**300**	150 (675 per hh) (estimated)	Indoor dry single-vault urine-diverting pedestal toilet; decentralised piped greywater treatment using constructed wetland; local transportation included

(continued …)

(… continued)

Mainly peri-urban	Sewer connection with local labour (assumed without treatment)	**175**	88 (400 per hh) (South Africa) 25 (110 per hh) (Mexico, El Salvador, India, South Africa, Zimbabwe) (source: Morgan, 2005)	Dry single- or double-vault urine diverting squatting pan or pedestal toilet with permanent upper housing structure; greywater treatment using on site infiltration pit; transportation assumed as local labour
	Septic tank latrine	**160**	12 (55 per hh) (source: Lin Jiang, Nanning, Guangxi, China)	Dry single or double-vault urine diverting squatting pan or pedestal toilet (LASF or Skyloo) with permanent upper housing structure; greywater treatment and disposal onsite; local recycling
Mainly rural	Pour-flush latrine	**70**	8 (35 per hh) (West Africa) (source: Klutse & Ahlgren, 2005)	
	Ventilated improved pit latrine Simple pit latrine	**65** **45**	8 (40 per hh) (Zimbabwe, Mozambique) (source Morgan, 2005)	Soil composting pit with cement slab and simple upper housing structure (Arborloo or Fossa Alterna); grey water treatment and disposal onsite; local recycling
	Improved traditional Practice	**10**	3 (10 per hh) (estimated)	soil composting shallow open pit; soil added after each use

* initial cost calculations based on ongoing large scale pilot projects

The authors note that, apart from the data collected as part of the few large projects, mainly in Asia, the costs should be seen as a first indication based on pilot projects of limited size (SEI 2005). Hence, in order to get comprehensive data much more research in this topic is required.

Development, design and marketing of environmentally sound products from recyclates

Products of ecosan schemes may include soil conditioner, plant nutrients, irrigation water, energy from biogas and heat. To complete the cycle in sustainable sanitation systems, further research is required to make sure that these products are safe, to market them and to propose measures that they can better compete in the open market. Marketing will require tailoring the products to local needs, meeting regulations and establishing suitable distribution systems.

Advocates of eco-sanitation make the plausible claim that human excreta have been used to restore soil fertility for centuries. However, that does not mean that the products of ecosan systems are economically, institutionally, or legally marketable in many countries. For this to happen there is a need for research on the use and marketability of excreta products. Do health regulations allow households to use their own excreta for home gardening? If such products are put on the market, what standards do they have to meet? Which government agencies have jurisdiction over these types of questions: ministries of health, ministries of agriculture, ministries of commerce?

Appropriate marketing of ecosan products is essential to ensuring the sustainability of the system, however producers may have problems in finding, stimulating or establishing their market. Research can help in this process by developing tools and methods to assist producers in analysing their markets. An outline of how this can be done is given in “Sustainable Composting – case studies and guidelines” by Ali and Rouse (2004).

5.4.2 Research on ecological sustainability

In addition to safeguarding public health, ecological sanitation is also addressing ecological sustainability by introducing a closed loop approach to water and sanitation. In order to compare the ecological sustainability of different sanitation systems, the impact on natural resources, soil fertility, energy consumption, freshwater resources, climate change, and other risks have to be assessed.

From an ecological perspective end-of-pipe and closed-loop-sanitation systems may be compared through life-cycle analysis, which includes the resource efficiency during operation and maintenance (consumption of water, fossil fuels and other finite resources). As part of this comparison an energy balance should also be carried out. Aspects that must be considered would therefore include:

- Energy requirements for operation of sewer systems (e.g. pumping energy) and treatment plants versus recycling systems and their gain of energy (e.g. through biogas generation, or the recovery of heat energy from wastewater using heat exchangers) and irrigation water for saving water and other natural resources,
- Energy and resource requirements, for example for the production and transport of mineral versus ecosan fertiliser,
- The requirement of high-quality drinking water to transport excreta versus reduced water use, contributing to protection and conserving groundwater and other freshwater resources,
- The degradation of surface water bodies through sewage discharge versus improvement of regional ecological parameters through the application of reuse systems.

In general research should be looking at ways to assess the environmental impact of different sanitation systems on water, soil, air, climate and other natural resources, to enable a fair comparison of their ecological sustainability.

Material Flux Analysis

An additional tool that can be used to analyse the resource use of sanitation systems is a Material Flux Analysis (MFA) (Baccini and Bader 1996, Brunner and Rechberger 2004). This can serve as a tool to protect finite resources and reduce energy consumption, applicable even on a global scale. MFA allows the quantification of different material flow streams, enabling comparisons to be made between different sanitation systems. Modelling material fluxes on a local or regional level can be used to support the optimisation of system design and decision making processes.

Analysis of material flows on a global scale can highlight the resources required for transport and related emissions, for example for phosphorous mined in Morocco, transported to Switzerland, where it is processed to mineral fertiliser, and used in agriculture in Germany, where it may very well end up to a large degree in surface waters and finally in the ocean.

In an MFA, the materials to be considered may include:

- finite and renewable natural resources (water, phosphorous, energy, ...)
- macro- and micro-nutrients, agricultural products
- pollutants (toxic substances, heavy metals, hormones, medical residues)
- substances with relevance for climate change (e.g. CO_2, CH_4, etc)
- construction materials

Current practice in industrialised nations is to remove or destroy the phosphorous and nitrogen in wastewater, using expensive, energy intensive technology, preventing it from entering surface water. This reduces the pollution in receiving waters, but increases the energy consumption and CO_2 emissions, and does not stop the depletion of finite resources. Recognising that phosphorus is a finite resource (EcosanRes 2005b, Rosemarin 2004), current research is focussing on its recovery by a range of different technical processes. A broader approach occurring at the legislative level is being adopted in Sweden, where a law is being proposed to parliament which sets a target of recovering 60% of the phosphorous in wastewater and recycling it to productive land by 2015 (Regeringens proposition 2004).

The material flow in many industrialised nations is also characterised by the import of large quantities of agricultural products. A considerable amount of e.g. fodder-maize imported from Southern countries is used for meet-production in the North. The manure from these and other animals combined with the use of artificial fertilisers, leads in several regions of central Europe to an accumulation of phosphorus in the top-soil and to problems of high nitrate concentrations in groundwater. An overall mass balance could show which areas in central Europe are the end destinations for large volumes of nutrients.

In developing countries however, negative nutrient mass balances can often be found. With farmers having not enough money to pay for artificial fertilisers, and with agricultural products often produced for export, not enough nutrient rich material is returned to the soil in many regions.

Material flux analysis enables the identification of problems and the quantification of the impact of potential measures.

Research is required to establish material flow analyses, taking into account the differences between the situation in the north and in the south. This research may be used to assess the effects of different sanitation concepts on the given material flow situation, and for the identification of the most ecological friendly solution serving best for the long term conservation of resources and the fertility of soils.

Box 13: Example for MFA in Ghana

"In developing countries, demographic and urban growth often results in severe environmental and social problems, including the lack of adequate water supply, environmental sanitation services and food security. Reusing waste products in peri-urban and urban agriculture can contribute to food security and reduce environmental pollution and sanitation costs. A comprehensive method is required to assess the potential and limitations of channelling urban waste products to peri-urban and urban agriculture. Material Flux Analysis is a helpful tool to assess material fluxes in a given system. It allows to identify problems and to quantify the impact of potential measures on resource recovery and environmental pollution. The present study analyses the material/nutrient fluxes of the city of Kumasi, Ghana. Import and export of products into or from the given system are recorded. Processes are identified and material fluxes between these processes are determined. The analysis revealed that households are the key process for material and nutrient fluxes. The groundwater and surface waters receive large amounts of waste products from the households. Reusing organic waste products in peri-urban and urban agriculture could significantly improve the organic matter and nutrient situation of agricultural soils and also protect the environment. However, a treatment process (e.g. co-composting) is required to reduce the health hazards related to the use of waste products." (Forster, Schertenleib and Belevi 2003)

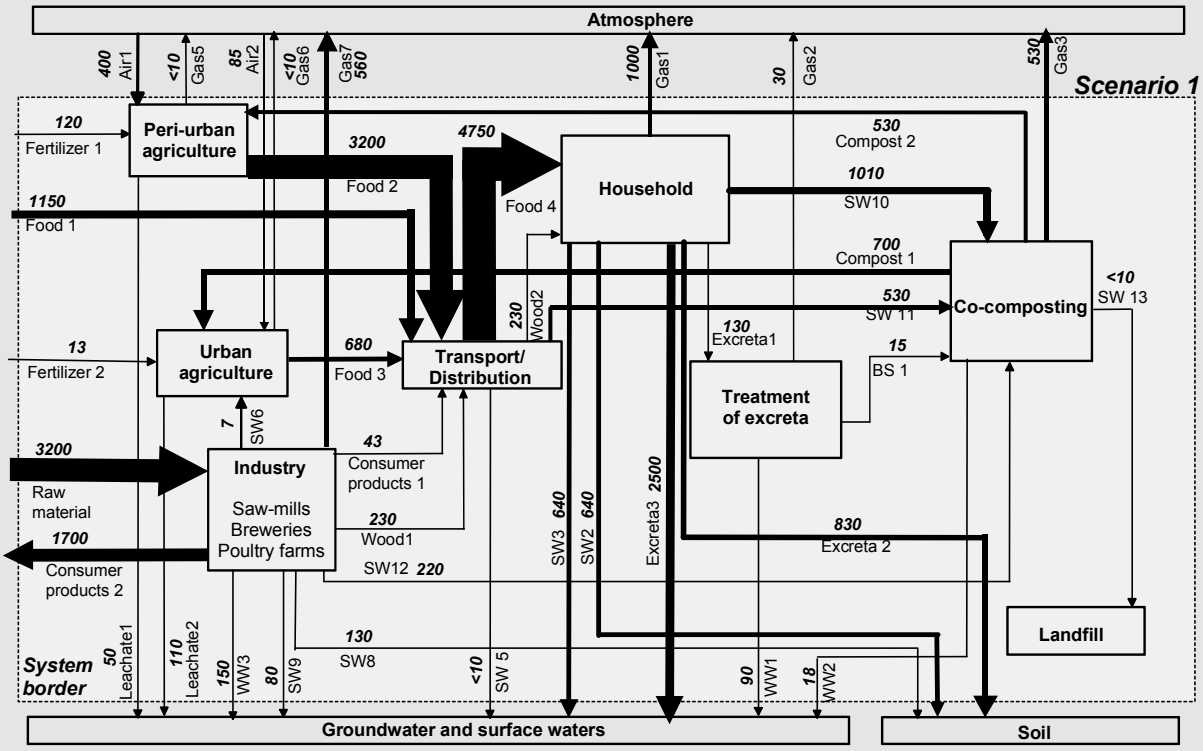


Figure 26: Estimated annual nitrogen flows of Kumasi, Ghana in tons/year for the scenario "reuse of co-composted solid waste and faecal sludge" (Belevi 2002).

Ecosan, urban agriculture, food security and quality of life in the city

Most population growth is now occurring in urban areas. Consequently, the number of poor living in these areas has dramatically increased in recent years. To produce food and generate income many urban residents engage in urban and peri-urban agriculture using space that is available to grow crops or raise livestock. Wastewater or excreta is already often used in urban agriculture as it is readily available in urban areas. For example in Dakar Senegal, more than 60% of the vegetables consumed in the city are grown in urban areas using a mixture of groundwater and wastewater (untreated) (Faruqui, Niang, Redwood 2004). A proportion of vegetables sold in markets in Nairobi, Kenya and Kumasi, Ghana are also raised within the surrounding urban areas and irrigated with wastewater (Cornish and Kielen 2004). In Moscow, urban agricultural activity increased three-fold between 1970 and 1990. In Dar es Salaam it nearly quadrupled from 1968 to 1988, and in Romania it more than tripled (up 333%) from 1990 to 1996. In Argentina home gardening association members grew from 50,000 in 1990 to 550,000 in 1994. In metropolitan areas in the United States, food production increased from 30% in 1988 to 40% in 1996, and from 1994-1996 the number of farmer's markets selling locally-grown produce increased 40%. In great Bangkok 60% of the land is under cultivation. Urban agriculture facilitates the closing of the loop to food security. The demand for food by consumers and water and nutrients by producers reconnects resources and wastes in a safe, non-polluting and economic fashion (Esrey 2001).

FAO estimates that 800 million urban residents (up to two-thirds of all urban households) world-wide grow products for income or for their own consumption (FAO 1999). Urban agriculture can impact food security by increasing the amount, variety, nutritional value and freshness of food available to farming families (FAO, 1999) and provides additional income to purchase food. Some case studies have shown improvements in nutrition, especially in children, in poor urban families that produce their own food (Smit, Ratta and Nasr 1996).

Urban agriculture can be sustainable because it promotes the reuse of excreta, grey water organic wastes (Birley and Lock 1999). By closing nutrient loops and improving soil fertility and structure, yields should be higher per unit space, plants will be healthier and more nutritious, and lower levels of external inputs and less water will be required. Growing food closer to consumers also strengthens local communities. Food production and costs can be reduced by lowering the costs of inputs and producing food closer to where people live. Urban agriculture and home gardening can produce more food per unit space, as food can be grown on roofs, walls and in and around buildings. This in turn improves food security, and when food and non-food products are grown to generate income, food security and nutritional status can also improve. It is well known that women, who dominate the sphere of urban farming and gardening, are more likely to spend their extra income on food than men. Increasing national food availability will help to reduce child malnutrition. (Esrey 2001)

However, urban and peri-urban agriculture is often not adequately regulated to ensure that these activities do not negatively impact human health and the environment (Birley and Lock, 1999). In promoting urban agriculture, the following concerns need to be adequately researched and addressed to protect public health (Smit, Ratta and Nasr, 1996):

- Using best practices for the safe use of excreta and grey water;
- Restricting the use of industrial effluents for irrigation;
- Preventing contamination of crops with chemicals and or pathogens;
- Preventing contamination of drinking water sources;
- Promoting the safe use of pesticides; and
- Managing water and crops to prevent expansion of vector-borne diseases.

Ecosan systems can make considerable amounts of nutrients and irrigation water available, it allows constructed wetlands, urban agriculture and green belts to be systematically integrated into urban planning. The application of ecosan may thereby have clear impacts on nutrition, livelihood, local climate and on quality of life in the city. Research may therefore also need to concentrate on how to best make use of urban agriculture and ecological sanitation for the improvement of livelihood and the quality of living in urban areas. The cross sectoral characteristic of sustainable urban water and

nutrient management will require the development of instruments for the co-operation of different sectors institutions and allow for the participation of all relevant stakeholders.

Project Box 9: ecosan within a natural resource management project in Botswana (GTZ - project-data sheets 2005-009)

In Botswana the village of Paje is affected by strong winds, extreme erosion and soil degradation, whilst the Hanahais settlements are characterised by an extremely dry climate and sandy soil. Water consumption varies between 12 to 340 l/p/d depending on the access to a piped water connection and gardening activities, but mostly waster is used for gardening purposes.

To establish ecosan and other environmentally sound practices in the villages of Paje and east and west Hananhai in Botswana, the GTZ-supported IUCN natural resources management project placed a strong emphasis on participatory approaches and focused on 'learning by seeing'. Raising community and household awareness for the ecosan concept included tangible activities, which were undertaken in all households.

Figure 27: Training workshop (left); traditional hut with ecosan toilet (middle); revised ground structure (right). (IUCN/GTZ)

Following these activities, most of the families chose a urine diverting (UD) toilets to address their sanitation problem when given a choice of several options. In the first pre-pilot step, 20 ecosan single vault urine diverting (UD) dry toilets were implemented and adapted according to the needs of the users. Faeces were collected in 20 or 50 l containers, and 1-3 months later, they were put in a composting unit for further hygienisation. They were composted together with organic waste and animal refuse for 1-2 years to produce a safe soil conditioner.

The urine was collected in 20 l containers and used after about 3 weeks. Some users preferred the application of diluted urine for compost humidification rahter than its direct use on the field.

From pilot trials, it was found that fertilisation with urine and compost led to a 40-50% higher production when compared to unfertilized plots.

Agricultural research

As ecosan systems close the loop between sanitation and agriculture, agricultural research is as important as research into sanitary aspects.

A broad range of topics need to be addressed from an agricultural perspective – ranging from purely technical issues, to aspects of agricultural extension and the dissemination of research results for practical use. Topics to be addresses will include:

- Comparative risk benefit analysis of different types of fertilisers
- Fertiliser value and efficiencies of fertilisers
- Fertilisation strategies and application techniques when using excreta
- Impact of fertilisers quality of agricultural products and soil - and the development of related standards and guidelines
- Contribution of reuse to food security
- Effects of micro nutrients
- Degradation and effects of micro pollutants
- Assessing farmers needs regarding fertiliser
- Extension methodologies for the use of treated excreta

There are gaps in current knowledge concerning the use of urine and faeces as fertilisers. Lack of documented research in this area currently makes the development of standards and norms difficult. However, excreta and wastewater have been used in agriculture since ancient times, and there is a lot of undocumented knowledge based upon practice that needs to be researched and documented and may serve as a basis for modern, risk based standards. (Jönsson et al 2004)

In the urban context, home gardens, allotments and community gardens offer great potential for combined research on urban agriculture and ecosan in closed-loop systems, e.g. in the Philippines allotment gardens have recently been implemented, which use as fertiliser composted organic household wastes from integrated waste management (Universität Freiburg 2004; Holmer at al. 2003). These gardens are now combined with ecosan systems for the reuse of human excreta in the gardens (PUVeP 2005; GTZ-ecosan newsletter 2005-18). “Organoponics”, a system similar to hydroponics has been promoted in Mexico (Sawyer, Arroyo and Delmaire 2003).

Project Box 10: Constructed wetland treatment and wastewater reuse in Haran-Al-Awamied in Syria (GTZ -project-data sheets 2005-015)

The village of Haran Al-Awamied is located south east of Damascus, Syria. The inhabitants are poor; with farming the main source of income. The use of untreated wastewater from the existing gravity sewers for irrigation was common. The specified purpose of the GTZ supported ecosan project in Haran Al-Awamied was therefore to make irrigation with wastewater hygienically safe and to use the fertilising effect of the nutrients contained in the waste water.

Therefore a new combined public sewer system was installed to collect and transport rain and wastewater to the new wastewater treatment plant. The plant consists of bar screens and a sedimentation tank as pre-treatment, two reed beds to treat the wastewater, and one reed bed for sludge soilification. The treated water is collected in a tank for storage, and is pumped from the collection tank to the fields near the plant when needed, with the distribution being organised by the farmers.

Figure 28: Constructed wetland reed beds (left); sludge reed bed (middle); official inauguration of the pilot project (right). (Mohamed)

The improved availability of irrigation water which contains valuable nutrients reduces the expenses of the farmers for commercial fertilisers. It contributes to higher yields in crop production, and increases the number of harvests from one to several per year. The reed plants of the constructed wetland are used for wicker and roof materials The treated sludge is used as soil conditioner.

As the residents get these benefits from the constructed wetland, they provide a great deal of support to ensure its correct functioning.

Other convincing reasons why the reed bed systems were chosen, are its low costs, easy construction and simple operation and maintenance.

Monitoring ecosan systems, quality control and environmental impact assessment

In Germany around 7.000 water works currently treat and discharge the wastewater of 80 Million people. If a closed loop strategy is pursued the number of treatment facilities will sharply increase (compare Thomas 2000), as local, decentralised sanitation systems will be recognised as a convenient, cost-efficient option. The development of systems to monitor this increased number of decentralised facilities will be necessary to minimise any possible adverse effects on human health and the environment. Research should also help develop systems to enable products emanating from eco-sanitation to be standardised, allowing quality control and the assessment of environmental impacts and guaranteeing that the products conform to legal and market requirements.

Project Box 11: Biogas-ecosan-project Waldmichelbacherhof in Germany (GTZ -project-data sheets 2005-006)

For the last ten years, the family-owned farm and restaurant Waldmichelbacher Hof in rural Bavaria, Germany, uses a closed-loop biogas plant system for sanitation and waste management. All nutrients generated on-site are reused on the 200 ha of land. This agricultural land is mainly used for grazing, fodder production, cattle breeding and meat production (the meat is sold at the restaurant and farm shop).

The toilets used in this sanitation system are conventional low flush toilets, as neither dry toilets nor urine diversion toilets were seen to bring any additional benefit to this project, as the black water is digested together with animal manure in a heated anaerobic digester. The resulting product, liquid "digested manure", is easy to apply to the pasture as fertiliser (with no need for dilution). A co-generation plant converts the biogas from the anaerobic digester to produce heat and electricity (excess electricity is sold back to the grid).

Figure 29: Waldmichelbacherhof (left; Schultes); collection channel under the barn floor (right; Wang)

The system is a good example of an on-site ecologically sustainable system in a European rural context. It is a closed-loop system, where only negligible amounts of nutrients are added or removed. Further benefits are that the farmer has observed better yields when using the digested manure as fertiliser compared to non-digested manure. There are also no odour problems when applying the digested manure to the fields.

The development and establishment of an Environmental Management Plan (EMP) will be necessary for ecosan systems. The plan should cover all aspects of the system, which pose a risk to the environment, human and livestock health, and provide a framework to assess its long-term sustainability. The EMP should address a number of issues such as product quality and quantity, storage, site controls, buffer distances if needed, warning signs, application rates and timing, irrigation methods, ground water quality monitoring, salinity controls, soil testing etc. Users of the system may consider the regular monitoring costs as an extra financial burden in addition to the initial cost of infrastructure, and research will be needed to establish how these costs can best be distributed between for example households, users of the products and the state.

Box 14: Learning from organic waste management

9 Million tons of organic wastes are currently recycled into compost in Europe and regarding logistics, system management, market orientation and regulations ecosan systems can profit from these experiences! Josef Barth (2004) provides an overview of the treatment of organic waste in Europe. Many of the points raised are equally valid for ecosan systems. Barth writes “Investigations in Europe indicate that quality and marketing of the end product are the most crucial composting issues. Both producers and users are of the opinion that sustainable recycling of organic wastes demands clear regulations with regard to what is suitable to be recycled and how it should be managed and controlled. Around 15% of the estimated total recoverable potential of 60 million tons of organic waste is presently treated biologically in Europe. The re-use has to meet environmental and market requirements. Therefore, the trend in Europe goes definitely towards source separation of the organic residues from gardens and households. Quality requirements for composts regarding heavy metals, organic pollutants and hygiene allow no other alternative. There is no longer a market for mixed-waste compost. The introduction of source separation and composting must go hand in hand with the introduction of a quality assurance system for compost plants. Assuring compost quality entails more than just fulfilling a number of heavy metal limits. ... ” (Josef Barth 2004). Researchers and educators alike need to consider how the lessons of these systems can be tranferred and applied to eco-sanitation.

5.4.3 Health related risks and benefits

Generally speaking, water supply and sanitation systems can expose the public to two basic types of risk – the risk of infection from water-borne diseases caused by faecal contamination, and the risk of exposure to toxic or harmful substances present in the water or wastewater, for examples heavy metals, toxic organic compounds, medical residues, or hormones.

The prevailing economic, social, and environmental conditions do increase these risks in many countries. Increased temperatures or humidity may for example favour the spread of particular faecal pathogens, which in turn will result in an increased occurrence of diarrhoea; or, severe malnutrition may in turn increase the impact of diseases, so that the otherwise harmless diarrhoea increasingly has lethal consequences.

In many ways ecosan intends to better the situation, for example through a multi-barrier concept and through contributing to the nutrition status of the people.

It is however recognised, that with any sanitation system, there are associated risks, and systems should therefore be designed with the aim of minimising these whilst at the same time maximising the benefits the system can bring to all stakeholders. Such a risk based approach is proposed in the up-coming guidelines from the WHO for the safe use of wastewater in agriculture and aquaculture and the safe use of excreta and greywater. In fact the risks should be lowered to an extent that they do not differ from other everyday risks in a safe way of living.

A method which allows to make such a risk assessment and enables to compare different types of risks is the so called DALYs (Disability Adjusted Life Years) concept (Foege 1994). After accumulating in a first step all years lost to deaths and illnesses for a given population, it is possible to analyse in a second step which risks do contribute how much to this burden. The total burden of disease for the world in 1990 was calculated to be 1.4 billion DALYs lost, or 259 per 1000 population, or 0,26 DALYs per person. (See Box below for further information on the DALYs concept).

For drinking water WHO has set a high safety level and decided to recommend measures which reduce the risk below a level of 10^{-6} DALYs (or 0,00001 DALYs) per person. The same high safety level is now set in the above mentioned forthcoming WHO publications for all risks related to sanitation and reuse systems and the WHO guidelines will describe the measures enabling to reach this safety level.

Box 15: Disability Adjusted Life Years (DALYs)

Disability Adjusted Life Years (DALYs)

DALYs are a measure of the health of a population or burden of disease due to a specific disease or risk factor. DALYs attempt to measure the time lost because of disability or death from a disease compared with a long life free of disability in the absence of the disease. DALYs are calculated by adding the years of life lost to premature death (YLL) to the years lived with a disability (YLD). Years of life lost are calculated from age-specific mortality rates and the standard life expectancies of a given population. YLD are calculated from the number of cases multiplied by the average duration of the disease and a severity factor ranging from 1 (death) to 0 (perfect health) based on the disease (e.g., watery diarrhoea has a severity factor from 0.09 to 0.12 depending on the age group) (Prüss and Havelaar 2001; Murray and Lopez, 1996). DALYs are an important tool for comparing health outcomes because they account for not only acute health effects but also delayed and chronic effects – including morbidity and mortality (Fewtrell and Bartram 2001).

When risk is described in DALYs, different health outcomes (e.g., cancer vs. giardiasis) can be compared and risk management decisions can be prioritized.

Finally, it is possible to use the DALYs approach to allocate research funds. Representatives of three foundations (the Rockefeller Foundation, the John D. and Catherine T. MacArthur Foundation, and the Edna McConnell Clark Foundation) held a meeting in 1993 to determine research priorities in combating global microbial threats. They realized that some disease conditions responsible for major burdens of disease, such as malaria, require significant basic research if better interventions are to be developed. On the other hand, with other diseases (e.g. vaccine-preventable diseases, lower respiratory tract infections, watery diarrhoea), good interventions are available but are not reaching those in need. In such cases, applied research or behavioural research is needed to produce better outcomes (Foege 1994).

However, the reality today is that a high percentage of wastewater world-wide is discharged untreated into the environment. At the same time farmers around the world use untreated wastewater and excreta to secure their livelihoods, often being completely unaware of the related health risks. Ecosan systems do offer the possibility to greatly reduce risks during reuse, improve the efficiency of nutrient recovery, and avoid wastewater discharge.

It is in this context that the WHO is updating guidelines from 1989 (WHO 1989), and is devoting an entire set of books to “the safe use of wastewater in agriculture and aquaculture”, and to “the safe use of excreta and greywater”, using recent research findings and results from practice. A screening of existing epidemiological studies and research on treatment efficiencies has been made for the new edition, which will appear in 2006. Continuous research is required in this field to keep pace with rapid developments. Knowledge management is urgent to disseminate the latest results to the public in an appropriate form.
Health-related research fields should include:

- Sanitisation of excreta and grey water and wastewater
- Comparison of risks from different technologies and system approaches
- Epidemiological studies (given infection rate in a certain environment and social or regional group and its relation to water and sanitation)
- Comparative research on sanitisation effects of different technological components in different climate zones and local conditions (e.g. research on effects of constructed wetlands; on adding of ammonium for the sterilisation of faecal matter; on pH-change and its sterilising effects in urine)
- Health oriented multiple barrier concepts
- Social aspects of crop restriction and exposure control (the use of safety equipment such as boots or shoes, or the use of excreta on cash crops)
- Hygiene education
- Comparative research on toxic substances, and their pathways in the food chain, including metabolites etc. (e.g. comparing effects from heavy metals like cadmium in current artificial fertilisers, with those from hormones in fertiliser from animal manure and from ecosan-systems)
- Effects of the use of the eco-fertilisers on the nutrition and health status especially in poor communities

Project Box 12: Use of reclaimed water in the Jordan Valley in Jordan (GTZ -project-data sheets 2005-013)

The GTZ supported Reclaimed Water Project aims to encourage the use of treated wastewater (reclaimed water) in the Jordan Valley on about 10.000 ha of agricultural land as a substitute for freshwater and in accordance with environmental and public health regulations.

The project area is characterised by a low annual rainfall with a mild winter allowing the off-season production of vegetables under irrigation. As irrigated agriculture consumes about 70 % of the available fresh water resources, which are also urgently needed as drinking water, the use of marginal water resources, such as brackish and reclaimed water for irrigation, is highly desirable.

In the project region, the main source of reclaimed water for irrigation is the countries largest treatment plant with the effluent being distributed through wadis, reservoirs and canals to agricultural areas. Reclaimed water, diluted with surface and rain water is then used for agricultural irrigation. Drip irrigation is most commonly practiced, in combination with a black plastic covering.

Figure 30: Demo plot (left); irrigation and mulching (middle); planting (right). (GTZ)

The Reclaimed Water Project monitors and evaluates agronomic and irrigation practices on 20 selected farm units. Analysis of local practices and comparison with international experience will lead to appropriate and practical guidelines for the use of reclaimed water.

The implementation of crop quality monitoring is difficult because so far governmental agencies do not feel responsible for sampling and analysis of crops irrigated with reclaimed water. Providing guidelines in this field will help clarify and improve the situation. In the beginning, the majority of farmers in the project were not aware of the nutrient content of the reclaimed water but now they are starting to appreciate its quality.

To reduce health risks from handling urine and excreta in agriculture a guideline by Schönning and Stenström (2004) has recently been published. The guideline discusses as main physicochemical and biological factors that affect the survival of micro organisms in the environment: temperature, pH, ammonia, moisture, solar radiation, UV-light, nutrients, and presence of other micro organisms. For the comparatively harmless urine they state that in “small-scale family based systems, the urine may be used directly or after short periods of storage if the crops are intended for family use. The likelihood of transmission is larger between family members than through urine fertilised crops.”

As needs for further research Schönning and Stenström (2004) point out that for large-scale systems additional studies on appropriate handling and use systems are essential, including a systematic microbial risk assessment and epidemiological follow-up investigations. When secondary treatment is applied, different methods need to be considered, including pH elevation with lime and other alkaline chemicals, including urea. For lime, experience from large-scale treatment of sewage sludge exists, and laboratory scale studies with faeces are presently ongoing.

For future studies, it would be valuable to consider a harmonization of treatment methods under different local conditions and using the same type of analytical methods, so that the results easily could be compared. All methods need to be evaluated in a systematic analytical way regarding environmental effects.

5.4.4 Technical and performance aspects of ecological sanitation

Obviously the technical reliability and performance of the system is key to its success and ultimately its sustainability.

Research on technical and performance aspects of ecological sanitation needs to assess system aspects like collection, treatment, transport and use of household wastes and wastewater, the management, maintenance, operation and logistics for large matter fluxes in large cities, or resource and energy efficiency during operation of conventional versus ecological sanitation systems. Researchers should also pay attention when analysing such systems to ensure that what is developed is actually appropriate to the needs and desires of the users. It will be easier to adapt technologies and systems to the needs of the users than to adapt the users to the needs of the system. Researchers also need to consider the robustness and flexibility, both within the system (to be able to receive varying loads) and externally (to be able to withstand varying extreme environmental conditions as well as user abuse).

Research has already begun to adapt and further develop existing innovative technologies, for their use in recycling oriented waste water management schemes.

For example, vacuum systems, commonplace on ships and aircraft, have been adapted, tested and standardised in the domestic context, and have proven successful. Other innovative technologies do not have such proven tracks and may require further development. Membrane technology is one example of this. Following their rapid development over the last decades, membranes are increasingly used in split stream systems and for wastewater treatment. New technologies are continuing to emerge for closed loop systems, for example from NASA and ESA who have developed closed loop sanitation systems for space flight that are designed to function over many years. (CNN 2005, GTZ – ecosan newsletter 2005-16).

Eventually an internationally acceptable set of standardised system components should be developed and established as the state of the art. As development in this area is continuing apace, databases and knowledge management system are of high importance to share new findings and discoveries. The available data should be of a high quality making it attractive to professional associations and ultimately to governments. A series of case studies and of research results emanating from them should allow qualified statements on components and combinations of components answering context specific questions such as:

- Which kind of treatment will result in which kind of fertiliser-quality?
- Which kind of treatment will guarantee which hygienic standard?
- What are the maintenance and operation costs of a certain component? What is the expected life-time of this component in the system?
- What is the best combination of components to solve a specific problem?
- What logistical and institutional arrangements are possible, and to which contexts are they most suitable?
- How suitable are existing standardised devices for their use in ecosan solutions?

However in a field developing as quickly as ecological sanitation a special conflict arises with respect to standardisation:

- On one hand standardisation of a set of modular system elements is urgently needed as planners, constructors and those financing the projects want this kind of “certificate” to insure that reliable and proven elements and systems are implemented.
- On the other hand this standardisation may hinder further development and standard technologies may simply be applied in situations where large-scale research and demonstration projects are still missing, and where new technologies may be needed to correctly address the context.

5.4.5 Socio-cultural aspects of sustainable sanitation

In recent years, there has been a growing realisation that access to sanitation does not increase unless there is demand from the user, and as most expenditure for sanitation is at the household level, where promotional efforts are most needed here. Previous attempts to market sanitation have relied on the promotion of the health benefits that sanitation and hygienic behaviour can bring. Whilst this is clearly the most important reason for promoting sanitation and hygiene from an institutional point of view, it often proves to be much less of a motivating factor for spending money on sanitation at the individual or household level. When households contemplate a shift, other factors may prove to be a greater motivation. Research by the World Bank Water and Sanitation Programme has identified several other factors that serve to motivate even very poor households to invest in sanitation (Cairncross 2004). These include (and see Box 16 for an example of drivers for sanitation from the Philippines):

- Convenience and comfort
- Privacy and safety
- For women and girls, avoidance of sexual harassment and assault
- Less embarrassment with visitors
- Dignity and social status

Box 16: Why people want toilets

The following responses concerning satisfaction with a new toilet were recorded in a survey of rural households conducted in the Philippines. The following reasons for having a toilet were listed in order of preference:

- Lack of flies,
- Cleaner surroundings,
- Privacy,
- Less embarrassment when friends visit, and
- Reduced gastrointestinal disease.

Similar results have been obtained from surveys conducted in other parts of the world, where health is often found to be a less important driver for obtaining sanitation for households than dignity, convenience and social status.

WHO 1997 in WHO/UNICEF JMP 2000.

User views are also related to how hygienically safe the design allows them to be. Hence introducing and operating ecosan installations in rural and urban areas requires a thoughtful combination of technical and managerial aspect fitting the prevailing socio-cultural context. Cordova and Knuth (2005) studied user satisfaction with Dry Toilets (DT's) in 5 urban and peri-urban sites in Mexico. They found high satisfaction rates with different combinations of program style and toilet models, as well as among populations with different motivations, income-levels and previous sanitation history. User satisfaction was influenced by the degree of choice users had in obtaining DT's and their understanding of the benefits of Dry Sanitation (DS), whereas user dissatisfaction was related to technical and programmatic factors. Cordova and Knuth (2005) also found that indoor, aesthetic toilets with a complementary greywater system for the household; maintenance and end-product collection services; and high water supply costs would be incentives for users to accept DS in the long-term. And they suggested that associating DT's with high social status might increase user acceptance of this technology.

Project Box 13: Public toilet project in Rajendar Nagar Slum in Bangalore, India (GTZ-ecosan-newsletter 2005-18)

To meet urgent community needs the Indian NGO ACTS and the Swiss Seecon GmbH established an eco-friendly public toilet centre in Rajendra Nagar Slum, Bangalore, and a co-composting site for faecal matter at the ACTS Rayasandra Campus, serving about 500 to 600 users per day. Although it has successfully been in operation for almost 4 years now, the originally designed logistic system, which was based on the collection of source-separated urine and faecal matter in plastic drums and the transportation of those drums to the processing side at Rayasandra Campus, was often discussed controversially. A socially and culturally more acceptable, sustainable and hygienically safe collection, transportation and processing scheme has therefore been developed and implemented with the support of GTZ.

For the improved system, storage tanks now replace the barrels for collection of urine and faeces. A suction truck, equipped with tanks and a pumping system, evacuates faeces and urine and manual handling is no longer necessary. Urine and faeces are then transported to the treatment site, where urine is stored in large storage tanks and faeces are treated in a biogas plant.

Figure 31: Urine diverting public toilet in Bangalore (left; Heeb); biogas plant (right; Wafler)

The stored urine and digested slurry are used as fertilisers and the biogas is being used for cooking. The biogas plant has a much higher capacity to treat faeces than the previous co-composting system. The higher treatment capacity will allow the extension of the project for further public toilet blocks.

Social marketing techniques are currently seen as an extremely useful tool in promoting sanitation amongst private households. They involve the application of commercial marketing techniques to advance social goals, in this case the safe use of excreta and greywater through appropriate sanitation solutions. Social marketing has been used successfully to increase sanitation coverage in rural India. The marketing side is based on the "four Ps" - Product, Price, Place, and Promotion.

Product
Toilet and sanitary system designs must respond to what people want, rather than what sanitary engineers believe they should have.

Price
Includes all costs (monetary and non-monetary) needs to be affordable, and therefore it is necessary to offer a range of products available at different prices. This is the hardest part of selling sanitation to those who lack it. The poor, who need it most, can least afford it. Hence the need to keep costs down and market a range of products with various price tags.

Place
The product must be delivered to the right place; in particular, a toilet must be installed in the customer's own home. This means that the supply chain has to reach every household.

Promotion
Promotion is communication with consumers about the product or service. This includes advertising, mass media, word of mouth, and anything in between. It can also include many other means to get customers' attention and convince them to buy the product: demonstration toilets, time-limited special offers, coupons and vouchers, competitions and prizes, door-to-door sales, credit sponsored by local traders, and mutual help schemes to help the poorest with the cost and the elderly with the digging.

When designing social marketing campaigns to promote sanitation and the safe use of excreta and greywater, the possible barriers to the promotion and success of the campaign should be identified, explicitly addressed, and integrated into the campaign. With regard to sanitation Simpson-Hébert and Wood (1998) have identified 10 barriers to progress in sanitation, all of which are equally valid for the safe use of excreta and greywater:

- Lack of political will;
- Low prestige, priority and recognition;
- Poor policy at all levels;
- Weak institutional framework and unclear distribution of responsibilities;
- Inadequate and poorly used resources;
- Inappropriate approaches;
- Failure to recognise defects of current excreta management systems;
- Neglect of consumer preferences;
- Ineffective promotion and low public awareness; and
- Women and children last.

Research on sanitation, reuse knowledge and traditions

As stated previously, many sanitation projects have failed due to a poor consideration of the socio-cultural sustainability of the system. For example, in India pit toilets installed during supply driven programmes of the 1980 ended up to a high percentage as being used as store rooms. In the programmes it was ignored that these toilets were culturally disliked as claustrophobic, that people wanted excreta to be deposited at a distance from their homes and not kept under the ground beneath their feet, and that, when the pit was full, it had to be emptied and the content handled – by someone (Black and Talbot 2005). Today several projects in India focus instead on awareness raising campaigns for "zero open defecation" and develop demand driven programmes e.g. with woman self help groups which have a clear interest in well maintained toilet facilities. In general sanitation projects in India should take into account aspects of the "old" history, e.g. the problematic concept of untouchability, as well as those of the "recent" history, during which e.g. Mahatma Ghandi was a ferocious advocate for more hygienic methods of sanitation, and campaigned against the degradation of humanity contained in the concept of untouchability. (Black and Talbot 2005)
Research on sanitation-related socio-cultural aspects and traditions can therefore greatly contribute to the socio-cultural sustainability of sanitation systems. Generally projects and related research have to realise that:

- Defecation is a highly private and intimate topic and related habits may largely differ between regions and cultures
- In some cultures handling of excreta is subject of strong taboos and may be related to aspects of human dignity
- Knowledge and perception of the reuse of excreta largely varies between cultures and regions
- Sanitation practices differ (wet versus dry hygiene, squatting versus sitting, etc.)

Problems to be addressed by research for socio-cultural sustainable sanitation systems include:

- Household motivations to invest in sanitation
- Household expectations from the system
- Lack of awareness of hygienic risks and practices
- Traditional practices which may be wise or may pose severe hygienic risks
- The need to modify existing practices as a result of increasing urbanisation in recent years

All these socio-cultural aspects have a large impact on the required design of sanitation systems, their operation, and the possible reuse of products from waste water and excreta. Therefore research is required in order to take into consideration these aspects during the preparation, implementation and operation of the sanitation systems.

Although social norms may at first complicate the introduction of innovative sanitation systems, research should concentrate on the flexibility of these systems, and determine in what way ecosan systems could most acceptably be introduced to society - for example after seeing the benefits through pilot/demo systems. Social acceptance is not just a simple yes or no, but a flexible parameter that changes with time.

Summarizing the above we can say that no technical sanitation solution can be successful unless it complies with the attitudes, norms and the cultural context. The term “cultural” covers a large spectrum ranging from contemporary habits and perceptions over historical heritage, religious norms, and the often unpronounceable “feelings” of the population. It is obvious that research on these viewpoints is still needed, both in general terms to allow methodologies to assess this to be developed, and in case specific studies, as each project and region has its own individual particularities, and not taking them into account may provide a false picture and lead to project failure. The aims of research are of course to gain knowledge, but also to deliver arguments, since habits may change, and viewpoints so far unknown to the population may meet with a positive interest. To allow an informed choice the decision should be based on a broad pre-selection of sanitation alternatives.

Participatory planning, knowledge management and decision making

Ecosan projects are more complex than conventional systems, being trans-sectoral and including topics ranging from calculating diameters of pipes to the analysis of cultural habits. The stakeholders however should have a central role in these planning processes. Thus a stakeholder analysis, awareness raising, education and information is necessary, to allow an informed choice. Practitioners may therefore require a different set of tools and instruments to make ecosan baseline assessments, to prepare projects, plan, chose technologies, implement, monitor, and evaluate the system. So far mainly the material and social aspects have been addressed.

One of the key challenges in knowledge management and research is to develop or identify these tools, and test them in the sanitation context. A number of tools are available from related disciplines, and can be adapted. Some sanitation-specific planning tools, which are suitable for ecosan, and are based on the model of active participation and stakeholder involvement, have been recently developed and have to be field-tested now. Among others these include the “Household Centred Environmental Sanitation Approach” (HCES) of the WSSCC (Eawag 2005), the adaptation of the HCES for ecosan projects as described in the GTZ-ecosan source book (Werner et al. 2004), and Open planning of sanitation systems developed by EcosanRes (Sweden) by Kvarnström and Petersens (2004)

To date, most planning and implementing systems for conventional sanitation have tended to be highly centralised, hierarchical and bureaucratic, focusing on formal knowledge, and severely limiting opportunities for the participation of a range of stakeholders. Similarly, sanitation policy and legal frameworks are focused on regulating the government organisations or their private sector agents who deliver services, which themselves are often rigidly defined.

The practice of centralised sanitation planning, decision making and financing removes central planners from the daily experience and problems of the users. Steeped as it is in formal knowledge, it creates the illusion that it represents the ultimate in scientific truth, and blinds practitioners to the drawbacks and weaknesses of the system. Sanitation practice, for example, has not significantly changed since the early part of the 20th century, and so, other than the addition of tertiary treatment, it has not benefited from the insights and knowledge of modern environmental management.

In contrast, if planners were more open to and familiar with either environmental management, or traditional knowledge, they might understand that the processes of generation and management of faeces, urine, and are intricately related to social and cultural values and norms. The equipment and treatment used, the necessary maintenance, cultural and religious rules about who may handle excreta and when, the conditions under which these materials may be recycled, and customs and taboos, govern much of behaviour. Elizabeth Shove (2003) bundles these factors under the terms "comfort, cleanliness, and convenience." Sanitation systems, if they are to work for the users, have to take these things into account. In the 21st century, in an age when public utilities are under pressure to match the financial performance of the private sector, such systems also depend on user payments and compliance with rules. This means that they also have to be affordable to the user. If the user is not consulted, there is little likelihood that the resulting systems will meet their needs.

On the system side, sanitation systems have to allow the system provider, whether public, private, or hybrid, to design, build, and maintain (and in some cases dismantle) the system. System providers are dependent on information from users about rate and type of use of equipment and resources; about failure rate; and, more directly, they are dependent on users for paying for the systems themselves. Moreover, system providers depend on the goodwill and local knowledge of users and neighbours when they have to install or repair infrastructure, site facilities, or store equipment and materials. When decisions about infrastructure are made without consultation, the system providers are also operating with partial blinders, depriving themselves of key local knowledge that could make their work more effective.

Participation also adds to the knowledge available for planning. Open channels of communication between users and system providers are a key feature of modernised socio-technical systems, which build an element of user choice and discursive awareness into the planning process (Spaargaren and van Vliet 2000).

The paradigm shift in sanitation depends on the participation of users and other stakeholders, in order to arrive at a collectively acceptable informed choice, so that the sanitary systems are tailored to their needs and demands. Providing for an informed choice generally means inviting potential users and stakeholders to explore alternatives in terms of toilets, storage facilities, transformation of excreta into soil conditioners and fertilisers, and the like. It requires transparency as to the benefits and drawbacks of both conventional and alternative systems, including their financial and economic requirements and benefits. Only in the context of this transparency can users have the room to participate in the decision-making. Then there is still the question of whether the system providers will listen, and will give the users' non-formal knowledge the respect and legitimacy they deserve.

Almost all experience with a participatory approach to planning has given special attention to the differences in practices, preferences, status, and knowledge of women, men, and children. Whereas traditional sewered sanitation is associated with the highly masculinised engineering culture that arose in the middle of the 19th century, alternatives both offer and require more participation of women and children in decision-making, management, and use. This in turn requires a more refined analysis and understanding of the role of the household, the unit of sanitation planning, than has normally been the case. Gender analysis offers both tools and guidelines for this added level of analysis.

Box 17: What is "gender"?

"In all societies men and women play different roles, have different needs, and face different constraints. Gender roles differ from the biological roles of men and women, although they may overlap in nearly all societies. Gender roles are socially constructed. They demarcate responsibilities between men and women, social and economic activities, access to resources, and decision making authority. Biological roles are fixed, but gender roles can and do change with social, economic, and technological change. Social factors underlie and support gender-based disparities." (Fong, Wakeman and Bhushan 1996)

The household is the basic unit of sanitation planning, but even within the household, there are deep differences between children, women and men in terms of behaviour, preferences, power, access to resources, time spent at home, information, and skills (Khabeer 1994).

Addressing gender issues in sanitation means having a closer look at social relationships, to see the different roles of community members and the complicated structure between women and men, girls and boys with regard to decision making, choice and manner of use of technology, hygiene, food security, financial security, crop production and health issues. Participation does not mean merely inviting the men from all types of households to come to a meeting and vote on toilet designs, it requires deliberate and skilled facilitation to elicit this same information from women, servants, and the social or ethnic classes who are given the "dirty work" in any particular society. The people charged with the dirty work have critical knowledge about the workings of the system, but they are frequently ignored as key stakeholders.

Box 18: Who does the dirty work?

In most societies, the dirty work is done by special castes, ethnic groups, or social or age classes. For example, emptying of pit toilets in East Africa is done by extremely poor youths, called "frogs". In India, the Dalit ("untouchable") caste had this and other functions. In Bulgaria and Romania, if there is a need to clean out a sewer or sweep a street or empty a toilet, the answer is 'call a Gypsy' (Roma). In Egypt Coptic Christians (the Zabbaleen) handle the waste; until recently, in North America (like in Victorian England) housecleaning was something only unmarried girls from poor families were called on to do.

Participation in ecosan projects also serves to include appropriately the different interests, needs, priorities, and framework conditions, as well as the economic and organisational potential and limits of the different stakeholders, in the decision making process, insofar as they do not contradict the needs of other participants. If at times in the process no consensus can be achieved, then mediation or other mechanisms to balance the different interests may be necessary, for example majority decisions or decisions made by legal representatives.

Willingness to pay and degree of participation in the system operation and maintenance

When adopting a demand responsive approach to sanitary provision on the basis of a freedom of choice and willingness to pay, the questions "whose demand?" and "whose willingness to pay?" may have to be answered to address equity concerns. "Payment" in this case may include all forms in which the users may contribute, i.e., in cash, in kind, and with time and energy for obtaining, operating, maintaining, and managing services.

Also inherent in this definition is the understanding that "choice" means a lot more than technology or cost options. It can also mean who participates in which choices, i.e., which groups within the communities and households make which of the several key decisions, such as:

- initiation of the projects;
- the type of technologies and service levels;
- the location of the facilities;
- the local management, maintenance, and financing systems; and
- the candidates for training.

The "capacity to pay"can be verified through the process of facilitating informed choice - an essential requirement of the demand-responsive approach. It is not possible to assess "willingness to pay" with any accuracy in the absence of choices and full information about choices being offered and discussed with potential consumers. Both willingness and capacity to pay can be surprisingly elastic, depending on what options are being offered, at what immediate and longer term costs, and how clearly this information is communicated to and discussed with women and men from wealthier, intermediate, and poor groups, who are all potential consumers of services. Gender-sensitive methods play an important role in assessing the overall demand for services.

In researching and establishing demand, researchers will need to investigate and control for incentives in the potential users' environment which may distort their willingness or capacity to pay. For example, if people believe that services might be provided free of charge, they may have an incentive to say that they are too poor to pay. In such cases it may not be possible to get an accurate assessment of demand until the initial stages of project implementation are under way. At this time potential consumers can begin to see the real terms under which the services are finally being provided.

Demands and meeting demands are not static issues. Continued maintenance and use of services and user payments depend on how well the improved facilities continue to match the expectations and resources of the different groups. Users also continually compare how benefits relate to the costs of obtaining them. A close monitoring and documentation of these processes in pilot projects by an accompanying research programme will provide valuable lessons for further implementation of ecosan systems (Mukherjee and van Wijk 2002).

Policy and institutional aspects, enabling environment

In most countries the use of surface and ground water is subject to respective national water laws. Other laws concerning soil, transport of chemicals, utilisation of fertilisers etc. supplement these water laws. The laws which have to be consulted in ecosan-related projects therefore are potentially much wider reaching than for more conventional sanitation systems, for example emission laws, soil protection, groundwater protection, labour regulations, fertiliser regulations, impact of subsidies, and the broad application of health regulations.

As ecological sanitation is still a relatively new approach, these types of sanitation systems are usually not yet included in the respective legal national frameworks. However there are some guidelines available that do create opportunities for ecosan systems, for example the new edition of the 1989 WHO Guidelines on the "Safe Use of Wastewater and Excreta" which are currently under preparation, or the EcoSanRes guidelines (Jönsson et al. 2004), as well as national policies, for example in Sweden (Regeringens proposition 2004).

Irrigation with water from other than natural sources is subject to rigid regulations and here ecosan may encounter legal problems. For example in Germany urine from urine separating toilets is seen legally as wastewater (as long as it is mixed with water), or solid waste (as long as it is not mixed with water). As solid waste the existing legislation applies and urine can not be used as a fertiliser (as it is not included in the list of certified fertilisers). Even struvite - magnesium ammonium phosphate (a substance that contains both N and P with a high fertilising potential) that may be produced from urine by precipitation technologies - meets this problem.

In view of the legal uncertainty concerning ecosan systems they "should be codified into the local, national and international systems of technical standards and norms in order to provide reference for Best Practice and Best Available Technology. The regulatory framework should be verified or adjusted with the aim of authorising and promoting a closed loop with new innovative technologies and management concepts." Furthermore, "Ecosan strategies should be implemented in national and international action plans including the Implementation Plans for the MDGs (Millennium Developments Goals), PRSPs (Poverty Reduction Strategy Papers) and the National Plans of Action within the UNEP GPA (Global Programme of Action for the Protection of the Marine Environment from Land-based Activities). The indicator system for safe and sustainable sanitation provision should be revised to reflect the real risks and dangers to the environment and public health posed by all forms of sanitation." (quoted from GTZ 2003)

A review of existing national and international regulations with respect of the requirements of ecological sanitation systems is needed. This has been started to some extent by a recently published report on sanitation regulatory frameworks (Johansson and Kvarnström 2005), which analysed and compared the frameworks in Mexico, South Africa, Sweden and Uganda. It has become evident, that the present regulatory and legislative set-up in many countries can hinder the introduction of eco-sanitation systems, and do not actively support recycling and sustainable resource management in the water and sanitation sector. Research needs to focus on providing a sound basis for developing legislation, regulation and technical standards that favour recycling oriented wastewater and excreta management, ensuring a high level of public health and environmental and performance standards.

Project Box 14: Vocational training centre "Dalit Shakti Kendra" in India (GTZ-ecosan-newsletter 2005-18)

The Navsarjan Trust was established in 1989 to help eliminate discrimination based on caste and gender and to assure equality of status and opportunities. In cooperation with GTZ and with support of the Swiss Agency for Development and Cooperation SDC, Navsarjan Trust has developed ecologically sound sanitation concepts based on various technological components on different sites.

A vocational training centre for Dalit youth called Dalit Shakti Kendra (DSK) was established in Gujarat in 1999. The DSK comprises an administration and kitchen building, a workshop building, a common toilet centre, a hostel and a community training centre. DSK is used by around 250 students, and a variable number of guests attending meetings and workshops. The sanitation concept comprises the following components: (1) A common toilet block with toilets for men and women, a biogas plant and subsequent treatment of the digested slurry in soilisation fields. The biogas plant also receives the manure of between 5 and 10 buffaloes. Source separated urine from the urinals and the squatting pans, is collected in tanks outside the toilet building. Urine storage and hygienisation tanks (black plastic tanks) are exposed to the sunlight to facilitate hygienisation. (2) Greywater from showers in the hostel and from the kitchen is treated in organic filters for solids removal and reused for surface irrigation; (3) Two double vault urine-separation vermi-toilets are installed. Earth worms facilitate the composting of faeces in the batch-chambers; (4) Urine is collected separately and directed together with water from hand washing to a greywater garden. Leachate from the composting chamber is treated and reused in a special leachate garden. The leachate is applied below surface to avoid public exposure to pathogens.

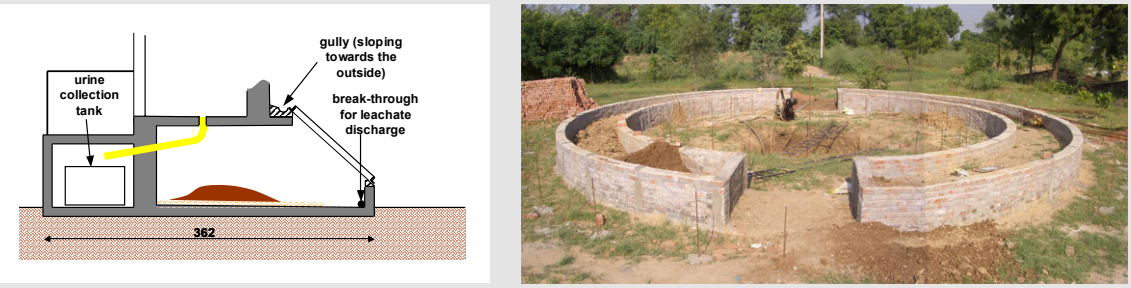


Figure 32: Urine-separation vermi composting toilet (left) and new school toilet block with bio-gas treatment - under construction (right). (GTZ)

(5) Mixed wastewater and blackwater from toilets in the community training centre is treated in organic filters, followed by evapotranspiration/infiltration beds. (6) Some greywater is being separately collected and directly treated and used in mulch trenches which allow a safe reuse of untreated greywater. As organic mulch material decomposes, the trenches have to be restored periodically

Awareness raising

Ecosan systems have the overriding aim of improving public health and hygiene. However, the basic premise of ecosan, of closing the nutrient loop between sanitation and agriculture, means that designers of ecosan systems must consider a much wider range of factors than those of conventional systems. This also leads to the consideration of soil conservation, increased long-term food security, and the sustainable use of resources (in the form of nutrients, organics, water and energy). As ecosan aims to solve sanitation problems and ensure reuse at the lowest possible level, promoters of these systems also have to consider the active engagement of the local private sector, contributing to job creation and poverty reduction.

The phrases "awareness raising" and "public education" came into wide use in the political modernisation of a number of urban environmental and governance systems in the 1990s. Another term, "social advertising", is slightly more accurate, in that all of these terms refer to a process of public relations or propaganda for stakeholders who are outside of – or peripherally related to – the

main decision-making processes. Awareness raising is often a strategy to bring these stakeholders into the process, sometimes as a counterweight to traditional or conventional institutions and experts.

Awareness raising focuses on “elevating the level of knowledge” that the users of a system have, so that they can participate in decision making at a more informed level. It is focused primarily on two kinds of communications: (1) instructions on how to use the system, comply with the rules, or change behaviour to match the needs of the system providers; and (2) information or justification about why this is necessary, desirable, morally appropriate, religiously approved, environmentally sound, or the like. There are a number of classic formulae for awareness raising, among them the “decision-makers guides”, “key sheets”, “decision trees”, SWOT analyses, and “advantages and disadvantages” tables.

The main reason for awareness raising with regard to ecological sanitation is that the ecosan approach and range of alternative technical, logistical, and institutional options are at the moment relatively unknown, not only to (potential) users, but also amongst engineers, planners, decision makers, agriculturists and even sanitation professionals. The role of awareness raising is therefore to spread this knowledge and to raise the profile of ecosan solutions among all stakeholders, with due attention to their power in the process, their tasks, their information needs, and the ways in which this information must be presented.

The strategy of most awareness raising is to de-construct and re-construct a particular discourse about alternatives, bringing in new information, criteria, or factors which weigh differently than those in the conventional approach. In sanitation, for example, the conventional criteria have to do with micro-biology, (in-house) health, and hygiene, whereas ecosan shifts the debate to a discussion (among others) of health and hygiene risks from contaminated surface water and insufficiently treated effluents, on water-intensivity, resource use, poverty reduction, nutrient cycles, and cultural appropriateness. The result of bringing them into the sanitation discussion is to create a demand for comparing conventional with new solutions, and (sometimes) creates a space for decision makers to take different decisions and support alternatives.

Topics of the new discourse are e.g.:

- participation versus top-down approaches
- sanitation only for those who pay for it versus pro poor sanitation
- comparing the money invested in sanitation with the gains for the national economy
- capital cost versus labour cost and job creation
- centralised versus decentralised
- large infrastructure versus modest investment
- end-of-pipe versus closed loop systems
- waste as a resource versus waste as something to be disposed of

6 Conclusion: The role of educational institutions in stimulating and supporting the paradigm shift towards sustainable sanitation

Education has a clear role to play, both in acknowledging the paradigm shift in sanitation and in incorporating the interdisciplinary theme of innovative sustainable sanitation systems into teaching curricula. Education on ecosan should enable the people to develop, plan and implement eco-sanitation systems that are hygienically safe, socially acceptable, economically feasible, environmentally sound and technically appropriate.

Educational institutions, universities, and technical schools can contribute to the mainstreaming of the new sanitation paradigm by fully integrating the discourse and criteria for sustainability into their curricula. They should make clear that defining criteria for sustainable sanitation is a political act and influences what is the accepted, legitimate form of sanitation, including the impacts from sanitation on other sectors. Sanitation capacity building should take the stakeholders in a sanitation project not as objects, but as partners for jointly developing sustainable sanitation solutions.

In response to satisfying especially the health needs of unserved, mostly poor population groups, education and research has to add resource conservation and waste reuse into taught sanitation paradigm, in order to improve economic conditions and the health of the population served, the quality of the environment and the long term availability of natural resources.

Sanitation engineers and practitioners, policymakers, managers, and operators get their ideas and information during their education. Therefore the curricula of universities, continuing education programmes, technical schools, research institutes and training centres have to include the ecosan philosophy. Thus several objectives, such as the improvement of human health, poverty reduction in developing countries, the conservation of natural resources and sustainable water and sanitation management systems in both, industrialised and developing countries may be addressed. Those responsible for the content of curricula should be informed about the new developments in this field.

The education system has to prepare students to think about urine and faeces and grey/black water as resources. Emphasis has to shift from the simple disposal to the hygienisation of contaminated flow streams, and to resource conservation and safe reuse. Teaching must make clear that health and a healthy environment is a prerequisite for human productivity, and productivity determines economic well being.

Many proven technical elements are available for ecological sanitation systems and the number of pilot demonstration and research projects, and of large scale applications, is continuously increasing. However, given the broad variety of local framework conditions and the large number of open questions in this complex interdisciplinary field, there is still a great need to further develop technical and operational solutions and to enlarge the knowledge base with respect to public health, risk management, economics, logistics, material-flow-streams, socio-cultural and many other aspects. Research in these disciplines will require trans-sectoral and interdisciplinary co-operation and inputs from a range of research fields.

Development and applied research should concentrate on a large series of pilot research and demonstration projects which can serve as laboratory for developing and field-testing a broad variety of technical and operational sanitation systems. The pilot research and demonstration projects should showcase innovative solutions in a variety of climatic, social, cultural, economic and geo-morphological contexts, and should enable the development of a series of model solutions covering the whole range of sanitation needs.

Research should concentrate on comparative studies between a range of conventional and innovative solutions comparing them against a set of sustainability criteria. It should also help in developing field tested and proven sustainable sanitation components and systems, and contribute to forming a knowledge base for drawing up technical standards. Documentation and case studies for innovative

sanitation solutions should be easily made available in a uniform comprehensive format, and technical information for components of innovative sanitation solutions should be provided to accelerate their dissemination.

The achievement of the sanitation MDGs is one of the major challenges for sustainable development in the next decade. Putting emphasis on education and research for ecologically sustainable sanitation may largely contribute to reaching this goal.

7 Annex - Examples of workshop contents, curricula outlines and an awareness raising presentation

These examples are demonstrating the broad range of awareness raising, teaching, practical training, and professional networking activities, which may serve as a source for the reader to build his own materials and tools.

Presentations, workshops and curricula have to be strongly tailored to the target group they are meant for. Further more an awareness raising workshop will differ from a project-start-up workshop or a decision-making workshop. Not only the target group in general e.g. secondary school teachers, but as well e.g. the specific geographic and socio-cultural context has to be addressed. Teachers in sub-Sahara countries need different input than those in Sweden. Hence no two presentations, workshops, curricula will be alike, if such differences are well addressed.

The below given examples are not more than a stimulation or first input for those planning to work out their own ecosan teaching-framework, presentation-material, or workshops for their individual context.

The intention is, however, to show the wide range of topics to be covered and groups to be specifically addressed, with the set of examples given below.

More Examples and material are found on the “ecosan resource” CD that is either found at the end of this publication, or can be ordered from ecosan@gtz.de. Information on up-to-date online-versions of this “ecosan resource” CD are found at http://www.unesco.org/water/ihp [search in “publications”] and at www.gtz.de/de/dokumente/en-ecosan-education-resources-2006.pdf.

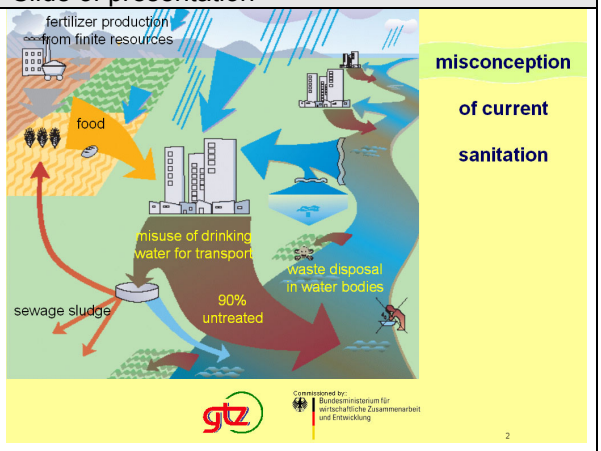
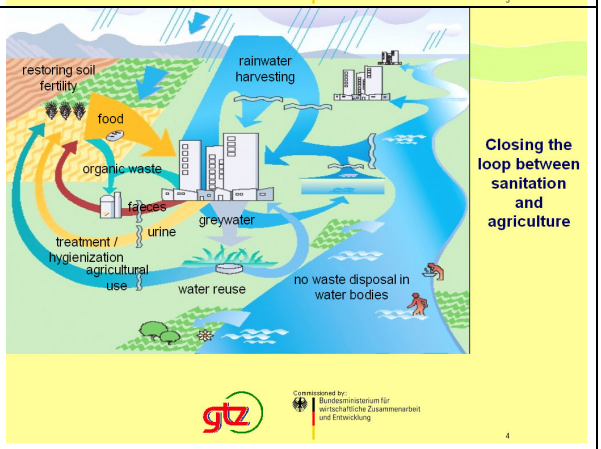
7.1 Example: A three-minute awareness raising presentation at CSD12

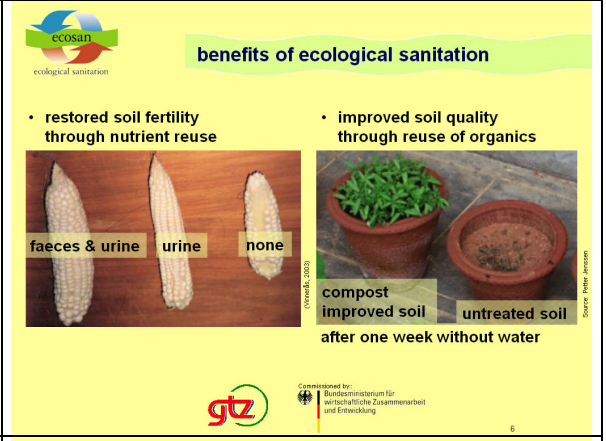
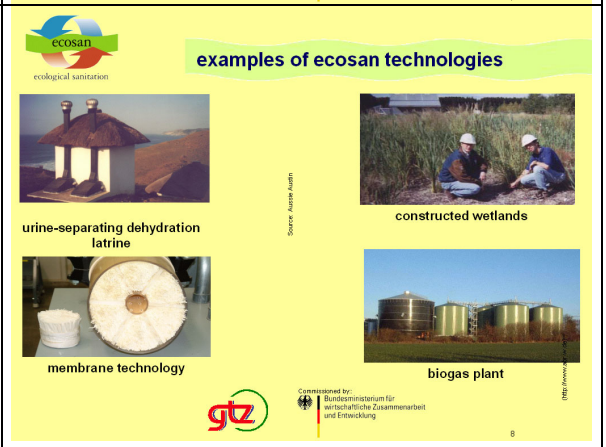
The speech and presentation “ecosan - principles, urban applications and challenges” given by Christine Werner at the 12th session of the UN Commission on Sustainable Development (12 CSD) on ecological sanitation is given as an example for an awareness-raising presentation.

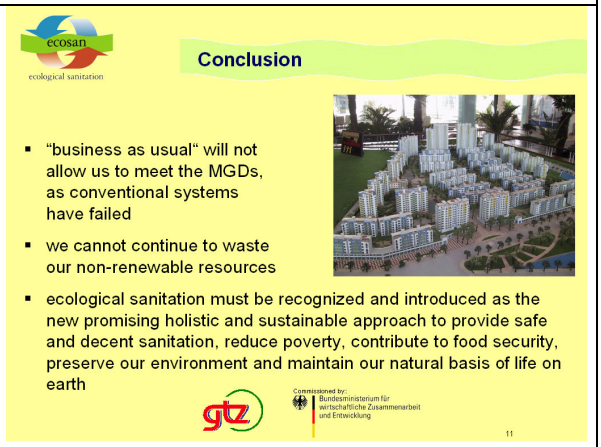
The speech had duration of 3 minutes, provoked a lively discussion at the CSD12 on the topic and was aimed at high ranking political decision makers.

Table 8: Example for a 3-minute awareness raising presentation

Text	Slide of presentation
Ecosan - principles, urban application and challenges Occasion: UN Commission on sustainable development CSD 12th session – New York, 14th to 30th of April 2004	

Text	Slide of presentation
The idea, that human excreta are wastes with no useful purpose is a modern misconception. It has led to the development of so-called “drop and store” or “flush and forget” sanitation solutions, where precious drinking water is used to transport excreta into the water cycle misusing our rivers, oceans and aquifers as a sink for untreated waste.	
On the other hand, farmers around the world yearly require 135 Mio tons of mineral fertiliser for their crops, while at the same time conventional sanitation dumps 50 Mio tons of fertiliser equivalents flows into our water bodies - nutrients with a market value of around 15 Billion US dollars.	
In nature however, there is no waste. All products of living things are used as raw materials by others as part of a cycle. Considering the environmental damage, the health risks, and the worsening water crisis, a revolutionary rethink of our current sanitation practises is urgently needed. To solve our self made sanitation problems, ecosan applies the basic natural principal of closing the loop by using modern and safe sanitation and reuse technologies, thereby continuing the historic tradition of recycling human wastes once applied in most farming societies. Eco-sanitation opens up a wider range of sanitation options than those currently considered.	
Firstly, flow streams with different characteristics, such as faeces, urine and greywater, are often collected separately. Rainwater harvesting and the treatment of organic waste and animal manure can also be integrated into the concepts.	Secondly, unnecessary dilution of the flow streams is avoided, for example by using dry, low flush or vacuum transport systems. This minimises the consumption of valuable drinking water and produces high concentrations of recyclables.

Text	Slide of presentation
Benefits of ecological sanitation comprise: the protection of human health through safe sanitation, the preservation of clean waters, and a safe and healthy environment	
Benefits of ecological sanitation comprise… the reuse of plant nutrients as valuable fertiliser restoring soil fertility and substituting expensive mineral fertilizers from limited natural resources the reuse of organic matter for improving soil quality, especially its water and nutrient retention capacity	
Benefits of ecological sanitation comprise… the recovery of energy contained in excreta and wastewater for example through the production of biogas and the reuse of water for irrigation, service water or groundwater recharge	
Examples of ecosan technologies Initially, when Scandinavian pioneers first began promoting the advantages of urine separation and nutrient recovery in the ‘80’s, the focus was on dry sanitation systems for rural areas only. Since then however, many different technical options have been developed, ranging from low cost systems - such as composting toilets, urine diverting dehydration latrines and constructed wetlands - to high tech water-borne applications - such as vacuum sewers, anaerobic treatment, chemical processing or membrane technology, most suitable for use in densely populated urban areas all over the world.	

Text	Slide of presentation
One of the most recent examples in Germany can be seen at the headquarters of the KfW banking group in Frankfurt, where vacuum technology, best known from trains and aircraft, is used to collect blackwater and greywater is being recycled to flush toilets, while at the GTZ main office, urine separation and agricultural use will be implemented in the course of the ongoing renovation of the building.	
However, there are still some challenges to be faced before ecological sanitation systems are widely adopted: Awareness of the alternatives offered by ecosan has to be increased Resource reuse needs to be integrated into sanitation planning processes from the very beginning Legal frameworks and technical standards need to be revised We need a full cost analysis and comparison of the environmental and health risks of all types of sanitation	
Innovation-friendly investors are required, as well as new financing instruments supporting private households investment	And, most important of all, we need large scale implementation of ecosan projects in urban areas for show casing the technical feasibility and the benefits of this new approach
We all recognise that a “business as usual” approach to provide sanitation will not allow us to meet the MDGs. Despite more than 100 years of experience and trillions of dollars of investment, conventional systems have failed. But we still continue to waste our non-renewable resources as if they were in infinite supply. Due to its huge potential, ecological sanitation must be recognised and introduced as the new promising holistic and sustainable approach to provide safe and decent sanitation, reduce poverty, contribute to food security, preserve our environment and maintain the natural basis of life on earth.	

7.2 Example: Advanced 3 plus 2 weeks ecosan training course in Sweden

This 3 plus 2 weeks advanced ecosan training course by Stockholm Environment Institute and funded by SIDA, Sweden, is designed for professionals (engaged in town planning, water supply, waste management, and socio-economic development), researchers and trainers (in the field of environmental sanitation), and key persons (e.g. engaged in NGOs with projects related to improved sanitation and water supply). It has the following overall objective and long term goal:
Objective: To acquire information and knowledge about new options in sanitation in order to support urban dwellers in reducing environmental health risks, improving their nutritional status and protecting their water sources.
Goal: Lead to better health and well being as well as the protection of the environment.
Duration / Structure / Location:
Part 1: The first 3-weeks introduction to the basics of ecosan takes place in Sweden.
Part 2: Back in their countries of origin, participants work on professional ecosan projects for several months, supported by the course supervisors.
Part 3: A two weeks course takes place in or near the participant's countries of origin. This part is based on the individual projects with discussions and seminars with professionals from the country where the course is given. This regional exchange and cooperation will support regional networking.
Method: A mix of lectures and work in groups. The first three weeks introduce the problem-based learning method.

Table 9: Programme for part 1 (3 weeks, in Sweden) of the advanced Sida/EcosanRes course of ecological alternatives in sanitation

Country	Sweden
Type of activity (Name)	Advanced 3 plus 2 weeks ecosan training course
Dates	14 August – 4 September, 2005
Place	Stockholm
Organizer	Stockholm Environment Institute
Sponsor	SIDA
No. participants	30
Objective	To acquire information and knowledge about new options in sanitation in order to support urban dwellers in reducing environmental health risks, improving their nutritional status and protecting their water sources

Sunday, 14 August

Time	Content	Lecturer/ressources	Base group assignment
18:00	Course opening with joint dinner (+ info on Sweden)	All	-

Day 1: Monday, 15 August

Time	Content	Lecturer/resources	Base group assignment
09:00	Welcome and course description	JOD	
09:30	Welcome by Sida/SEI	Andersson /AR	
10:45	Presentation of course programme Hygiene/food prod./management	JOD+TAS+HJ	
14:00	Introd. to Problem-Based Learning Introductory case	JOD+CS+BV+HK	
19:00	Pre-conceived ideas about ecosan	Individual task	

Day 2: Tuesday, 16 August

Time	Content	Lecturer/resources	Base group assignment
08:30	*"Pathogens & disease transmission"*	TAS+CS	
10:00	Base-group work	JOD+CS+BV+HK	Test case
13:00	Study tour to Skarpnäck (dry toilets)	CS+BV+HK	
16:30	Return to hotel (review in the bus)		

Day 3: Wednesday, 17 August

Time	Content	Lecturer/resources	Base group assignment
08:30	Base-group work	-	Test case cont.
10:00	BG-meeting (present test case +new)	JOD+CS+BV+HK	Start Case I
13:45	*"Indicators and the risk concept"*	CS	-
15:30	Free for shopping & sightseeing		

Day 4: Thursday, 18 August

Time	Content	Lecturer/resources	Base group assignment
08:30	*"Urban groundwater & treatments"*	GJ	Case I cont.
11:30	Base-group work		
14:00	*"Hygienisation of excreta and WHO Guidelines"*	TAS	
15:30	Base-group work		
17:00	Bus to Skansen + ferry to Gamla stan	Guide tour	

Day 5: Friday, 19 August

Time	Content	Lecturer/resources	Base group assignment
08:30	Base-group work	-	Case I cont.
10:30	*"Greywater treatment and use"*	HJ	
13:30	Report of Case I in plenum+comments	JOD+CS+BV+PR	Report Case I
14:30	Greywater in Erdos and Bufallo City	PR	
15:30	BG-meeting	JOD+CS+BV+HK	Start Case II

Saturday, 20 August

Time	Content	Lecturer/ressources	Base group assignment
08:15	Study tour: Building exhibition centre/ Nacka NaturCentrum /Hammarby Sjöstad/Bornsjön Travel to Linköping		-

Sunday, 21 August, Free activities

Day 6: Monday, 22 August

Time	Content	Lecturer/resources	Base group assignment
08:30	*"A holistic house"*	RSh (Nepal)	Case II cont.
11:00	BG-work		
13:00	*"How to produce interview protocols"*	JOD	
14:30	Sanitation experiences from participants' countries (plenum)	All participants 10min/country	

Day 7: Tuesday, 23 August

Time	Content	Lecturer/resources	Base group assignment
08:30	Study visit to Ekoporten		Case II cont.
13:00	"Wetland treatment of wastewater"	KS	
14:30	Sanitation experiences, cont.	Participants	

Day 8: Wednesday, 24 August

Time	Content	Lecturer/resources	Base group assignment
08:15	1/2-group interview training, prep. of individual interview protocol	Video mirroring	Case II cont.
13:00	1/2-group interview training, prep. of individual interview protocol	Video mirroring	

Day 9: Thursday, 25 August

Time	Content	Lecturer/resources	Base group assignment
08:15	Cont. base-group with Case II	-	Case II cont.
10:30	Individual interviews with *users and producers of ecosan*	-	
18:00	Multicultural dinner		

Day 10: Friday, 26 August

Time	Content	Lecturer/resources	Base group assignment
08:30	Report of Case II in plenum+comment	JOD+CS+BV+HK	Report Case II
10:30	BG-meeting	JOD+CS+BV+HK	Start Case III
13:00	"Treatment of excreta"	BV	
15:30	Outstanding issues of Case II	CS	

	introduction to professional project	JOD+CS+BV+HK	

Saturday, 27 August

Time	Content	Lecturer/resources	Base group assignment
08:30	Departure from Linköping Study visit to Enköping with ww irrigation. Travel to Uppsala. "*Small-scale options*" Visit to home garden in Uppsala Arrival at hotel	BV+JOD BV+Muller HJ	

Sunday, 28 August, Free activities

Day 11: Monday, 29 August

Time	Content	Lecturer/resources	Base group assignment
08:30	*"Urine, faeces & solid waste as fertilisers"*	HJ	Case III cont.
10:30	Reports of interviews in plenum	JOD+CS+BV+HK	
13:30	*"Residents' views and wants"*	RS	
15:00	Reports of interviews cont. + summary	JOD+CS+BV+HK	
17:00	*Production of simple ecosan-toilets*	BV+HJ	

Day 12: Tuesday, 30 August

Time	Content	Lecturer/resources	Base group assignment
08:30	*"Fertilisers in urban farming and gardening"*	HJ	Case III cont.
10:00	Base-group work		
13:00	*"Ecosan in practice-technical issues"*	HJ+JOD	
15:15	Discussion of professional project	BV+CS+JOD	
15:45	Base-group work		

Day 13: Wednesday, 31 August

Time	Content	Lecturer/resources	Base group assignment
08:30	*"Evolution of toilet systems (Gender)"*	JOD	Hand in draft of professional project
10:30	Base-group work	(KT)	
13:30	*"Institutional aspects of ecosan"*	JOD	
15:30	Film on dalits in India, Durban, etc.	JOD	

Day 14: Thursday, 1 September

Time	Content	Lecturer/resources	Base group assignment
08:30	"*Systems perspectives* incl. costs and returns of various arrangements"	HJ+JOD	
10:30	Report on Case III in plenum	JOD+CS+BV+HK	Report on Case III
13:00	Evaluation of experience of PBL	JOD+CS+BV+HK	
15:30	General discussion on ecosan		
18:00	Preparation for departure	All	DHL

Day 15: Friday, 2 September

Time	Content	Lecturer/resources	Base group assignment
08:30	Group discussion on planning & discussion of professional projects	All	
10:30	Ecosan in the future (MDG)		

13:00 13:30 19:00	Bengt Johansson, Sida-Natur Evaluation, summing up experiences Farewell dinner	Sida, all All	
Saturday, 3 September, departure			
Sunday, 4 September, departure			

Table 10: Programme for part 3 (2 weeks, regional) of the advanced Sida/EcosanRes course of ecological alternatives in sanitation in or near the participant's countries of origin

Country	African participants meet in S. Africa, Asian participants in India		
Type of activity (Name)	Follow-up course to professional projects		
Dates	13 – 24 February, 2006 (Africa) and March 13 -24 2006 (India)		
Place	variable		
Organizer	Stockholm Environment Institute and a local organiser		
Sponsor	Sida		
No. participants	15 African participants in South Africa, and 15 in India		
Objective	To strengthen the ability to organise and improve ecosan projects		
Day 1: Monday, 13 February			
Time	Content	Lecturer/resources	Base group assignment
09:00 09:30 10:15 13:30 17:00 19:00	Welcome by local organiser Presentation of course programme **Seminar:** *"Sanitation norms & policy"* Presentation of participant projects (20 min for each) Welcome dinner	SM JOD DWAF Each participants	
Day 2: Tuesday, 14 February			
Time	Content	Lecturer/resources	Base group assignment
08:30 11:00 13:15 15:15	Project presentations continue Peri-urban sanitation projects Base-group task: select 2 focus areas Base-group work	Each participant DG JOD+SS Participants	 Case V
Day 3: Wednesday, 15 February			
Time	Content	Lecturer/resources	Base group assignment
08:00 11:30 13:00 14:15	Study visit to periurban sanitation units Follow-up of visit e.g. "An array of technical solutions" **Workshop A:** "*Fit or misfit of technical systems in the urban context"*	Schoman, Booysen JOD Base group A DG	 Report 1 of Case V Team 2

[… continued]

Day 4: Thursday, 16 February

Time	Content	Lecturer/resources	Base group assignment
08:30	e.g. "Monitoring activities"	Base group B	Report 2 of Case V
09:15	*"Work in communities. Promotion & monitoring strategies for ecosan"*	SM	
13:15	Practical task: produce info material for toilet/greywater use and maintenance	Local professional & work in groups	

Day 5: Friday, 17 February

Time	Content	Lecturer/resources	Base group assignment
08:30	Presentation of information material	Participants	Reports
10:00	Base-group task: "Sanitation matters"	JOD+SS	Case VI
13:30	Preparation of individual interviews	JOD	
14:15	Preparation continue in small groups	Participants	

Saturday, 18 February

Time	Content	Lecturer/resources	Base group assignment
24:00	"Ghost" tour in town?		

Sunday, 19 February, Free activities

Day 6: Monday, 20 February

Time	Content	Lecturer/resources	Base group assignment
08:30	**Workshop B:** *"Reuse of greywater, urine and dried faecal matter"*	CB, HJ	Case VI cont., Team 3
13:00	*"Prevention is better than cure"*	T-A Stenström	
14:30	Individual interview in town	Participants	

Day 7: Tuesday, 21 February

Time	Content	Lecturer/resources	Base group assignment
08:00	Study visit to small ecosan projects	Henk	Case VI cont.
11:00	Follow-up of visit and lessons learnt	TAS	
11:30	**Workshop C:** *" A sanitary city"*	AA	
15:30	Preparation of presentations by groups	Participants	

Day 8: Wednesday, 22 February

Time	Content	Lecturer/resources	Base group assignment
08:30	Presentation of interviews in groups with similar informants. Discussion.	JOD+SS	Case VI cont.
10:30	" "	Still open slot	
13:30	*Base-group work*	Participants	
14:30	*"Systems Analysis and an algorithm"*	JOD+ HJ	

Day 9: Thursday, 23 February

Time	Content	Lecturer/resources	Base group assignment
08:30	Presentation of ideas for future work	Participants	Case VI cont.
10:30	Working groups on future work	Participants+some former	
13:15	Cont.		
15:00	Presentation of Case VI	Participants	Report of Case VI

[… continued]
Day 10: Friday, 24 February

Time	Content	Lecturer/resources	Base group assignment
08:30	Establishing local and country working groups. Plans for networking	Participants	
11:00	Oral evaluation of course	JOD	
13:30	Evaluation cont.		
14:30	Closure of the training programme	Invited guest	
18:00	Farewell dinner		

Abbreviations for names used in this table are:	
IA	*Ingvar Andersson, Sida*
AR	*Arno Rosemarin, SEI, Stockholm*
BV	*Björn Vinnerås, Swedish University of Agricultural Sciences, Uppsala*
CS	*Carolina Schonning, Swedish Institute of Infectious Disease Control*
HJ	*Hakan Jönsson, Swedish University of Agricultural Sciences, Uppsala*
HK	*Helena Krantz, Linköping University*
JOD	*Jan-Olof Drangert, Linköping University*
KS	*Karin Sundblad, Linköping University*
GJ	*Gunnar Jacks, KTH, Stockholm*
PR	*P. Ridderstolpe, WRS, Uppsala*
RSh	*R. Shrestha, UN-Habitat, Nepal*
RS	*Ron Sawyers, Sarar, Mexico*
TAS	*Thor-Axel Stenström, Swedish Institute of Infectious Disease Control*
AA	*Aussie Austin, CSIR, South Africa*
CB	*Chris Buckley, University of Kwa Zulu Natal, Durban*
SM	*Shelly van der Molen, Consultant, Kimbreley*
GD	*Duke Gumede, Cape Town City council, South Africa*
SS	*Saskia Senekal, Homevale WWTP, Kimberley*

7.3 Example: Schedule of a 5-day ecosan introduction course in Norway

The Agricultural University of Norway (NLH) offers different courses which include ecological sanitation in their curricula. The course schedule presented below refers to the course “Appropriate sanitation in the developing world” which is a 5-day course for both, professionals and students.
Focus: The focus of this course is to explore ecological solutions for developing countries. Specifically, recycling and natural waste treatment systems are examined. Case-studies are presented by sanitation specialists, followed by analysis of associated issues – both technical and social. The range of case studies covers Asia, Africa and Latin America. And the scope of analysis offered by engineers, scientists, and public officials is wide and timely.

Target group: The course is designed for both the professional and student. Its purpose is two-fold: (1) to illustrate how ecological sanitation is applied in developing countries, and (2) to explain, in-depth, the principles of ecological engineering. Participants are expected to include professionals from consulting firms (e.g. civil engineers), NGO personnel (field and administrative), public officials (e.g. health and foreign services), research scientists, and students from various disciplines.

Table 11: Schedule of a 5-day ecosan introduction course in Norway

Country	Norway
Type of activity (Name)	5-day ecosan introduction course
Dates	Every year; e.g. from 24 to 28 May, 2004
Place	Agricultural University of Norway, Ås, (30 km from Oslo)
Organizer	Agricultural University of Norway (NLH)
Sponsor	Financed by fees, limited number of scholarships available
No. participants	30
Objective	Explore ecological solutions for developing countries

Day 1: Monday, 24 May (Fundamentals of ecological sanitation)

Time	Content	Presenter
09:30 – 09:40	Welcome	
09:40 – 10:20	Ecological sanitation an option for all	P. D. Jenssen
10:20 – 10:40	The UN goals for water and sanitation	M. Svelle
10:40 – 11:00	Coffee break	
11:00 – 11:10	Welcome to the University	O.J. Skjelhaugen
11:10 – 11:35	The wastewater resource	P. D. Jenssen
11:35 – 12:15	Ecological sanitation in developing countries	H.P. Mang
12:15 – 13:15	Lunch	
13:15 – 14:00	Composting and dry sanitation toilets	P.D. Jenssen
14:15 – 15:00	Vacuum toilets and vacuum transport	K. Haddal
15:15 – 16:00	From blackwater and organic waste to fertilizer	J. Morken
16:15 – 17:00	Demonstrations: toilet options for the future, greywater treatment and slurry injection	J. Morken, P.D. Jenssen

Day 2: Tuesday, 25 May (Sanitation under stress - Agricultural aspects)

Time	Content	Presenter
08:30	Sanitation under stress: scenarios, challenges -experiences after Tsunami	A. Koestler
	Case study - input parameters: New settlements along tsunami affected coast lines	A. Koestler
	Case study exercise - group work A	Koestler/P.D. Jenssen/ H.P. Mang
12:15	Presentation and discussion of students work	A. Koestler/P.D. Jenssen/ H.P. Mang
12:15 – 13:15	Lunch	
13:15 – 14:00	Summary and formulation of future tasks and challenges - what is really needed in disasters!	A. Koestler/ P.D. Jenssen/ H.P. Mang
14:15 – 15:00	Urine diverting systems - an overview	E. Kvärnström
15:15 – 17:00	Agricultural aspects of ecological sanitation with practical demonstrations	E. Kvärnström

Day 3: Wednesday, 26 May (Natural systems – Health aspects)

Time	Content	Presenter
08:30 – 10:00	Soil for groundwater protection and wastewater treatment	P.D. Jenssen/ S. Jonasson
	Coffee break	
10:15 – 11:00	Soil for groundwater protection and wastewater treatment	P.D. Jenssen/ S. Jonasson
11:15 – 12:15	Greywater treatment and reuse	P.D. Jenssen
12:15 – 13:15	Lunch	
13:15 – 14:00	Health aspects of ecological sanitation	T.A. Stenström
14:15 – 15:00	Health aspects of ecological sanitation	T.A. Stenström

15:15 – 16:00	WHO guidelines for excreta and greywater reuse	T.A. Stenström
16:15 – 17:00	Energy aspects and co-treatment of waste	P.H. Heyerdahl
19:00	Garden party	

Day 4: Thursday, 27 May (Energy – Wetlands, ponds and aquaculture for wastewater treatment – Participant presentations)

Time	Content	Presenter
08:30 – 09:45	Biogas systems	H.P. Mang
09:45 – 10:00	Coffee break	
10:00 – 10:45	Wetlands and ponds an overview	P.D. Jenssen
10:45 – 11:30	From pit latrines to constructed wetlands-peri urban solutions near Colombo Sri Lanka	A. Heistad
11:30 – 12:15	Ecological Sanitation for Megacities: Calcutta Wetlands and other examples	B. Guterstam
12:30 – 13:15	Lunch	
13:15 – 13:45	Experience from an ecovillage in Denmark	D. Wulfson
13:45 – 14:30	Ecosan examples	H. P. Mang
14:30 – 14:45	Coffee break	
14:45 –17:00	Participants presentations	
18:00	Excursion to the Klosterenga urban greywater treatment system in Oslo - dinner and sightseeing	

Day 5: Friday, 28 May (Social and economic issues related to sanitation)

Time	Content	Presenter
08:30 – 09:15	Organizing decentralized systems – a GIS based tool	H. Borch
09:30 – 10:00	Socioeconomic issues related to ecological sanitation	O. Hanserud
10:00 – 10:15	Coffee/tea	
10:30 – 12:30	Case Bangalore: Eco-san public toilets Starting an economic spiral Generating employment Grassroot involvement for success Economy and gender aspects The influence of religion	K. Gnanakan, J. Heeb
12:30 – 13:15	Lunch	
13:15 – 14:00	Case Bangalore continued	
14:00 – 15:00	Discussions and summing up	J. Heeb/H.P. Mang/ P.D. Jenssen
15:00	Adjourn	

7.4 Example: Workshop in the frame of the large urban ecosan project in Erdos, China

Erdos represents a cluster of cities in a coal mining belt of Inner Mongolia. The ecosan project undertaken by EcosanRes and the Chinese Government takes place in a new eco-town which is being developed as a suburb a few kilometres from the city centre of Dongsheng.

The outline below refers to an awareness raising workshop, undertaken with government officials and various experts. Its aim was to introduce the ecosan concept and to identify an appropriate innovative solution for its local application in the eco-town.

Table 12: Schedule of a 4-day ecosan training course in China

Country	China	
Type of activity (Name)	4-day ecosan training course	
Dates	17-22 July 2003	
Place	Dongsheng, Inner Mongolia	
Organizer	China-Sweden Erdos Eco-town Project	
Sponsor	Swedish International Development Agency	
No. participants	n.a.	
Objective	Introduce ecosan concept and discuss future adaptation at local level	
Day 1: Thursday, 17 July		
Structure	Content	Presenter
Lecture 1	The current situation and the challenge of the UN Millennium Goals: globally and in China Issues: environment, costs, awareness and institutions Conventional solutions: pit toilets and flush toilets	Q. Zhu
Lecture 2	The vision: a systems approach to the management of human excreta; closing-the-loop vs. a linear approach Basic principles: diversion, containment, sanitization and recycling	U. Winblad
Groupwork 1	Read training material; discuss existing sanitation systems in Inner Mongolia, advantages, disadvantages, what people want. (For example 20 min group discussions, 5 min presentations/discussions - 5 groups.)	J. Xiao
Lecture 3	Excreta management and public health: - excreta related diseases - barriers - how pathogens die	J. Xiao
Lecture 4	Stepwise pathogen destruction: - divert urine - prevent dispersal of faeces - reduce volume and weight - kill pathogens - primary and secondary treatment	U. Winblad
Groupwork 2	Read training material; discuss public health aspects of existing sanitation systems in Erdos Municipality. Formulate questions to be answered / discussed by resource persons and participants.	J. Xiao
Lecture 5	Urine and faeces - amounts and properties Examples of urine diversion	J. Xiao U. Winblad

Day 2: Friday, 18 July		
Structure	Content	Presenter
Lecture 6	Check Peter Morgan's writings - reports and website; Stockholm Water report "Urine Separation -closing the nutrient cycle"; Esrey et.al. "Closing the Loop"; Reports by Hakan Johnsson/ Recycling: - waste or resource? - advantages of recycling - recycling of urine - recycling of faeces	Q. Zhu
Groupwork 3	Discuss recycling of human urine and sanitized faeces in Erdos Municipality	J. Xiao
Lecture 7	Examples of ecological toilets based on dehydration: south China "open toilet", Vietnam, Guangxi, Mexico, Sweden, solar heated, Yemen, Ladakh	U. Winblad
Lecture 8	Examples of ecological toilets based on decomposition: Clivus Multrum, Mexican solar heated, Norway, Kerala, Sweden (Kalmar University)	U. Winblad
Day 3: Monday, 21 July		
Structure	Content	Presenter
Groupwork 4 continued	Build a mock-up model of the ecological toilet designed by the group.	Q. Zhu, J. Xiao, U. Winblad
Lecture 9	Design and management features: - urine diversion vs combined processing - dehydration vs decomposition - multiple vaults - anal cleaning material and absorbents - solar heater - ventilation	U. Winblad
Lecture 10	What can go wrong? - Troubleshooting: - lack of participation - lack of knowledge - poor design - defective materials and workmanship - improper maintenance	J. Xiao
Lecture 11	Greywater: - concept and terminology - controlling quantity and quality - processing - utilization	Q. Zhu
Groupwork 5	Discuss different possibilities of handling greywater in the HZK project.	Q. Zhu

Day 4: Tuesday, 22 July		
Sturcture	Content	Presenter
Lecture 12	Large-scale applications, ecostations: - when and where to apply ecological sanitation? - concept and role of ecostations - source separation and community participation - collection and processing	Q. Zhu U. Winblad
Groupwork 6	Discuss the application of the ecostation concept in Erdos.	Q. Zhu J. Xiao
Plenary discussion	Ecological urban development in Erdos Municipality	Q. Zhu J. Xiao U. Winblad
Closing remarks	The Sida-funded R&D project in Erdos Municipality	A. Rosemarin

7.5 Example: Schedule of a 2-day ecosan workshop in Eritrea

The following table shows the schedule of a 2-day ecosan workshop conducted by the GTZ in Eritrea in 2005, which may serve as an example for a 2-day awareness-raising workshop.
The workshop was aimed principally for representatives from the Water Resources Department under the Ministry of Land, Water and Environment (MoLWE), but was also attended by representatives from the Ministry of Agriculture, the Ministry of Health and other local authorities. The workshop was planned to be a forum for presenting the roles and responsibilities of the different authorities on national level in regard of sanitation, discussing the overlap of roles about sanitation issues. It addressed the existing sanitation situation in the country, and promoted the ecosan concept as a possible solution to improve the current situation, by the same time saving and protecting the scarce natural resources.

Table 13: Schedule of a 2-day ecosan workshop in Eritrea

Country	Eritrea	
Type of workshop (Name)	2 days in depth workshop on ecological sanitation program	
Dates	7-8 May, 2005	
Place	Asmara, Eritrea	
Organizer	Water Resource Department (WRD), GTZ	
Sponsor	GTZ	
No.participants	40	
Objective	The workshop was planned to be a forum for presenting the roles and responsibilities of WRD, MoH and MoA in the promotion of sanitation system on a national basis, presenting the existing sanitation situation in Eritrea, discussing the significant overlap of roles about sanitation issues amongst governmental organisations, and training in great detail the concept of ecosan, so that the participants can share and incorporate it in their sanitation planned activities.	
Day 1: Saturday, 7 May		
Time / Activity	Content	Presenter
8.30 – 8.45 9.00 – 9.30 Presentation 9.30 – 10.30 Presentation 10.30 – 11.00 11.00 – 13.00 Presentation 13.00 – 13.30 Discussion 13.30 – 14.15 14.15 – 15.45 Presentation 15.45 – 16.15 16.15 – 17.45 Discussion in groups	Introduction of participants Participant expectations and key questions The role and activities of the Water Resources Department in sanitation Assessment of the existing sanitation situation in Eritrea Tea break An introduction to ecological sanitation – concept, technologies and case studies The National sanitation framework (reponsibility) Who is involved in sanitation in Eritrea (ministries, departments etc.)? What co-operation exists between those responsible and what is needed? Lunch Agricultural aspects of ecological sanitation Health aspects of ecological sanitation Tea break Opportunities and obstacles for ecological sanitation – next steps in Eritrea: What steps are now needed for adoption on a national and individual level?	 WRD Local Consultant, GTZ GTZ, ecosan Program Participants GTZ, ecosan Program
Day 2: Sunday, 8 May		
Time / Activity	Content	Presenter
9.00 – 9.20 Presentation 9.20 – 9.40 Presentation 9.40 – 10.00 Presentation 10.00 – 11.00 Presentation 11.00 – 11.30 11.00 – 12.15 Closing session	Summary of day 1 Urban agriculture in Eritrea Public health and sanitation in Eritrea Planning for ecological sanitation Tea break Refer back to expectations and questions and check if they have been achieved. Summing up.	 Min. of Agriculture Min. of Public Health GTZ, ecosan Program

7.6 Example: Schedule of a 3-day ecosan symposium in Syria

The symposium on ecosan was organised by the Syrian order of engineers, the University of Damascus, and the GTZ for water professionals in 2005.

It gives a general introduction in ecosan, it draws on local experience, e.g. from wetlands designed to produce hygienic safe irrigation water from waste water, and includes a case study excursion.

The main objective of this symposium is the capacity building for ecological sanitation and the identification of further activities, which could be realized in order to implement ecosan projects in Syria and other countries of the region.

Table 14: Schedule of a 3-day ecosan symposium in Syria

Country	Syria	
Type of workshop (Name)	Ecological Sanitation Symposium	
Dates	11-13 December, 2005	
Place	Damascus, Syria	
Organizer	Order of Syrian Engineers and Architects (OSEA) and German Technical Cooperation (GTZ), University of Damascus	
Sponsor	GTZ- Water Programme and Order of Syrian Engineers and Architects (OSEA)	
No.participants	500	
Objective	Capacity building for ecological sanitation and identification of further activities for implementing ecosan projects in Syria and other Arab countries.	
Day 1 : Sunday, 11 December (Introduction and Syrian situation)		
Time / Activity	Content	Presenter
08:00 - 08:30	Registration	
08:30 – 09:00	Opening Ceremonies (Moderation Saad Ahmad, OSEA)	Mr. Hassan Majed Ali (OSEA); Prof. Wael Mualla (President of Damascus University) Mr. Volkmar Wenzel (Ambassador Germany)
09:00 – 09.20 Presentation	Syrian-German cooperation in the water sector	Mr. Harald Heidtmann (GTZ Syria)
09:20 – 09:40 Presentation	Future vision for the drinking water supply and sewage sector within the 10th five year investment plan	Dr. Kamal Al-Sheikha (MoHC)
09:40 – 10:00 Presentation	Water pollution and environmental situation in Syria	Mrs. Reem Abdrabo (MLAE)
10:00 – 10:30	Discussion	Mr. Saad Ahmed (OSEA)
10:30 – 11:00	Tea / Coffee break	
11:00 – 11:45 Presentation	Introduction to ecological sanitation	Mrs. Christine Werner (GTZ, Germany)
11:45 – 12:30 Presentation	Overview of ecosan technologies	Prof. Dr. Petter Jenssen (Norwegian University of Life Sciences)
12:30 – 14:00	Tea / Coffee break	
14:00 – 14:45 Presentation	Experiences from a one-year training course for the management of sewage treatment plants in Germany	Mr.Jamal Jarad Mr. Hesham Al-Fandi
14:45 –15:30 Presentation	International experiences in ecological sanitation / Project examples	Mrs.Christine Werner (GTZ, Germany)

[… continued]		
Day 2: Monday, 12 December (Experience Exchange)		
Time / Activity	Content	Presenter
08:30 - 08:45	Summary of the previous day and presentation of the present day	
08:45 - 09:30 Presentation	Present wastewater and reuse standard in Syria and practices	Mrs.Intesar Mardini (MoHC)
09:30 – 10:15 Presentation	International Guidelines WHO, FAO and Sweden: health and agriculture aspect	Mrs. Christine Werner (GTZ, Germany)
10:15 – 10:45	Tea / Coffee break	
10:45 – 11:30 Presentation	Anaerobic systems for biological treatment in ecological sanitation systems (ecosan) for biogas and fertilizer production	Mr.Michael Köttner (Int. Biogas and Bioenergy Centre of Competence)
11:30 – 12:15 Presentation	Demonstration of anaerobic technology for cost-effective municipal wastewater treatment and reuse - experience from Germany and Egypt	Dr. Walid Abdel-Halim (Housing and Building Nat. Res. Center, Inst. of Env. Eng., Cairo, Egypt)
12:15 – 13:00 Presentation	Constructed wetlands for the provision of irrigation water- and the production of regrowing raw products	Dr. Roland Müller (UFZ-Centre for Env. Research Leipzig/ Germany)
13:00 – 13:30	Tea / Coffee break	
13:30 – 14:15	Wastewater reuse experience in Jordan	Mr. Artur Vallentin (GTZ)
14:15 – 14:45 Presentation	Greywater treatment and reuse	Prof. Dr. Petter Jenssen (Norwegian Univ. LifeSc.)
14:45 – 15:30 Presentation	Reuse of greywater in the Kingdom of Saudi Arabia	Mr. Jäger (BIOCLEAN GmbH)
15:30 – 17:30	Lunch / or Dinner	
Day 3: Friday, 13 December		
Time / Activity	Content	Presenter
08:30 - 08:45	Summary of the previous day and presentation of the present day	
08:45 - 09:30 Presentation	German Association for Water, Wastewater and Waste (DWA)- standards, capacity building and networking	Mr. Roland Knitschky (DWA)
09:30 – 10:15 Presentation	Batch humification of sewage sludge in grass beds	Dr. Holger Pabsch (IPP,Hildesheim)
10:15 – 10:45 Presentation	Constructed wetlands – experiences from a pilot project in Syria	Dr. Abir Mohamed (MoHC, Syria)
10:45 – 11:15	Tea / Coffee break	
11:15 – 12:00 Presentation	Planning process of WWTP for small communities in Syria, overview of difficulties and solutions	Dr. George Zahr (Damascus University)
11:15 – 12:15 Discussion	Future developments	Mr. H. Heidtmann (GTZ); Dr. A. Mohamed (MoHC)
12:15 – 12:30	Closing remarks	Mr. Saad Ahmed
12:30 – 16:30 Excursion	Excursion to Haran Al-Awamied	Dr. Abir Mohamed (MoHC, Syria)

7.7 Example: Schedule of a 3-day ecosan workshop in Zambia

This 3-day workshop was meant as a first awareness raising and capacity building workshop for experts and decision-makers in water supply and sanitation in Zambia. At the same time, it served to support regional networking between ecosan initiatives and pilot projects in Southern African countries.

Table 15: Schedule of a 3-day ecosan workshop in Zambia

Country	Zambia	
Type of workshop (Name)	1st International Workshop on Ecological sanitation	
Dates	21-23 January, 2004	
Place	Lusaka, Zambia	
Organizer	GTZ-Lusaka and WASAZA	
Sponsor	GTZ-ecosan	
No. participants	n.a.	
Objective	To provide a forum for discussion on ecological sanitation among decision/policy makers, organisations and other donor agencies. The workshop will be the starting point for the promotion of ecological sanitation in Zambia.	
Day 1: Wednesday, 21 January (Introduction, official opening, pilot case studies, hygiene considerations)		
Time / Activity	Content	Presenter
08:00 – 09:00	Registration	
09:00 – 09:15	Introductions	Simataa Nakamboa (GKW Consult, Zambia)
09:15 – 10:00 Presentation	Overview of the National Environmental Sanitation Strategy	C. Mulambo (MLGH/DISS, Zambia)
10:00 – 10:45 Presentation	Toilets and Urban Agriculture infrastructure / Ethiopia	Gunder Edström (SUDEA, Ethiopia)
10:45 – 11:30 Presentation	Water-borne ecological sanitation technologies/ closing the loop on-site – experience in Lesotho	Mantopi Lebofa (DED, Lesotho)
11:30 – 12:00	Tea / Coffee break	
12:00 – 12:25 Presentation	Ecological sanitation concept – an introduction	Heinz-Peter Mang (GTZ-ecosan, Germany)
12:30 – 13:00	Official Opening Address	Levi Zulu (WASAZA, Germany) Martina Bergschneider (GTZ Country Director) Sylvia Masebo (Minister of Local Government and Housing, Zambia)
13:00-13:15	Ecological sanitation concept – an introduction cont'd after the speeches	Heinz-Peter Mang (GTZ-ecosan, Germany)
13:15 - 14:15	Lunch	
14:15 – 15:00 Presentation	Experiences in piloting ecosan projects in Zambia	Ernest Hamalila (WaterAid, Zambia)
15:00 – 15:45 Presentation 15:45 – 16:30 Presentation	"CBNRM-missing link"-piloting ecological sanitation in Botswana Institutional and implementation aspects of ecosan in Ouagadougou, Burkina Faso	Catherine Wirbelauer (IUCN, Botswana) Patrick Bracken (GTZ-ecosan, Germany)
16:30 – 17:00	Tea / Coffee Break	
17:00 – 17:45 Presentation	Diseases linked to poor sanitation and their prevention	Dr. M. Mbewe (UTH, Zambia)
17:45 – 18:30 Presentation	Health aspect of ecological sanitation	Aussie Austin (CSIR, South Africa)
18:30 – 20:00	Cocktails, discussion and open market space for ecological sanitation components – with invited companies	

[… continued]

Day 2: Thursday, 22 January (Overview of different aspects of ecosan)

Time / Activity	Content	Presenter
08:30 – 08:45	Summary of the previous day and presentation of the present day	Simataa Nakamboa (GKW Consult, Zambia)
08:45 – 09:30 Presentation	Urban ecological sanitation experiences in Uganda	Austin Ali Tushabe (Directorate of Water Development, Uganda)
09:30 – 10:15 Presentation	Effects of urban expansion on groundwater quality	H. Mpamba (Department of Water Affairs, Zambia)
10:15 – 10:45	Tea / Coffee break	
10:45 – 11:30 Presentation	Urban Integrated Sustainable Resource Management	Gert de Bruijne (WASTE –NL)
11:30 – 12:15 Presentation	Design of feasible ecological sanitation toilets	Aussie Austin (CSIR, South Africa)
12:15 – 13:00 Presentation	Selling the ideas and gender aspect of ecosan	Almaz Terrefe (SUDEA, Ethiopia)
13:00 – 14:00	Lunch	
14:00 – 14:30 Presentation	Agricultural aspects of ecological sanitation	Heinz-Peter Mang (GTZ-ecosan, Germany)
14:30 – 15:30 Presentation	Technical components for ecological sanitation systems - world-wide examples	Heinz-Peter Mang (GTZ-ecosan, Germany)
15:30 – 15:45 Group work	Introduction in group work	Simataa Nakamboa (GWK Consult, Zambia), Patrick Bracken (GTZ-ecosan, Germany), Catherine Wirbelauer (IUCN, Botswana)
15:45 – 16:15	Tea / Coffee Break	
16:15 – 18:00 Group discussions	Three themes	

Day 3: Friday, 23 January (The way forward for ecosan in Zambia)

Time / Activity	Content	Presenter
09:00 – 09:30	Summary of the previous day and presentation of the present day	Simataa Nakamboa (GWK Consult)
09:30 – 10:15 Presentation	Ecological sanitation in peri-urban areas – main opportunities and constraints	Brian Hangoma (SWSC)
10:15 – 10:45	Tea / Coffee break	
10:45 – 11:30 Presentation	The Regulator and issues of ecological sanitation	O. M. Chanda (NWASCO)
11:30 – 12:15 Presentation	The general way forward for ecological sanitation in Zambia	Pamela Chisanga (WaterAid Zambia)
12:15 – 13:00 Presentation from participants	Group presentation and Recommendations from workshop participants on ecological sanitation development in Zambia	Participants
13:00 – 14:00	Closing remarks	Heinz-Peter Mang (GTZ-ecosan, Germany) Gert de Bruijne (WASTE – NL) T. C. Chanda stood in for P. Lubambo (MLGH/DISS) Simataa Nakamboa (GKW Consult)

7.8 Example: Schedule of a 3-day ecosan workshop in Botswana

The Ecosan approach, tested by the IUCN-PTB "Missing Link" project (funded by GTZ) in Botswana consists of small-scale integrated natural resources management activities around the households and within the communities. The schedule presented below is from a workshop held in the frame of this project. It was held to present and discuss the results of the first phase of the project, and dicussed options for up-scaling ecosan on to the national level.

Table 16: Schedule of a 3-day ecosan workshop in Botswana

Country	Botswana	
Type of workshop (Name)	Awareness Raising Workshop on Ecological Sanitation	
Dates	2nd – 4th September, 2003	
Place	Maharaja, Gaborone, Botswana	
Organizer	IUCN, GTZ, DSWM	
Sponsor	IUCN, GTZ	
No.participants	48	
Objective	Awareness raising fort the ecosan concept; discussion of results from agricultural research and pilot activities and of potential for up-scaling	
Day 1: Tuesday, 2 September (Introduction and pilot case studies)		
Time / Activity	Content	Presenter
8:15 – 8:30	Registration	
8:30 – 8:45	Opening remarks/introductions	K.A. Selotlegeng (DSWM)
8:45 – 9:15 Presentation	Closed loop oriented wastewater and waste management	Heinz-Peter Mang (GTZ-ecosan, Germany)
9:15 – 10:00 Presentation	National Master Plan for Wastewater and Sanitation ("The Need for Integrated Sanitation Services")	Neil Mudge (SMEC International)
10:00 – 10:30	Tea / Coffee break	
10:30 – 10:55 Presentation	Effects of urban expansion on groundwater quality in Francistown	Benjamin Mafa (Geological Survey)
10:55 – 11:20 Presentation	Effects of urban expansion on groundwater quality in Ramotswa	Dr. Horst Vogel (Geological Survey)
11:20 – 11:45 Presentation	The CBNRM Missing Link – Piloting Ecological Sanitation in Botswana	Cathrine Wirbelauer (IUCN/DED, Botswana)
11:45 – 12:10 Presentation	Vacuum sewer system in Shoshong	Michael Buxton-Tetteh (CPP, Gaborone)
12:10 – 12:35 Presentation	Health and safety aspects of ecosan and excreta handling	Aussie Austin (CSIR, South Africa)
12:35 – 14:00	Lunch	
14:00 – 14:30 Presentation	Experiences in piloting composting toilets in Botswana	Gaba Moanakwene (RIIC)
14:30 – 15:00 Presentation	Example on water-borne closed loop sanitation systems in Maseru	Alice Leuta (DED, Lesotho)
15:00 – 15:30	Tea Break	
15:30 – 16:00 Presentation	Decentralised Wastewater Treatment Systems/CBS	Christopher Kellner (FEDINA-BORDA)
16:00 – 16:30 Presentation	Water saving devices and low flush technology	Johannes Selke (Orbit pumps/Roediger, Germany)
16:30 – 17:00	Design of ecosan systems and the urine	Aussie Austin

Presentation	diversion component	(CSIR, South Africa)
17:00 – 19:00	Cocktail discussion	
Day 2: Wednesday, 3 September (Experience Exchange)		
Time / Activity	Content	Presenter
8:30 – 8:45 Presentation	Summary of the previous day and presentation of the present day	Cathrine Wirbelauer (IUCN/DED, Botswana)
8:45 – 9:15 Presentation	Acceptance and awareness for ecological sanitation	Elisabeth-Maria Huba (GTZ-ecosan/ FRUXOTIC, Germany)
9:15 – 9:45 Presentation	Gardening and agriculture with ecosan subproducts	Tobias Hanke (GTZ-ecosan, Germany)
9:45 – 10:15 Presentation	Multiple strategies for ecological sanitation	Heinz-Peter Mang (GTZ-ecosan, Germany)
10:15 – 10:45	Tea / Coffee break	
10:45 – 12:30 Group work	Working Groups	Two or three groups
12:30 – 13:30	Lunch	
13:30 – 16:30 Excursion	Site visits to ecosan facilities around Gaborone (Kgatleng District)	DSWM/KDC
16:30 – 18:00 Exposition	Open market space for ecosan component companies from Botswana, SA, Swaziland and Germany	
Day 3: Thursday, 4 September (Introduction and pilot case studies)		
Time / Activity	Content	Presenter
8:30 – 8:45	Summary of the previous day and presentation of the present day	Cathrine Wirbelauer (IUCN/DED, Botswana)
8:45 – 10:00 Group work	Report back from the groups, Recommendations	Groups
10:00 – 10:30	Tea / Coffee break	
10:30 – 11:30 Presentation	Overview on technical components and worldwide strategies and Planning procedures for an ecosan project	Heinz-Peter Mang (GTZ-ecosan, Germany)
11:30 – 12:00 Presentation	National Master Plan for Wastewater and Sanitation: “On-site Sanitation-The Way Forward”	Neil Mudge (SMEC International)
12:00 – 12:30 Presentation	General Way Forward for ecological sanitation in Botswana	Kentlafetse Mokokwe (DSWM/IUCN)
12:30 – 12:45	Closing remarks	Rapelang Mojaphoko (UNDP)
13:00 – 14:00	Lunch	

7.9 Example: Schedule of a 4-day ecosan workshop in El Salvador

This is an example of a 4-day ecosan workshop organized by Oikos and WASTE in co-operation with GTZ and others to consolidate the link between organisations, which have realized ecosan projects and activities in Latin-America.

The programme was designed to expose each day different components of an ecosan system so those, which are not familiarized with the topic, could get a clear idea about the principles of ecological sanitation and the problems of conventional systems. It combined expositions about experiences in ecosan and practical exercises.

Table 17: Schedule of a 4-day ecosan workshop in El Salvador

Country	El Salvador	
Type of workshop (Name)	Ecological Sanitation Workshop (Taller de Saneamiento Ecológico)	
Dates	27-31 October, 2003	
Place	El Tránsito, El Salvador	
Organizer	WASTE and Oikos	
Sponsor	WASTE, Cordaid, GTZ and UNDP	
No.participants	42	
Objective	Introduce formal knowledge about the importance of sustainable and ecological sanitation, the exchange of experiences and interests and the creation of alliances and compromises between the participants on developing specific actions in the region.	
Day 1: Monday, 27 October		
Time / Activity	Content	Presenter
Presentation	Participatory diagnosis on ecological sanitation	Alberto Isunza Ogazón (Mexico)
Presentation	Some principles and questions on ecological sanitation	Gert de Bruijne (WASTE)
Presentation	Ecological sanitation in intervention areas	Vicente Hernández (OIKOS)
Presentation	Situation of the environmental health in El Salvador	Herbert Aparicio (Ministry of Health of El Salvador)
Presentation	Presentation on the present situation of standards on latrines	Jorge Soto
Day 2: Tuesday, 28 October		
Time / Activity	Content	Presenter
Presentation	Environmental Sanitation and Health	Alberto Isunza Ogazón
Presentation	Evaluation of the fertilizing family solar latrines (LAFS) in El Salvador	Christine Moe/ R. Izurieta
Presentation	Latrinisation and parasite infections in rural areas in El Salvador	Lana Corrales
Day 3: Wednesday, 29 October		
Time / Activity	Content	Aim / Presenter
Presentation	Cultural and gender aspects in ecological sanitation	Silvia Diaz Urdanivia
Presentation	Improvement of the nutritional security and sanitation in peri-urban areas: City of Pachacutec Ventanilla - Peru	Oswaldo Cáceres L
Presentation	Nutrients recycling 1 & 2	Francisco Arroyo
Presentation	Holistic and Sustainable Management of Waste - Acepesa - UWEP	Victoria Rudin
Presentation	Implementation of approaches on ecological sanitation aspects in Cuba	Viviana Avendaño
Presentation	Experiences on the introduction of the ecological sanitation concept in Ecuador	Jenny Aragundi
Presentation	The integrated microsystem of alternative sanitation, Ecodess, an ecological sanitation instrument in Lima - Perú	Juan Carlos Calizaza (Peru)
Presentation	Experiences and projects of the GTZ	Heinz-Peter Mang (Germany)

Day 4:

Time / Activity	Content	Aim / Presenter
Presentation	Tepoz-Eco- pilot project on urban ecological sanitation for the municipality of Tepoztlán	Ron Sawyer (Mexico)
Presentation	Feasibility study in the archipelago of San Andrés, Providencia and Santa Catalina	Patrick Newball

Other activities taking place during the four-day workshop

Time / Activity	Content	Presenter
Exercise	Sanitation Ladder	Ron Sawyer and participants
Exercise	Groups to be interviewed and question guide	
Exercise	Guidelines for solar latrines with urine separation These guidelines are taken from the project developed in Palestina by the Palestinian Hydrology group (PHG)	
Exercise	Decision Tree This tree or decision diagram was developed by the Ministry of Health from El Salvador within the project of norms for latrines	
Exercise	Health Educational Model and Environmental Sanitation in the community and schools in El Salvador – Educational Methodology SARAR.	Ministry of Public Health and Social Security of El Salvador
Exercise	General Questionnaire for Sanitation Practical Questionnaire, which can be used to evaluate the current situation of the sanitation and water system in the population	
Contribution of participants	Aspects to consider or to use to generate public awareness	J.Carlos Calizaya/Patrick Newball
Contribution of participants	Aspects which should be included in a presentation on ecological sanitation	Oscar Murga
Contribution of participants	Presentation on Environmental Awareness	Patrick Newball
Discussion	Diagnosis on sanitation- field trip	Alberto Isunza (Mexico)
Discussion	Revison on the Ecological Santitation Concept	Viviana Avendano and Jenny Aragundi/ Participants
Discussion	MISD (Holistic and Sustainable Management of waste)	Participants
Discussion	Regional Cooperation – Network Forum	
Discussion	Particular discussions (30-31 October)	
Discussion	Comments on presentations 1 and 2	
Drawing contest	The Environment and I	OIKOS and WASTE

7.10 Example: Schedule of a 2-day ecosan workshop in Turkey

This 2-day workshop took place in early 2004 in Turkey in the frame of an erosion control and desertification programme in collaboration between German and Turkish institutions.
The aim of this workshop was to introduce the assistants to decentralised sanitation and ecological sanitation, in order to analyse the possibilities of the sustainable use water, wastewater and nutrients. The programme included as well an introduction to constructed wetlands and biogas generated from agricultural residues.

Table 18: Schedule of a 2-day ecosan workshop in Turkey

Country	Turkey	
Type of workshop (Name)	Wastewater Management and Nutrients Recovery in rural areas in Turkey	
Dates	14-15 February, 2004	
Place	Ankara, Turkey	
Organizer	TEMA, GTZ	
Sponsor	GTZ	
No.participants	80	
Objective	Introducing ecological sanitation including the sustainable use of wastewater, nutrients and agricultural residues into the turkish-german programm of erosion control and disertification in Turkey.	
Day 1: morning, Saturday, 14 February (Overview Presentations)		
Time / Activity	Content	Presenter
09:00 – 09:45	Opening	Köy Hizmetleri TEMA GTZ
09:45 – 10:15 Presentation	Overview of the wastewater system in rural areas in Turkey	Prof. Dr. Celal Ferdi Gökcay (Middle East Technical University)
10:15 – 10:30	Discussion	
10:30 – 11:00	Break	
11:00 – 11:25 Presentation	Natural Wastewater Treatment Systems	
11:25 – 11:30	Questions – Answers	
11:30 – 11:55 Presentation	Wastewater Management and Nutrients cycle in rural areas	Michael Köttner (IBBK)
11:55 – 12:00	Questions – Answers	
12:00 – 12:25 Presentation	Nutrients' Close Cycle: The Ecosan Concept	Christine Werner (GTZ – ecosan, Germany)
12:25 – 12:45	Discussion	
12:45 – 14:00	Lunch Break	
Day 1: afternoon, Saturday, 14 February (Goals and legal framework)		
Time / Activity	Content	Presenter
14:00 – 14:20 Presentation	Legal Framework in Turkey: The actual situation and the necessary modifications	Fevzi Isbilir Cevre Yonetimi Genel Müdür Yardimcisi (Representative of the General directive for Environmental Management of the Ministry of the Environment and Forestry)
14:20 – 14:30	Discussion	

14:30 – 14:50 Presentation	The legal framework of Wastewater Management in Germany	Wolfgang Holleis (Regional Authority for Water Pollution Control of Bavaria, Germany)
14:50 – 15:00	Discussion	
15:00 – 15:20 Presentation	Qualification of municipal services in the wastewater field	Dieter Blome (GTZ- Project "Qualification of municipal services")
15:20 – 15:30	Discussion	
15:30 – 16:00	Break	
16:00 – 16:20 Presentation	Conditions for a successful implementation of a decentralized wastewater system	Johannes Biener
16:20 – 16:30	Discussion	
16:30 – 16:50 Presentation	Canalisation system in rural areas	Istanbul Technical University, Turkey
16:50 – 17:00	Discussion	

Day 2: morning, Sunday, 15 February (Technical Solution Approaches)

Time / Activity	Content	Presenter
09:00 – 09:20 Presentation	Low-cost solutions in Turkey: Proposals for the Bayburt-Project	Prof. Dr. Omer Saygin (Bosphorus University, Turkey)
09:20 – 09:30	Discussion	
09:30 – 09:50 Presentation	Adequate alternatives for the clarification of wastewater in rural areas	Vahap Balman Nava (ING, Turkey)
09:50 – 10:00	Discussion	
10:00 – 10:15		
10:15 – 10:30 Presentation	Wastewater clarification in wet areas	Dr. Kemal Günes (Marmara Research Center, TÜBITAK, Turkey)
10:30 – 10:45	Discussion	
10:45 – 11:15	Break	
11:15 – 11:30 Presentation	Anaerobic Systems and Biogas	Prof. Dr. Izzet Öztürk (Istanbul Technical University, Turkey)
11:30 – 11:40	Discussion	
11:40 – 11:55 Presentation	One-tank wastewater treatment plants: The Sequencing Batch Reactor	Ralf Weber (Fa. Biogest)
11:55 – 12:00	Discussion	
12:00 – 12:15 Presentation	Reuse of sludge as a fertilizer in agriculture	Nesteren Bilgrin (Research Institute of the Department of Provision of Rural Services, Turkey)
12:15 – 12:20	Discussion	
12:20 – 12:35		
12:35 – 12:40	Discussion	

Day 2: afternoon, Sunday, 15 February (Development of the project)

Time / Activity	Content	Presenter
12:40 – 12:55	Total Village System	Jason Gondron (Global Water INC.)
12:55 – 13:00	Discussion	
13:00 – 14:00	Lunch Break	
14:00 – 14:20 Presentation	Possibilities of support of the Iller-Bank in rural areas in Turkey	Figen Ildir (Iller Bankasi, Turkey)
14:20 – 14:30	Discussion	
14:30 – 14:50	Break	

14:50 – 15:00 Presentation	The activities of the "Kreditanstalt für Wiederbau" (KfW) in the wastewater field in Turkey	Burghard Hinz (German Development Bank, KfW, Germany)
15:00 – 15:15	Discussion	
15:15 – 17:00 Discussion	Working Group Project Development (Wastewater Management, based on the aproaches of the Bayburt-project)	Discussion coordination and moderator: Dr. Hartlieb Euler

7.11 Example: 2-day workshop held in the frame of an Indian ecosan network

A series of regional workshops has been organised by the Innovative Ecological Sanitation Project India (IESNI) with support from Norway, Sweden, the Netherlands, Switzerland and Germany aiming at introducing ecological sanitation, initialising pilot projects, and supporting capacity building and networking in ecological sanitation in India.

The following table shows the schedule of one of these workshops.

Table 19: Schedule of a 2-day ecosan workshop in India

Country	India	
Type of workshop (Name)	2nd Workshop on Ecological Sanitation	
Dates	1-2 March, 2005	
Place	Pune, India	
Organizer	Innovative Ecological Sanitation Network India (IESNI) in cooperation with GTZ	
Sponsor	GTZ	
No.participants	80	
Objective	Introducing ecological sanitation, initialising pilot projects and supporting capacity building and networking in ecological sanitation in India.	
Day 1: Tuesday, 1 March		
Time / Activity	Content	Presenter
10.00-12.00 Presentation	Introductory general overview about ecosan	H. Bartels/C. Werner and IESNI (Mr. Patankar)
13.30-16.00	Status reports about ongoing IESNI projects	
Presentation	- Bangalore project	K. Gnanakan (ACTS, India)
Presentation	- DSK/Navsarjan project	M. Mcwan (Navsarjan project, India)
Presentation	- Khopoli/Nagpur project	M. Wafler (GTZ, India)
16.30-18.30	Information panel about other ongoing and upcoming activities	
Presentation	GoI Total Sanitation Campaign etc.	GoI-Representative
Presentation	Linking with Sulabh India	Sulabh-Representative
Presentation	Mumbai project idea	ACTS – Rotary Mumbai Rotary-member
Presentation	Chennai project idea	IIT-Representative
Presentation	Water for Billions	C. Werner (GTZ-ecosan, Germany)
Presentation	Reconstruction in South India	K. Gnanakan (ACTS, India)
Presentation	BMBF/Megacity	C. Werner (GTZ-ecosan, Germany)

Presentation	UNICEF School Projects	Unicef Representative
Presentation	Trivandrum Projects	P. Calvert
	Further	WB, EU, WASTE, BORDA, SIDA, Gramalya, etc.
Day 2:2nd of March, 2005		
Time / Activity	Content	Presenter
08.30-10.30	Presentation and Discussion of several Aspects of Relevance	
Presentation	Guideline for agricultural use of ecosan products	B. Vinneras (SLU, Sweden)
Presentation	Nitrogen based hygenization	B.Vinneras (SLU, Sweden)
Presentation	Vermicomposting	GoM Agri Dept.-Representative
Presentation	Vacuum technology	U. Mosel (GTZ)
Presentation	Development of Urine Separation Squatting Toilet	Moderator
	Further	
11.00-12.30	Communication and Information	
Presentation	Introduction to myNetWorks	J. Heeb (SEECON, Switzerland)
Presentation	E-Learning on ecosan with Bangladesh	H. Bartels (GTZ, India)
Presentation	ecosan courses and local networking aspects (website, etc)	J. Heeb (SEECON, Switzerland)
Presentation	Information/awareness campaign	Mr Patankar/ Sulabh-Representative
Presentation	SIDA funded ecosan course in India	SIDA-Representative
Presentation	Durban ecosan conference	C. Werner (GTZ ecosan, Germany)
14.00-16.00	Planning next Steps, “to do’s”	

7.12 Example: Expert meetings held in the Netherlands on a shift in the sanitation paradigm

In January – March 2005, a total of four expert meetings were held to discuss the relationship between sustainable sanitation and integrated urban planning. During these meetings, Dutch participants from various professions were encouraged to look beyond the boundaries of their discipline and the borders of the Netherlands. Their observations lead to a critical evaluation of the sustainability of current sanitation systems and to a series of recommendations to ensure the implementation of sustainable and efficient approaches now and in the future.

“At the End of the pipe” aimed to accelerate the policy dialogue in the Netherlands towards the adoption of integrated urban sanitation planning, a strategic approach, which should enable a more effective response to the current environmental challenges facing decision-makers. The programme also sought to develop a number of concrete proposals for increasing the sustainability of sanitation provision to present to the 13th CSD meeting in New York in April 2005.

“At the End of the pipe” consisted of three closed informal discussion meetings and concluded with one public debate. The informal meetings each highlighted one element of sanitation systems. The first informal discussion meeting focussed on planning and demand, the second meeting on management, while the last meeting focussed on resource management of human excreta. The public

debate expanded upon the ideas and statements that were generated during the informal discussion meetings and prioritised the actions and measures identified.

The series of expert meetings and the public debate, offer an example of how to accelerate the policy dialogue to move towards an integrated approach to urban sanitation planning which responds to current environmental challenges.

Full documentation of the workshop and its results is available online (www.ecosan.nl). The proceedings and all presentations given during the meetings can be downloaded from this website as pdf-files. Below an overview is given on the programmes of the expert meetings and public debate.

Table 20: programme expert meetings

Country	The Netherlands
Type of workshop (Name)	"At the End of the Pipe" expert meetings held in the Netherlands on a shift in the sanitation paradigm
Dates	January – March , 2005
Place	The Hague
Organizer	WASTE
Contributions by	NCDO, Habitat Platform, Netherlands Water Partnership (NWP) and Partners for Water-
No.participants	65
Objective	• To evaluate existing sanitation systems as part of urban environmental infrastructure in the Netherlands • To bring different sectors and stakeholders together and evaluate existing sanitation approaches as part of urban environmental infrastructure. • To exchange and compare experiences in the development and management of sanitation facilities between developing countries and the Netherlands. • To familiarise stakeholders with the social, environmental, institutional, legal, and financial aspects of sustainable sanitation approaches developed outside the Netherlands. • To accelerate the policy dialogue in the Netherlands and to move towards an integrated approach to urban sanitation planning which responds to current environmental challenges. • To discuss current sanitation problems from the point of view of worldwide sanitation demand, management and resource recovery in order to formulate concrete recommendations about required initiatives and stakeholders that need to participate in these initiatives. Programme recommendations include recommendations for policy makers at the 13th session of the Commission for Sustainable Development (CSD-13) and recommendations for actions needed for the implementation of the goals of the European Union Water Frame Directive ('Europese Kaderrichtlijn Water').

[… continued]	
Thursday, 20 January	**Meeting 1: Problems with sanitation planning**
Time / Location	Content
9.30 - 12.00 VROM, The Hague	The problems, policy and developments with respect to sanitation in the Netherlands as well as in South Africa and Kenya (city of Nakuru) – will be presented. Special attention is given to the social aspects of the transformation towards sustainable sanitation planning
	Participants
	Host: Ton Boon von Ochssee invited – Dutch Ambassador for Sustainable Development, Ministry of Foreign Affairs Moderator: André Frijters – Board member of WASTE; Directorate-general for Public Works and Water Management from the Dutch Ministry of Transport and Public Works Speakers: Harm Baten – Water Control Board district Rijnland, the Netherlands Adriaan Mels – Lettinga Associates Foundation, the Netherlands Aussie Austin – CSIR Building and Construction Technology, South Africa Moses Ochola Otieno – WASTE-IHE, Nakuru
Thursday, 27 January	**Meeting 2: Municipal management of sanitation systems**
Time / Location	Content
9.30 - 12.00 Partners for Water, The Hague	Insight is given how cities in Germany, India and the Philippines are dealing with problems of current sanitation systems with respect to management of human excreta in the context of urban development
	Participants
	Host: Wouter J. Veening, Director Institute for Environmental Security Moderator: Ron Spreekmeester, Habitat Platform Speakers: Harald Hiessl – Fraunhofer ISI, Germany Anton Peter-Fröhlich – Berliner Wasserbetriebe, Germany Viju James - Pragmatix Research & Advisory Services Pvt. Ltd., India Dan Lapid – CAPS-Centre for Advanced Philippine Studies, the Philippines
Thursday, 3 February	**Meeting 3: Treatment and resource management**
Time / Location	Content
9.30 - 12.00 LNV, The Hague	What motivates Sweden and China (Guangxi) to search for sanitation options in which resource management is one of the key words? How to deal with safety issues and recycling issues in agriculture?
	Participants
	Host: René van Veenhuizen, ETC-UA (ETC-Foundation, Urban Agriculture Programme) Moderator: Jaap Warners – Amongst others former council of Environment from the city of Gouda, and chairman of the Task Force Wind Energy Speakers: Pascal Karlsson – Municipality of Göteborg, Sweden Lin Jiang – Guangxi Committee JiuSan Society, China Caroline Schönning – Swedisch Institute for Infections Disease Control, Sweden

Table 21: programme public debate

Country	The Netherlands	
Type of workshop (Name)	"At the End of the Pipe" Programme public debate "Are we connected?"	
Dates	3. March 2005	
Place	Habitat Platform – VNG, Nassaulaan 12, The Hague	
Organizer	WASTE	
Contribuions by	NCDO, Habitat Platform, Netherlands Water Partnership (NWP) and Partners for Water	
No.participants	40	
Objective	• Bringing different sectors and stakeholders together and evaluating the existing sanitation approaches as part of the urban environmental infrastructure. • To exchange experiences with sanitation options in developing countries and in the Netherlands. • To discuss the main sanitation problems from a point of view of sanitation demand, management and resource recovery worldwide in order to formulate concrete recommendations towards required initiatives and identified actors. The recommendations include among others recommendations for policy makers at the 13th session of the Commission for Sustainable Development in order to achieve the Millennium Development Goals (MDG's) and recommendations for actions needed for the implementation of the goals set in the Water policy in the European Union ('Europese Kaderrichtlijn Water').	
Moderator: Ron Spreekmeester – Habitat Platform		
Time / Activity	Content	Presenter / Participants
14.00 Opening	Presentation of the background and the objectives of the debate	Gert de Bruijne, WASTE
14.10 Opening speech	Introduction on the subject from international and national perspective	Joep Bijlmer, DGIS, Dutch Ministry of Foreign Affairs
14.20 – 16.00 Presentations	Sharing of sanitation experiences between North – South	
14.20	Demand for improved sanitation: Insight in the sanitation demand in the Ukraine	Anna Tsvetkova, Mama 86, Ukraine
14.45	Management of sanitation systems: Case from Mexico which elaborates on decentralisation of management of sanitation in relation to decentralisation of the functioning of sanitation systems	Ron Sawyer, Sarar Transformación SC, Mexico
15.10	Management of resources in sanitation systems: Insight in the global nutrient balance focussing on the geopolitics of phosphorous	Arno Rosemarin, Stockholm Environment Institute, Sweden
15.35 Break		
16.00 Plenary discussion	Main obstacles and successes for a transition towards sustainable sanitation approaches	plenary
16.45 - 17.30	Recommended actions	
16.45 Working groups	Prioritisation of formulated concrete actions: Prioritisation of actions in order to come to up scaling of sustainable sanitation approaches	

	(recommendations for CSD 13 and implementation of European Water Policy)	
17.15	Break	
17.30 Judgement by the jury of the considered most relevant actions	Presenting the results of the prioritisation by the working groups and remark on this result by the jury	Jury: Ralf Otterpohl (Chair), Hamburg University of Technology, Germany Anna Tsvetkova, Mama 86, Ukraine Ron Sawyer, Sarar Transformación SC, Mexico Arno Rosemarin, Stockholm Environment Institute, Sweden
18.00 Closing	Closing and follow-up of the meeting	Joep Bijlmer, DGIS, Dutch Ministry of Foreign Affairs
18.15	Informal Reception	

7.13 Example: Schedule of an ecosan e-course

The internet has a high potential for capacity building and e-learning becomes more and more important for distributing innovative knowledge. Use of the internet allows reaching people all over the globe without costs for travelling. It allows pupils to do their individual tasks in their home environment and in their rhythm. In several of the courses presented in this Annex, distance learning is part of the preparatory phase, which is then followed by a face to face phase. However, the below given schedule is an example for a five day e-courses on ecosan.

Table 22: Schedule of a 5-day e-course on ecosan

Day 1: Monday, 6 December, 2004 (Ecosan - Concept)		
Day- Place/Tool	Activity/Material	Tutors
12:00 to 12:30 Classroom	Welcome chat Material: Manual of myNetWork	Johannes Heeb and Marieke Slob
12:30 to 13:30 Classroom	Chat on the concept of ecosan Material: Read course material for course 1	Johannes Heeb and Christine Werner
Discussion-forum ecosan-concept	Starting up discussion-forum ecosan-concept	
Day 2: Tuesday, 7 December, 2004 (Ecosan -Tools and Experiences)		
Day- Place/Tool	Activity/Material	Tutors
12:00 to 13:00 Classroom	Chat on the ecosan tools and experiences Material: Read course material for course 2	Johannes Heeb and Petter Jennsen
13:00to 13:30 Classroom Talk	Introduction to assignments Material: assignment.doc	Johannes Heeb and Marieke Slob
Discussion-forum tools and experiences	Starting up discussion-forum ecosan tools and experiences	
Day 3: Wednesday, 8 December 2004 (Ecosan - Health and Security, Agricultural and Social Aspects)		
Day- Place/Tool	Activity/Material	Tutors
12:00 to 13:30 Classroom Talk	Chat on the specific ecosan aspects Material: Read course material for course	Johannes Heeb and Ken Gnanakan
Discussion-forum health and security, agricultural and social	Starting up discussion-forum health and security, agricultural and social aspects	

aspects		
Day 4: Thursday, 9 December, 2004 (Aquaculture Day)		
Day- Place/Tool	Activity/Material	Tutors
12:00 to 13:00 Classroom Talk	Chat on the ecosan tools Material: Read course material for course 4	BB Jana and crew
Discussion-forum aquaculture	Starting up discussion-forums aquaculture	
Day 5: Friday, 10 December, 2004 (Ecosan - Summing up, Assignments)		
Day- Place/Tool	Activity/Material	Tutors
12:00 – 13:00 Classroom Talk	Summing up, discussion of open questions and assignments Material: Read course material for course 5	Johannes Heeb and Merieke Slob
13:00 – 13:30	Good bye chat	Johannes Heeb and Merieke Slob

7.14 Example: General set of interactive modules produced for teaching ecosan, including PowerPoint-presentations

A SDC (Swiss Agency for Development and Cooperation) funded project has been undertaken with the aim to process the available ecosan material, to present it in a professional way, and to structure the knowledge into modules.

Target groups of the resulting materials are:
- University and college teachers and students
- Planners, architects, engineers, investors
- Decision making bodies such as communities, public administration, NGOs, development cooperation etc.

Each module consists of:
- Power-Point Files which can be used as independent tutorials for students (e-learning courses, independent study etc.). They contain explanatory text, images, links, further reading material. The files themselves are linked to further reading material as well as other resource material (see below). Navigation inside the modules and inter-linkages are accessible with the help of buttons.
- Power-point Presentations which can be used as ready-made and adaptable lectures
- Further readings (state of the art literature)
- Videos (if available)
- Links to relevant institutions, programs, websites, etc.
- Exercises
- Assignments
- Furthermore, there is a comprehensive link list to ecosan relevant websites.

Knowledge Based on:
- Existing training experiences and training material of authors and other experts
- State of the art literature
- Existing expert knowledge
- Evaluated case study based experience
- Further material (Videos, product information, etc.)

The training material can be used for face to face courses and e-learning (2-3 credit points).

In the tables below is given a general overview on all modules and a more detailed example of the content of on sub-module.

Table 23: Content of integrated ecosan training material - overview

Module	Name	Goal
M1	Water and Sanitation in Regard to the Millennium Development Goals	Clarifying the relevance of sustainable sanitation options in relation to the Millennium Development Goals.
M2	Overview of Household and Community Based Sanitation and Wastewater Treatment Systems	Providing an overview about sanitation systems: toilet systems, collection systems, treatment systems and reuse systems are described to give readers an overview
M3	ecosan - an Approach to Human Dignity, Health and Food Security	Clarifying the role of ecosan in closing nutrient and water loops, improving community health and human dignity and thus acting as an essential promoter for development.
M4	ecosan Systems and Technology Components	Providing an overview about individual ecosan technology components and the referring technical, operational and biological processes. Clarifying advantages and disadvantages of each system depending on the enabling environment and context.
M5	Management: Planning, implement-ation and operation	Providing basic knowledge for a successful planning and implementation of ecosan projects; covering socio-cultural aspects; gender aspects; institutional aspects and options; economic aspects and options; health, hygiene and education; awareness building and monitoring; agricultural aspects and options.
M6	Case studies (India, Africa, Central America, China)	Providing a set of good practices examples reflecting the content of M1-5.

Table 24 below shows the structure of one of the sub-modules of M5 (Management, Planning, implementation and operation). In the second row, the subchapters of the modules are specified; the third row gives a selection of the resource materials used for this Module.

Table 24: Content of integrated ecosan training material – example gender aspects

Module 5-3	Subchapters:	Selection of Used Resource Material (not complete)
Gender aspects	Gender Perspectives on Ecological Sanitation Urban Agriculture and Women Gender Issues in Latrine Design Management Roles Involvement in Decision Making Processes Sanitation and Education Gender Mainstreaming in Community Water & Sanitation Projects Gender Mainstreaming in Community Water & Sanitation Projects Making Gender Roles Visible The way forward	• Bolt, E. (1994): Together for Water and Sanitation: Tools to Apply a Gender Approachc. IRC • Brikke, F. (2000): Operation and Maintenance of rural water supply and sanitation systems. WHO, IRC. • Gender and Water Alliance GWA: "Sidestream or Mainstream? Making all water uses the business of women and men". • Gender and Water Alliance GWA: Advocacy manual for Gender & Water Ambassadors. • Gender and Water Alliance GWA (2002): The Gender Approach to Water Management. Lessons Learnt Around the Globe. Findings of an electronic converence series convened by the Gender and Water Alliance. January – September 2002. Available at: http://www.genderandwateralliance.org/english/advocacy.asp • Gender and Water Alliance GWA (2003): The Gender and Water Development Report 2003. Gender Perspectives on Policies in the Water Sector. Gender and Water Alliance, Delft, Netherlands. • Hannan, C. & Andersson, I. (no year): Gender Perspectives on Ecological Sanitation. Available at: www.undp.org/water/docs/gen_eco_san_chi.doc • IRC: Gender in Water Resources Management, Water Supply and Sanitation • SDC (2004): GENDER & TRAINING Mainstreaming gender equality and the planning, realisation and evaluation of training programmes. http://www.deza.admin.ch/ressources/deza_product_en_1519.pdf • UN Water Policy Brief 2: Gender, Water and Sanitation. A Policy Brief. • United Nations Development Programme UNDP: Mainstreaming Gender in Water Management. A Practical Journey to Sustainability: A Resource Guide. Available at: http://www.undp.org/water/docs/resource_guide.pdf **Internet links:** • Gender and Water Alliance: http://www.genderandwateralliance.org/english/ • UN Habitat Gender Analysis Tool http://www.unhabitat.org/cdrom/governance/html/yellop25.htm • IRC International Water and Sanitation Centre http://www.irc.nl/

7.15 Example: ecosan as part of a M.Sc. curriculum for students of environmental science and engineering at the University of Science and Technology Beijing, China

Here an example of the ecosan part of a M.Sc. curriculum for Students of environmental science and engineering at the University of Science and Technology Beijing, China is given. The full program for master studies has a duration of five semesters. The ecosan part, as elective course, is given in the 2nd semester as weekly activity of 2 hours and has a total duration of 30 hours. Along with the course a related text book is being prepared for the students. The course includes an exam and runs for the first time in 2006.

Table 25: ecosan curriculum description

1.	History of sanitation and sewerage system development (1 hour)
2.	Conventional sanitation and sewerage system (2 hours)
2.1	Problems of conventional sewerage system (1 hour)
2.2	Possible solution (1 hour)
3.	Water and environmental problems in the world (2 hours)
4.	Alternative concept - ecosan (2 hours)
4.1	Principals and advantages of ecosan
4.2	Development and approaches for ecosan
4.3	ecosan for developing and emerging countries, countries in transition, and developed countries
5.	ecosan Technologies (8 hours)
5.1	Types of toilet
5.2	Collection system
5.3	Treatment system
5.4	Purposes for reuse
6.	Case study (4 hours)
6.1	Rural or underdeveloped areas
6.2	Suburban areas
6.3	Urban areas
6.4	Holiday spaces, public buildings
6.5	School & public toilets
7.	Financial and economic aspects (2 hours)
8.	Environmental and health risk assessment (4 hours)
9.	Socio-cultural aspects (2 hours)
10.	Policy and legal aspects of ecosan (2 hours)
11.	Discussions (1 hour)

7.16 Example: Description of a 1 week ecosan course in China for alumni

This course is an example provided by UNESCO-IHE Institute for Water Education for a training course that was funded by the Dutch fellowship programme Nuffic (www.nuffic.nl). The course was offered in September 2005 to alumni from UNESCO-IHE who live and work in Asia. These types of courses are called “refresher courses” by Nuffic because they are meant to refresh and bring up to date the knowledge that the participants gained while they completed their MSc degree at UNESCO-IHE with funding from the Dutch government (in Environmental Science and Technology, Water and Environmental Resources Management, Municipal Water Infrastructure, Sanitary Engineering). These alumni graduated several years ago (MEng or MSc degree) and have reached senior positions by now.

The course brochure describes the aims and objectives of the course as follows:

“The aim of this course is to provide active water managers from Asia with new views and insights of sustainable sanitation concepts and re-use of water and nutrients in a multi-disciplinary, multi-stakeholder setting. The general objective of this Refresher Course is to provide theoretical background and practical expertise in the field of ecosan, and to explain in some detail the closed-loop nature of this approach (including reuse and energy recovery aspects). The specific objectives of this course are to:

- Familiarise the participants with ecosan principles, which should be considered in all aspects of planning of sanitation systems;
- Enable the participant to make a first assessment of a given situation and to be familiar with the wide range of options that need to be considered;
- Provide tools to the participant so that he/she can make an in-depth assessment of the sanitation needs of a community or commercial facility and develop recommendations for appropriate technologyand systems;
- Encourage longer-term collaboration among resource managers using internet-based knowledge platforms and the formation of a Community of Practice (CoP).”

The course consisted of one week of face-to-face teaching in Nanjing, China (the local counterpart was Hohai University), preceded by six weeks of preparation by the participants in a distance-learning mode. Details for the content of both phases are provided in Table 26 and 27.

Table 26: Schedule for home country preparation for the ecosan alumni course in Nanjing China (Hohai University)

Schedule for preparatory phase in home countries (6 weeks, using the internet)	
Week	Activity
1	Registration to the platform Instructions about the use of the platform
2	Participants introduce themselves by providing a short CV and information about employer and about their work responsibilities
3	Preparation of a short powerpoint presentation (10 slides) to describe current sanitation situation in home region (issues and challenges)
4	Continuation of preparation of powerpoint presentation
5	Continuation of preparation of powerpoint presentation (if possible: describe ecosan activities in the home region, if known)
6	Continuation and finalisation of the presentation Presentation will be published on the platform

Table 27: Schedule for 6-day ecosan alumni course in Nanjing China (Hohai University)

Schedule for 6-day course in Nanjing China (Hohai University)	
Day	Activity
1	Registration, opening, workshop introduction Overview of sanitation issues and options Introduction to relevant Millennium Development Goals Conventional sanitation versus ecosan Nutrient cycles Welcome reception: staff, participants, resource persons
2	Technologies that can form part of ecosan concept: • Toilet devices (dry/wet, urine diversion, no diversion) • Anaerobic digestion, energy recovery • Composting • Constructed wetlands • Others Time for preparations of country presentations
3	Reuse of greywater and of nutrients in agriculture Closing nutrient cycles Ecosan in urban, rural and per-urban settings Introduction to case study Country presentations Use of the internet, platform, alumni facilities etc.
4	Case study: field trip Eco-city in Changzhou (decentralised wastewater treatment) Country presentations
5	Discussions from field trip Social and legal aspects Health risks and hygiene education Exercise: application of ecosan concept to participant's home region Preparation for reporting on exercise
6	Reporting by participants about exercise outcomes, followed by group discussion Evaluation and closing, farewell dinner

7.17 Example: Introducing ecosan concepts into a M.Sc. programme

In the following, one example is provided from UNESCO-IHE (The Netherlands) a post-graduate educational institution, which operates with the following mandate:

- Strengthen and mobilise the global educational and knowledge base for integrated water resources management; and
- Contribute to meeting the water-related capacity building needs of the developing countries and countries in transition.

Within this mandate the mission is defined as follows:
The mission of the Institute is to contribute to the education and training of professionals and to build the capacity of sector organisations, knowledge centres and other institutions active in the fields of water, the environment and infrastructure, in developing countries and countries in transition.

To achieve this mission, the institute teaches mid-career professionals from developing countries and countries in transition in five different MSc programmes (all connection to the study field of "water"). As an example, we now look at the MSc programme called "Municipal Water Infrastructure". This is structured as 12 months of taught programme, followed by six months of research (the MSc thesis). Provided below is the current curriculum overview for the MWI programme, showing the four specialisations on offer. The figure also includes suggested changes to this curriculum to embed the ecological sanitation paradigm firmly into this curriculum. Hence, it presents the situation "before and after" the introduction of ecological sanitation content into the MSc programme.

Table 28: MSc programme structure for MSc in Municipal Water and Infrastructure (with four specialisation options) for a 12-month taught programme, showing proposed inclusion of ecosan subjects within existing 3-week modules [see note below the figure for further explanation].

<table>
<tr><th colspan="4">Municipal Water and Infrastructure</th></tr>
<tr><th>Water Supply Engineering</th><th>Sanitary Engineering</th><th>Integrated Urban Engineering</th><th>Water Services Management</th></tr>
<tr><td colspan="4">Introduction [1]</td></tr>
<tr><td colspan="4">Integrated urban water management [2, 3, 5, 12]</td></tr>
<tr><td colspan="4">Project cycle and management [4, 6, 10]</td></tr>
<tr><td colspan="4">Christmas holiday</td></tr>
<tr><td colspan="2">Process technology [2]</td><td colspan="2">Infrastructure finance and planning [6]</td></tr>
<tr><td colspan="2">Unit operations</td><td>Urban mobility planning</td><td>Water services management [9, 10]</td></tr>
<tr><td>Groundwater treatment & resources</td><td colspan="2">Urban drainage and sewerage [2]</td><td>Water supply and sanitation systems [2, 12]</td></tr>
<tr><td>Surface water treatment</td><td>WWT process design & engineering [2, 10]</td><td>Road design and operations</td><td>Operations management</td></tr>
<tr><td colspan="4">Easter holiday</td></tr>
<tr><td>Water treatment processes & plants</td><td>Modelling and industrial WWT</td><td>Construction and maintenance</td><td>Financial management</td></tr>
<tr><td>Water transport and distribution I</td><td>Sustainable WWT and reuse [3]</td><td>Water transport and distribution I</td><td>Managing organisations and change</td></tr>
<tr><td colspan="4">Choice of elective: 1) Water transport and distribution II 2) Solid waste engineering and management [2, 4] 3) Decentralised WS & S [2, 3, 5, 11] or 4) Public Private Partnerships [8, 9]</td></tr>
<tr><td colspan="4">International fieldtrip and fieldwork [2-14]</td></tr>
<tr><td colspan="4">Groupwork [4-12]</td></tr>
<tr><td colspan="4">Individual study / MSc research proposal [2-13]</td></tr>
<tr><td colspan="4">Final examinations</td></tr>
</table>

The bold numbers **[in brackets]** refer to the ecological sanitation subjects listed below (for details see Table 4 in Section 4.5.2):

1. Introduction to ecological sanitation
2. Technologies applied in ecological sanitation
3. Resources recovery and agricultural reuse (nutrients, organics, water and energy)
4. Implementation, operation and maintenance management
5. Environmental and health aspects
6. Economic and financial aspects
7. Social and cultural aspects
8. Policy and Legal aspects
9. Institutional and organisational aspects
10. Case studies: successes and failures
11. Enabling search for up-to-date information on ecological sanitation (e.g. internet)
12. Interactions of ecological sanitation projects with existing infrastructure
13. Evaluation criteria for sanitation systems
14. Promotion and public awareness

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8.2 Selected links with information on ecosan research and education

Name or Abbreviation	Description and link
(All URLs retrieved on 2005-12-15)	
AGRICULTURE 21	FAO`s Online Magazine http://www.fao.org/ag/default.htm
AKWA 2100	Alternativen der kommunalen Wasserversorgung und Abwasserentsorgung, AKWA 2100 research project, Germany http://www.akwa-2100.fhg.de/
BMZ	German Ministry for economic collaboration and development http://www.bmz.de/
CREPA	Centre Régional pour l'eau potable et l'assainissement, Ouagadougou, Burkina Faso http://www.reseaucrepa.org/index.htm
CSD	UN Commission on Sustainable Development http://www.un.org/esa/sustdev/
CSE	Indian Centre for Science and environment, Delhi, India www.cseindia.org
CSIR	Council for Scientific and Industrial Research, Pretoria, South Africa www.csir.co.za http://www.csir.co.za/websource/ptl0002/docs/boutek/akani/print/2002/mar/print07.html
DWA	German Water Association (Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall, formerly ATV-DVWK) www.dwa.de
Eawag - Novaquatis	Integrated aquatic research project at the Swiss Federal Institute for Environmental Science and Technology (Eawag), Research of urine source separation for improved wastewater management www.novaquatis.eawag.ch
Eawag - Sandec	Swiss Federal Institute for Environmental Science and Technology, Department of Water and Sanitation in Developing Countries www.sandec.ch
ECN	European Compost Network http://www.compostnetwork.info
Eco solutions	Eco solutions (NGO from India) http://www.eco-solutions.org/
ecosan	ecosan program of the GTZ http://www.gtz.de/en/themen/umwelt-infrastruktur/wasser/8524.htm
EcoSanClub	Austrian NGO/consultancy group, homepage with information on many international ecosan activities, project information and publications http://www.ecosan.at/
EcoSanRes	International ecosan program, sponsored by the Swedish International Development Agency (SIDA). Extensive ecosan information, publications, case studies, etc

	http://www.ecosanres.org/
FAO	Food and Agriculture Organization of the United Nations http://www.fao.org/
Freiburg Vauban	Eco-Settlement in Freiburg, Germany http://www.passivhaus-vauban.de/idee.html
GTZ	German Technical Cooperation Association, Eschborn, Germany (implementing the GTZ – ecosan program) http://www.gtz.de/
GWA	Gender and Water Alliance (Open Network with over 300 organisations involved) http://www.genderandwateralliance.org/
HCES	Household Centred Environmental Sanitation Approach (HCES) of the WSSCC http://www.wsscc.org/dataweb.cfm?code=593
IDRC	International Development Research Centre, Canada http://www.idrc.ca/
IEES	International Ecological Engineering Society, Wolhusen, Switzerland (with EcoEng-Newsletter) http://www.iees.ch/news.html
IFS	International Foundation for Science, Stockholm, Sweden (funding program for scientists from developing countries) http://www.ifs.se/
InterWATER	Directory of organisations in the water and sanitation sector http://www.irc.nl/interwater/
IRC	International Water and Sanitation Centre, Delft, The Netherlands (news and information, advice, research and training, on low-cost water supply and sanitation in developing countries) http://www.irc.nl/
IUCN	International Union for the Conservation of Nature and Natural Resources (or World Conservation Union) http://www.iucn.org/
IWA	International Water Association, Specialist group on ecological sanitation http://www.ecosan.org/
IWMI	International Water Management Institute, Sri Lanka http://www.iwmi.cgiar.org/
KfW	KfW banking group, Germany (Kreditanstalt für Wiederaufbau) http://www.kfw.de/
Knoten Weimar	Knoten Weimar, Germany (International Transfer Centre for Environmental Technologies) http://www.bionet.net/
NCCR	National Centre of Competence in Research (NCCR) North-South (Partnerships for Mitigating Syndromes of Global Change) www.nccr-north-south.unibe.ch
PUVeP	Peri-urban Vegetable Project (PUVeP) of the Xavier University in Cagayan de Oro, Mindanao, The Philippines http://www.puvep.com/
RUAF	Resource centre on urban agriculture and forestry Leusden, The Netherlands http://www.ruaf.org/newslgen_fr.html
RWTH Aachen, Germany	Technical University Aachen, Department of Environmental Engineering, Germany www.isa.rwth-aachen.de
Sanitation Connection	An Environmental Sanitation Network http://www.sanicon.net/titles/topicintro.php3?topicId=17
SDC	Swiss Agency for Development and Cooperation (Direktion für Entwicklung und Zusammenarbeit DEZA)

	http://www.deza.ch/
SEI	The Stockholm Environment Institute, Sweden (SEI implements the EcoSanRes program) www.sei.se
SIDA	Swedish Agency for International Development Cooperation http://www.sida.gov.se/
Source news	Joint endeavour of IRC and WSSCC (with newsletter) http://www.irc.nl/source
TepozEco	Urban ecological sanitation program, Tepoztlán, Mexico http://www.laneta.apc.org/sarar/tepozeco.htm
TU Darmstadt, Germany	Institute of Water Supply and Groundwater Protection, Wastewater Technology, Waste Management, Industrial Material Cycles, Environmental and Spatial Planning at the TU Darmstadt, Germany www.iwar.bauing.tu-darmstadt.de
TUHH, Germany	Technical University of Hamburg Harburg, Institute of Municipal and Industrial Wastewater Management http://www.tu-harburg.de/aww/index.html
UMB, Norway	Norwegian University of Life Sciences (Ecosan courses, projects and publications) www.umb.no/ecosan
UN MDG homepage	UN MDG homepage http://www.un.org/millenniumgoals
UNDP	United Nations Development Program http://www.undp.org United Nations Development Program, page on Ecological Sanitation http://www.undp.org/water/ecol.html/
UNEP	United Nations Environmental Program http://www.unep.org/
UNESCO	United Nations Educational Scientific and Cultural Organisation http://www.unesco.org/
UNESCO-IHE	Institute for Water Education, Delft, Netherlands www.unesco-ihe.org
UNESCO-IHP	UNESCO-International Hydrological Programme http://www.unesco.org/water/ihp/index.shtml
UN-Habitat	United Nations Centre for Human Settlement http://www.unhabitat.org/
UNICEF	United Nations Children's Fund http://www.unicef.org/ United Nations Children's Fund, page on Water, Environment and Sanitation http://www.unicef.org/wes/index.html
University of Bonn, Germany	Institute of Plant Nutrition, Secondary Resources Management, University of Bonn, Germany www.rema.uni-bonn.de
Urban Water	Swedish Water and Sanitation Research Group http://www.urbanwater.org/default_eng.htm
WASH	Water, Sanitation and Hygiene for All – an Initiative of the WSSCC http://www.wsscc.org/dataweb.cfm?code=57
WASTE	Advisors on Urban Environment and Development, NGO, The Netherlands http://www.ecosan.nl/
Water Page	The Water Page (Africa) http://www.thewaterpage.com/ecosan_main.htm
WATER21	International Water Magazine http://www.iwapublishing.com/template.cfm?name=iwapwater21

WECF	Women in Europe for a Common Future http://www.wecf.org/
WEDC	Water, Engineering and Development Centre http://wedc.lboro.ac.uk/index.php
WELL	Resource Centre Network for Water, Sanitation and Environmental Health (includes an extensive link list) http://www.lboro.ac.uk/well/index.htm
WHO	World Health Organisation http://www.who.int/en/
WB	World Bank http://www.worldbank.org/ World Bank Water Supply and Sanitation (WSS) Program http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTWSS/0,,menuPK:337308~pagePK:149018~piPK:149093~theSitePK:337302,00.html
WSP	Water and Sanitation Programme, Washington, D.C., USA http://www.wsp.org/
WSSCC	Water Supply and Sanitation Collaborative Council, Geneva, Switzerland http://www.wsscc.org/
WTO	World Toilet Organisation, Singapore http://www.worldtoilet.org/hp/wto_hp.htm

9 Glossary and Abbreviations

9.1 Glossary

Agricultural use in relation to sanitation	Use of recyclates produced from liquid and solid household waste. Includes other forms of use - e.g. in horticulture, aquaculture, forestry, ...
Aquifer	An underground water source. Porous water bearing layers of sand, gravel and rock below the earth surface,
Black water	Water that contains excreta from humans and/or animals
Capacity building	Strengthening of skills
Curriculum	The subjects that are studied or prescribed for study in a school, university
DALYs	Disability Adjusted Life Years; a method to quantify risks, by translating them into years, lost or spend ill, by the people of a given target group
Digestion	The breaking down of organic substances under aerobic or anaerobic conditions
Diversion, diversion systems	The process of separating materials at their source, or point of generation. Diversion systems are systems, like urine-diverting toilets (or recycling separation containers) that stimulate users to separate waste streams at source.
Ecosan	Abbreviation for ecological sanitation.
Effluent	Liquids discharged out of a tank or sewage works
Excreta	Emitted human and animal wastes: faeces and urine
Faeces	Human and animal waste matter discharged from the bowels, containing undigested foods, bacteria, mucus, and dead cells.
Gender sensitive planning	Planning that includes the fact, that in all societies community members (e.g. men and women, young and old, rich and poor) play different roles, have different needs, and face different constraints. Gender roles differ from the biological roles of men and women, as they are socially constructed. They demarcate responsibilities between men and women, social and economic activities, access to resources, and decision-making authority. Biological roles are fixed, but gender roles can and do change with social, economic, and technological change. Social factors underlie and support gender-based disparities. (Adapted from: Fong, M. S., Wakeman, W. and Bhushan, A. (1996). Toolkit on Gender in Water and Sanitation. The World Bank)
Grey water	Household wastewater without input of human and /or animal excreta, including sources from baths, showers, hand basins, washing machines, dishwashers, laundries and kitchen sinks (also called 'sullage'). Eventually kitchen waste water may also be treated separately, or together with black water, as it may contain larger concentrations of organic matter, oil, etc.
Hormone	Chemical substances produced by the body that has specific effects on the activity or function of a certain organ.
Leachate	Liquids draining from sewers, pits or waste collection chambers.
Nightsoil	Fresh human excreta with or without anal cleaning material, which are deposited in

	a bucket or other receptacle for manual removal (often taking place at night).
Nutrients	In this document used as: Essential chemical elements and minerals, assimilated by plants and micro-organisms that stimulate growth and remain, through decomposition and other biochemical processes in the ecosystem
Pathogens	Organisms that create diseases in host organisms
Pharmaceutical residues	Residues consisting of/or containing pharmaceuticals
PRA	Participatory Rapid Assessment, an assessment methodology that includes sets of participatory techniques, includes integrated approaches and aims at facilitating poor, uneducated, or disempowered groups to take charge of their own development processes, and become subjects, rather than objects, of development and urban planning interventions.
Poudrette	French word for dried natural fertiliser from human excreta, manure or compost.
Rainwater harvesting	The capture and use of runoff from rainfall.
Recovery	The process of separation and collection of recyclable material from a waste stream
Recyclates	Recovered materials. In the sanitation sector this specific term is usually limited to products made from urine, faeces, and grey water.
Recycling	The reuse of materials, not necessarily in their original forms
Sanitation	Interventions to reduce people's exposure to diseases by providing a clean environment in which to live; measures to break down the cycle of disease. Sanitation involves both behaviours and facilities, which work together to form a hygienic environment.
Sanitation management system	The sum of several stages in the management of the flow of human waste and grey water within the city and the region
Sanitation, conventional	Sanitation systems based on collection, end-of-pipe treatment and disposal of excreta and wastewater, not considering reuse of water and nutrients
Sanitation, ecological	Holistic eco-system oriented approach towards hygienic safe, ecologically and economically sound sanitation; a concept where human waste is considered a resource and its management forms part of an integrated water resources, nutrient flows and waste management processes. Usually ecological sanitation systems are summarized under the term "ecosan". Other terms, which partly or fully comply with ecosan principles, include "wastewater reclamation and reuse", DESAR (Decentralised Sanitation and Reuse) or DEWATS (Decentralised Wastewater Systems).
Sanitation, environmental	Interventions to reduce peoples' exposure to disease by providing a clean environment in which to live, with measures to break the cycle of disease. This usually includes hygienic management of human and animal excreta, refuse, wastewater, storm water, the control of disease vectors, and the provision of washing facilities for personal and domestic hygiene. Environmental Sanitation involves both behaviours and facilities which work together to form a hygienic environment
Sewage	The spent or used water from a community that contains dissolved or suspended matter.
Sewage sludge	Sludge resulting from the treatment of raw wastewater.

Stakeholders	A person or an organisation that has a stake, an interest in a certain case
Strategic planning	A process of involving stakeholders in the articulation of problems, the setting of priorities, and the designating of desired actions and interventions to change the situation in relation to urban infrastructure, specifically sanitation, in the short-, medium- and long term.
Toilet	Place for defecation and urination
Urine	A pale-yellow fluid secreted as waste from the blood by the kidney, stored in the bladder, and discharged through the urethra
Waste	'Unwanted' for the person who discards it; a product or material that does not have a value for the first user and is therefore thrown away.
Wastewater	All types of domestic wastewater, commercial and industrial effluent as well as storm water runoff

9.2 Abbreviations

AKWA 2100	Alternativen der kommunalen Wasserversorgung und Abwasserentsorgung, AKWA 2100 Research Project
BCEB	Bahrain Convention & Exhibition Bureau, Manama, Kingdom of Bahrain
BMZ	German Ministry for economic collaboration and development
CBNRM	Community Based Natural Resources Management
CBO	Community-Based Organisation
CREPA	Centre Régional pour l'eau potable et l'assainissement, Ouagadougou, Burkina Faso
CSD	UN Commission on Sustainable Development
CSE	Indian Centre for Science and Environment
CSIR	Council for Scientific and Industrial Research, Pretoria, South Africa
DALYs	Disability Adjusted Life Years
DEZA	Direktion für Entwicklung und Zusammenarbeit (German for Swiss Agency for Development and Cooperation (SDC))
DS	Dry Sanitation
DT	Dry Toilets
DWA	Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall, German Water Association (formerly ATV-DVWK)
Eawag	Swiss Federal Institute for Environmental Science and Technology
Eawag - Sandec	Department of Water and Sanitation in Developing Countries at the Swiss Federal Institute for Environmental Science and Technology (Eawag)
Eawag - Novaquatis	Integrated aquatic research project at the Swiss Federal Institute for Environmental Science and Technology (Eawag)
ECN	European Compost Network
EcoSanRes	Ecological sanitation research – Swedish ecosan programme from SEI

EMP	Environmental Management Plan
ESA	European Space Agency
EUR	Euro
FAO	Food and Agriculture Organisation of the United Nations
GTZ	German Technical Cooperation Association
GWA	Gender and Water Alliance
HCES	Household Centred Environmental Sanitation Approach (HCES) of the WSSCC
IDRC	International Development Research Centre
IFAT	Internationale Fachmesse für Wasser-Abwasser-Abfall-Recycling
IFS	International Foundation for Science
IGB	Fraunhofer Institute for Interfacial Engineering and Biotechnology, Stuttgart
IMWI	International Water Management Institute
IPN	Inter-institutional professional network on ecosan
IRC	International Water and Sanitation Centre
IRTCID/CUW network	UNESCO endorsed network of centres for urban drainage / urban water
ISWM	Integrated Sustainable Waste Management
IUCN	International Union for the Conservation of Nature and Natural Resources or World Conservation Union
IWA	International Water Association
IWMI	International Water Management Institute
IWWA	Indian Water Works Association
KfW	Kreditanstalt für Wiederaufbau, KfW banking group
kg/cap/a	Kilogramme per capita and year
MDG	Millennium development goals
MFA	Material Flux Analysis
MIKA	Methodologies for Integration of Knowledge Areas
MPA	Methodology for Participatory Assessment
MSE	Micro- and Small-scale Enterprise
NASA	National Aeronautics and Space Administration
NCCR North-South	National Centre of Competence in Research (NCCR) North-South
NGO	Non Governmental Organisation
O&M	Operation and maintenance
OSEA	Order of Syrian Engineers and Architects
PNAS	Proceedings of the National Academy of Sciences of the United States of America
PRA	Participatory Rapid Assessment
PRSP	Poverty Reduction Strategy Papers

R&D Project	Research and Development Project
RUAF	Resource centre on urban agriculture and forestry, Leusden, Netherlands
SDC	Swiss Agency for Development and Cooperation
SEI	Stockholm Environment Institute
SIDA	Swedish Agency for International Development Cooperation
SWOT - Analyses	Strengths-Weaknesses-Opportunity / Opportunities-Threats - Analyses
TUHH	Technical University Hamburg Harburg
UN	United Nations
UNDP	United Nations Development Program
UNEP	United Nations Environmental Program
UNEP GPA	United Nations Environmental Program - Global Programme of Action
UNESCO	United Nations Educational scientific and Cultural Organisation
UNESCO-IHE	UNESCO-Institute for Water Education, Delft, the Netherlands
UNESCO-IHP	UNESCO-International Hydrological Programme
UN-Habitat	United Nations Centre for Human Settlement
UNICEF	United Nations Children's Fund
UWETTT	Urban Water Education, Training and Technology Transfer projects, UNESCO training material (UWETTT)
VIP latrines	Improved ventilated pit (VIP) latrines
WASH	Water, Sanitation and Hygiene for All – an Initiative of the WSSCC
WASTE	Advisors on Urban Environment and Development, NGO, The Netherlands
WATER21	International Water Magazine
WECF	Women in Europe for a Common Future
WEDC	Water, Engineering and Development Centre
WHO	World Health Organisation
WSP	Water and Sanitation Programme, Washington, D.C., USA
WSP-AF	Water and Sanitation Program for Africa
WSSCC	Water Supply and Sanitation Collaborative Council
WTO	World Toilet Organisation
YLD	Years lived with a disability
YLL	Years of life lost to premature death

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V03

Appropriate Wastewater Treatment in Developing Countries: Experiences with CEPT*

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Abstract

Water-borne diseases remain a rampant impediment to economic development in densely populated urban areas of developing countries. Most attempts to mitigate this problem of paramount importance have not succeeded. In devising policy to alleviate the public health problems related with wastewater, an important issue that needs to be addressed is whether the developing world should follow the model of using the municipal wastewater treatment technology of Western Europe and North America, or whether there is an alternative "sustainable sanitation" approach?

This short paper presents some of the authors' experiences with wastewater treatment related issues in cities of the developing world. Specifically, we relate our experiences concerning the simple and cost-effective technology of chemically enhanced primary treatment (CEPT). CEPT relies on small doses (i. e., $\leqslant$ 50 mg/L) of metal salts, which act to enhance particle settling by coagulation, and therefore treatment effectiveness. A short primer on CEPT is attached. Based on these experiences, we believe that the development of sustainable wastewater-related infrastructure in cities of the developing world is necessary, and we believe that CEPT should be considered as the first stage technology of choice because it is the lowest cost treatment technology that permits effective disinfection of the effluent.

Introduction

A committee of the U.S. National Research Council [NRC, 1996] reported on "sustainable water and sanitation services for mega-cities in the developing world". The authors indicate that "water and sanitation professionals must take a broader view of sanitation to

*Parts of this article have appeared in Harleman and Murcott [2001].

prevent disease resulting from a wide range of activities and multiple exposure routes." On the role of treatment technology, the authors state that "technical innovation should be based on carefully considered performance criteria appropriate to maintaining a healthy environment." While it is true that some cities (e. g., Jakarta) lack a sewage collection system, most urban areas have extensive sewerage systems that discharge untreated wastewater and contaminate adjacent rivers, shallow embayments or coastal waters. Only a small fraction of collected wastewater is treated, usually in "token" secondary plants with conventional primary settling and activated sludge. Such plants frequently suffer from poor performance due to inadequate funds for maintenance and operator training or to biological upsets caused by toxic industrial inputs. While the goals of industrialized world treatment are laudable, we believe that they are unrealistic in the near-term, and they do not address the most pressing need of disinfection. Rather than prescribing an effluent objective and its corresponding level of advanced treatment, it is more useful to define the most efficient and cost-effective first stage level of treatment needed to protect public health.

This short paper relates some of the authors' experiences with wastewater treatment in developing countries. Specifically, we present our experiences concerning the simple and cost-effective technology of chemically enhanced primary treatment (CEPT). It is our experience that most wastewater treatment objectives in developing country cities fall into two categories:

- need to upgrade existing conventional primary treatment plants
- new plant

In most instances, upgrades to existing overloaded conventional primary treatment plants and new plant designs have made use of biological treatment. Our perspectives on Mexico city and Brazil are outlined below; from these experiences, we conclude that a strategy of staged wastewater treatment implementation is the best path to follow. The goal should be one of treating and disinfecting all the wastewater produced in a given urban area, otherwise treated and untreated effluents are co-mingled in the receiving water with no public health benefit.

Mexico City — A Perspective on Mega-city Needs

The Valley of Mexico, with 21 million inhabitants, covers an area of 1,300 km^2. The city lies on an old lake bed on a high plateau with no natural drainage or source of fresh water. Most of the drinking water is pumped from deep ground water wells or from distant lower surface water sources. The city produces an average of 75 m^3/s of wastewater and this raw sewage is used to irrigate 85,000 ha of agricultural land in the neighboring state of Hidalgo. These crops feed and provide income for the local population. The raw sewage is high in organic matter, nitrogen and phosphorus nutrients, as well as in fecal coliforms and

helminth eggs, a debilitating parasite, in concentrations as high as 250 eggs/L. Because the soil in the valley is poor, the organic material, nitrogen and phosphorus in the wastewater have greatly improved crop yields — corn production has increased 150%, onion 100%, tomato 94%, etc. [Landa *et al.*, 1997]. The irrigated area receives over 80 kg/ha of nitrogen per year.

The critical issue in Mexico City's use of raw sewage for irrigation is the high prevalence of enteric and parasitic disease among the more than 100,000 agricultural workers in the irrigated areas [Comisión Nacional del Agua, 1995]. Mexico City's pressing need is to find a level of treatment that will protect the workers through helminth egg removal and pathogen inactivation, while allowing continued use of the organics and nutrients for irrigation. Okun [1996] advocates reuse of sewage for agriculture, but immediately couples it with the need for secondary treatment prior to disinfection. This is consistent with the thinking of most Western environmental planners and engineers. However, it must be questioned whether the capital and operating costs for full secondary treatment of the wastewater of Mexico City, given its other infrastructure needs, is a necessary or feasible option.

During visits to Mexico City in 1993—1995, the authors (DRFH & SM) urged the National Water Authority to consider and test chemically enhanced primary treatment (CEPT), as a single-stage treatment process that would result in a high level of suspended solids removal, including helminth eggs, and would thereby produce an effluent that could be effectively and economically disinfected. This proposal became the basis for a number of pilot and full-scale tests in Mexico City [Murcott *et al.*, 1996]. Additional pilot plant studies on the use of CEPT alone and in combination with high-rate sand filters have been completed [Landa *et al.*, 1997].

CEPT is very effective in removing helminth eggs to a range of 2∼5 eggs/L. Polishing sand filters were added to ensure an effluent with less than 1 egg/L. The Mexican authorities made a cost evaluation of CEPT treatment in comparison with conventional primary plus activated sludge treatment for a number of proposed plants [Comisión Nacional del Agua, 1995]. For example, for the proposed El Salto plant (15 m^3/s treatment capacity and 5.2 m^3/s mean flow), the construction cost (including sludge disposal) of the CEPT plant was estimated at US$70 million, while the conventional primary plus activated sludge facility cost was higher by a factor of 1.85. Annual operating costs were US$4 million for CEPT and US$7 million for the primary plus secondary plant. The annual cost of the CEPT chemicals is more than offset by the high energy cost for secondary aeration tanks.

Brazil — A Country-Wide Perspective

Bench-scale and full-plant CEPT demonstration tests have been successfully completed, first in São Paulo, under the sponsorship of the state wastewater agency [SABESP, 1996].

Next, in Rio de Janeiro, in 1997, the World Bank requested a demonstration of CEPT technology at an existing treatment plant. The objective was to show whether CEPT technology should be used in future treatment plants designed to solve severe eutrophication problems within Guanabara Bay. One of the major treatment objectives is low-cost phosphorus removal, the limiting nutrient controlling the large algal blooms that cause oxygen depletion and odors in the Bay. Tests of CEPT showed that it is possible to remove about 90% of the phosphate as well as high levels of TSS and BOD [Harleman and Murcott, 1998]. The first two CEPT treatment plants in Rio have been constructed by CEDAE, the state agency.

In l998 it was decided to use the Brazil CEPT experience to provide Master of Engineering thesis opportunities for Massachusetts Institute of Technology students. Site visits to design, test and collect data on innovative treatment processes were made. The focus was on municipalities which have overloaded and poorly functioning plants. In Brazil, most wastewater treatment in medium size cities is by open lagoons at the edge of the urban area. The usual method of upgrading existing lagoon performance and treatment capacity is by cleaning and reconstructing the lagoons and installing surface aeration units. However, in addition to the initial costs, most cities cannot afford the large annual costs to run and maintain the aerators.

Students obtained data on anaerobic and facultative lagoons serving a coastal community having a large variation in seasonal population. A numerical model Ferrara and Harleman [1980] was used to predict the performance of the wastewater treatment lagoons. The calibrated model was then used to design two treatment upgrade alternatives for a city which had planned to upgrade existing lagoons by installing aerators [Chagnon, 1999].

In the first treatment upgrade alternative, a small CEPT tank is placed in front of the first lagoon. This reduces the solids and BOD load on the lagoons and eliminates the need for aerators. The second alternative used an in-lagoon CEPT concept whereby chemical coagulants are added directly at the inlet of the first lagoon, again eliminating aerators. This type of CEPT lagoon, first successfully used in Scandinavia [Hanaeus, 1991], would be expected to perform better in the warmer climate of Brazil. A comparative cost study showed that both alternatives were less expensive, in capital and O&M costs, than the original aerated lagoon design [Cabral *et al.*, 2000].

Lessons Learned

Public health is the major water-related environmental concern in urban areas of the developing world. In many instances, drinking water and receiving water sources are contaminated by raw or inadequately treated wastewater effluents. Even when conventional primary treatment exists, its effluent cannot be effectively disinfected.

The objective of first-stage wastewater treatment investments or upgrades of existing treat-

ment facilities should be a high-flow rate, low-cost treatment technology that provides a high level of suspended solids removal, thereby permitting effective pathogen inactivation by disinfection. Chemically enhanced primary treatment is the most cost-effective first step; it can always be followed at a later stage by more advanced biological treatment processes if they can be justified and afforded.

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Thanks are also due to government and agency officials in other parts of the world for supporting and facilitating the development of ecological sanitation. In the first edition of the book we listed them. Since then there has been such a rapid development in a large number of countries that we can no longer provide a comprehensive list.

Finally we wish to acknowledge the contribution made by Steve Esrey. He played an important role in the development of the concept of ecological sanitation and in the drafting of the first edition of this book. Those of us who were there will never forget his inspiring opening speech at the First International Conference on Ecological Sanitation in Nanning, China, in November 2001. He was unable to come to Nanning due to the illness that a month later led to his death, but nontheless he prepared a wonderful, voiced powerpoint presentation for the opening session. The results of this very successful conference have been incorporated into this book.

Stockholm and Addis Ababa
July 2004
The Editors

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FOREWORD

Sida has a long-standing commitment to the development of water and sanitation services for all people. Early on Sida recognized that shortages of water resources and financial resources in many parts of the world are among the main barriers to progress. Thus, in the early 1990s, Sida put its support behind a new effort, a new way of thinking about this challenge, and the development of new concepts. In sanitation the new approach was to think in terms of developing systems that would save water, prevent water pollution and recycle the nutrients in human excreta. These new solutions should also save money and optimise the meagre financial resources of many cities, towns and government agencies around the world. The idea was to find solutions that were ecologically sound and would improve the environment while putting up barriers to water-borne diseases. Today we call this new approach "ecological sanitation."

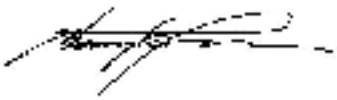
Sweden put its resources behind this effort because Sweden, a country with abundant water resources, was in fact polluting its fresh and salt waters. As early as the 1960s, Swedish researchers, inventors and planners were seeking new approaches to sanitation that would prevent this pollution. Ideas began to emerge that looked promising and this stimulated interest in further research and development of sustainable systems. Perhaps some of these ideas and experiences could be further developed and then shared with other countries? Perhaps ideas and experiences from other countries could be shared through a wider joint effort?

This book presents the findings of over ten years of research and development in ecological sanitation supported by Sida. We are grateful to the small group of dedicated professionals who have written the book.

Since 2000, the UN's Millennium Development Goals and its targets for water supply and sanitation have reaffirmed that the development community, and agencies such as Sida, need to continue to search for more viable and sustainable solutions to sanitation. This book contributes to that search and presents proven solutions.

We hope that this book will inspire different actors such as government agencies, NGO's, private sector, water companies, municipal authorities and individuals to work with ecological sanitation systems. It can be used in developed as well as developing countries and aims also at stimulating different actors to include ecological sanitation systems in all their activities in the water and sanitation sector.

Stockholm in July, 2004



Bengt Johansson
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Swedish International Development Cooperation Agency (Sida)

Chapter 1
INTRODUCTION

1.1 Challenges

This book is about sanitation for the future, in a world where most people will live in towns and cities. Over the next 25 years the world's population is expected to reach 8 billion, with 5 billion living in urban areas. More than half of the 8 billion will face water shortages and 40% of the urban population might be living in slums.[1] Already today billions of people, in urban as well as in rural areas, have no proper sanitation.

With this in mind, an international group of planners, architects, engineers, ecologists, biologists, agronomists and social scientists have developed an approach to sanitation that saves water, does not pollute and returns the nutrients in human excreta to the soil. We call this approach 'ecological sanitation', or 'eco-san' for short.

The major global challenges faced by the sanitation sector are the many people without sanitation, the health effects of poor sanitation, water shortage and pollution, food insecurity, urban growth and the inadequacy of current sanitation options.

People without sanitation
An often quoted figure is that the total number of unserved is about 40% of all people in the world.[2] If present trends continue, the number of unserved is going to increase.

Health effects of poor sanitation
Approximately 6000 children die every day from diarrhoeal diseases related to inadequate sanitation and hygiene.[3] About 1 billion people worldwide, mostly children, are infested with intestinal worms and as a result suffer nutritional deficiencies and poor growth.[4] Both of these groups of diseases are transmitted through human faeces in the environment.

Water shortage
Already today many areas are suffering from chronic freshwater shortages and the demand for freshwater has tripled in the past 50 years. By 2030 more than half the world's population will face a shortage of water.[5]

Water pollution
Sewage discharges from centralized, water-borne collection systems are a major component of water pollution all over the world. Only about 300 million people in the world today have end-of-pipe treatment of sewage to a secondary level (see 2.4) before the sewage is discharged into open bodies of water.[6] Pollutants also leak into groundwater from sewers, septic tanks, pit toilets and cesspools.[7]

Food insecurity
In today's urban societies the flow of plant nutrients is linear: nutrients are taken up from the soil by the crop, transported to the market, eaten, excreted and discharged. In a sustainable society the production of food must be based on returning the plant nutrients to the soil. The use of chemical fertilizers is not sustainable, since their production relies on non-renewable resources.

Urban growth
Over the next 25 years 90% of the world's population growth will be absorbed by the urban areas of the less developed regions, where the population will increase by 2 billion. Today 50% of the urban population live in cities of under 500,000 people. These smaller cities have less in the way of sanitation facilities and development than larger cities. Cities in developed countries have, according to UN-Habitat, 32 times as much money per person to spend on infrastructure and other urban services as cities in least developed countries.[8]

Inadequacy of current options
The sanitation practices promoted today are either based on hiding human excreta in deep pits ('drop-and-store') or on flushing them away and diluting them in rivers, lakes and the sea ('flush-and-discharge').

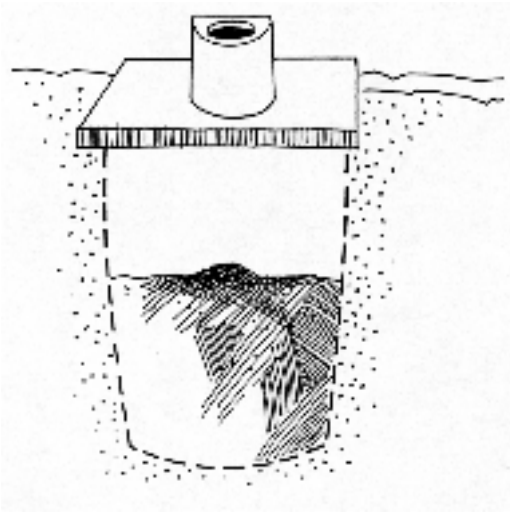


Figure 1.1 *Drop-and-store.*

Drop-and-store systems can be simple and relatively low-cost but have many drawbacks. Often they cannot be used at all in crowded areas, on rocky ground, where the groundwater level is high or in areas periodically flooded. They require access to open ground and the digging of new pits every few years.

Flush-and-discharge systems require large amounts of water for flushing, and for many municipalities unaffordable investments in pipe networks and treatment plants. Over a year for each person some 400-500 litres of urine and 50 litres of faeces are flushed away with 15,000 litres of pure water. Water from bath, kitchen and laundry may add up to another 15,000-30,000 litres for each person.

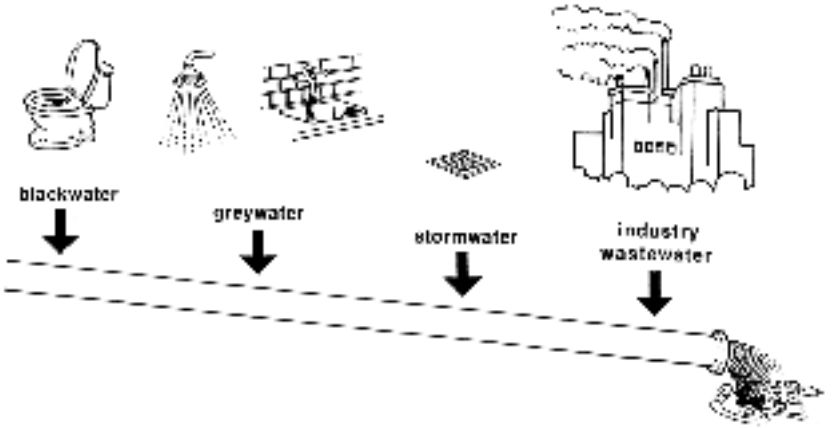


Figure 1.2 *Flush-and-discharge.*

Further down the pipe rainwater from streets and rooftops and wastewater from industries are often added. Thus at each step in the flush-and-discharge process the problem is magnified: the really dangerous component, the 50 litres of faeces, is allowed to contaminate not only the relatively harmless urine but also the huge amount of pure water used for flushing and an equal or even larger amount of greywater.

Leaders, professionals and communities are currently faced with two options: expand existing sanitation approaches, with all their limitations and weaknesses, or seek entirely new solutions. Existing approaches to sanitation are not viable or affordable to the vast majority of people, neither do they offer people an approach towards a sustainable society.

1.2 Response

Ecological sanitation is based on three fundamental principles: preventing pollution rather than attempting to control it after we pollute; sanitizing the urine and the faeces; and using the safe products for agricultural purposes. This approach can be characterized as 'sanitize-and-recycle'.

This approach is a cycle – a sustainable, closed-loop system. It treats human excreta as a resource. Urine and faeces are stored and processed on site and then, if necessary, further processed off site until they are free of disease organisms. The nutrients contained in the excreta are then recycled by using them in agriculture.

An essential part of eco-san is to contain and sanitize human excreta before they are recovered and reused. Human faeces, rather than urine, are responsible for most diseases spread by human excreta. Thus, a method is needed to sanitize faeces. Two methods are discussed in this book: dehydration and decomposition. Dehydration, or drying, of faeces is easier if they are not first mixed with urine and water. When faeces decompose, the pathogens in them die and are broken down. Thus, with either method, viruses, bacteria and worm eggs are destroyed. It is only then that faeces can be recycled. Urine is usually safe enough to be used in agriculture without further treatment, either directly or after a short period of storage.

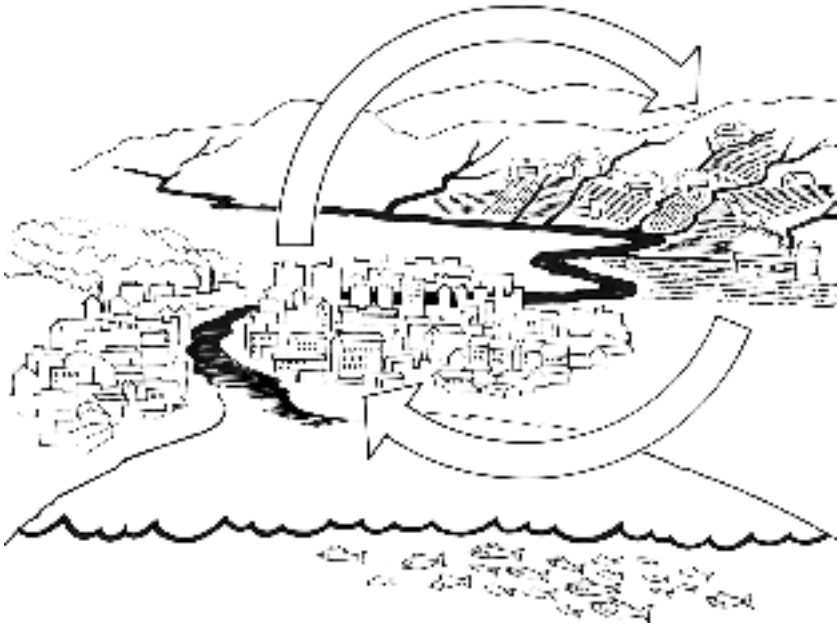


Figure 1.3 *Ecological sanitation replicates nature by returning the plant nutrients in human urine and faeces to the soil. Instead of polluting the environment, human urine and faeces are used to improve soil structure and supply nutrients.*

In summary, key features of eco-san are prevention of pollution and disease caused by human excreta, management of human urine and faeces as resources rather than as waste, and recovery and recycling of the nutrients. In the natural world, excreta from humans and other animals play an essential role in building healthy soils and providing valuable nutrients for plants. Conventional approaches to sanitation misplace these nutrients, dispose of them and turn the cycle into a linear flow.

Box 1.1 *A new public health revolution* [9]

"Ecological sanitation could be the beginning of a new public health revolution. During the 20th century we have witnessed several public health revolutions including universal childhood immunizations, the eradication of smallpox, improved water supplies, the green revolution with its improved food yields and expansion of primary health care. The one public health problem that has proved intractable this past decade has been a lack of sanitation for about half the population of the world."

1.3 Criteria

Sanitation is a key determinant of both equity in society and society's ability to sustain itself. If we cannot meet the sanitation challenges described above, we will not be able to provide for the needs of the present generation without hindering that of future generations. Thus, sanitation approaches must be resource minded, not waste minded. Similarly, there can be no equity as long as half the world's population goes without even basic sanitation.

A system of sanitation that contributes towards the goals of equity and a sustainable society must meet or at least go some way towards meeting the following criteria:

Disease prevention
A sanitation system must be capable of destroying or isolating faecal pathogens.

Environment protection
A sanitation system must prevent pollution and conserve valuable water resources.

Nutrient recycling
A sanitation system should return nutrients to the soil.

Affordability
A sanitation system must be accessible to the world's poorest people.

Acceptability
A sanitation system must be aesthetically inoffensive and consistent with cultural and social values.

Simplicity
A sanitation system must be robust enough to be easily maintained with the limitations of the local technical capacity, institutional framework and economic resources.

Successful implementation of these criteria requires an understanding of sanitation as a system. The criteria also require that all the components of the system are considered together, not just one or two, when designing and making sanitation systems work. The main components of that system are nature, society, process and device.

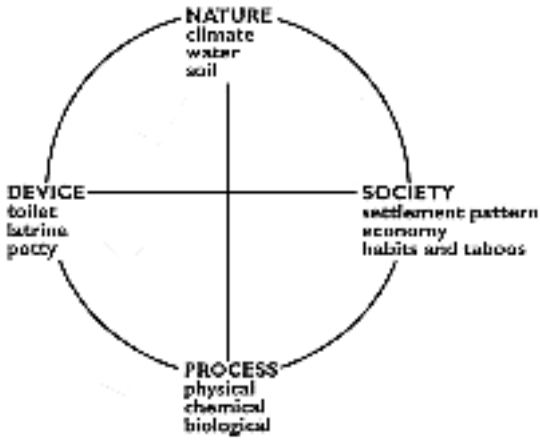


Figure 1.4 *Sanitation is a system where the main components are nature, society, process and device. All these components must be considered together.*

- The most relevant **nature** variables are climate (temperature, humidity), water (amount available, groundwater level), and soil (stability, permeability, pickability).
- **Society** includes settlement pattern (concentrated/dispersed, low/high rise), attitudes (faecophobic/faecophilic), habits (washers/wipers), beliefs and taboos related to human excreta as well as the economic status of the community in question.
- By **process** we mean the physical, chemical and biological processes by which human excreta are turned into a non-dangerous, inoffensive, useful product. In this book we discuss two such processes: dehydration and decomposition.
- By **device** we mean the on-site structures specifically built for defecation and urination. Much of the literature on sanitation is focused on devices, without relating them to the other components of the sanitation system.

The principles underlying eco-san are not novel. In different cultures sanitation systems based on ecological principles have been used for hundreds of years. Eco-san systems are still widely used in parts of East and South-East Asia. In Western countries this option was largely abandoned as flush-and-discharge became the norm, but with a growing realization that conventional sewerage is unsustainable there is now a revival of interest in ecological approaches to sanitation.

Applying the criteria above and developing and implementing a systems approach to sanitation requires a change in our thinking. We must move away from an approach based on disposal to one aimed at zero-discharge and recycling.

1.4 This book

This book does four major things: it treats sanitation as part of a larger ecological system, it systematizes experience from different parts of the world, it describes how to proceed when developing and implementing eco-san approaches, and it provides a vision for urban applications of the eco-san concept.

In this first chapter we have explored the global challenges that we are facing in the next 25 years and how eco-san can help meet those challenges. We have also introduced the criteria for an eco-san system. In Chapter 2 we explain how human excreta can be sanitized in a two-step process to render it safe for re-use in agriculture. In Chapter 3 we introduce a great variety of eco-toilets and eco-san systems suitable for rural homesteads and urban residential areas. In Chapter 4 we go into the details of the design and management of eco-san systems. In Chapter 5 we report on recent and on-going research on the re-use of excretal nutrients in agriculture and how they affect plant growth and crop production. In Chapter 6 we turn our attention to handling greywater. Chapter 7 discusses the important area of planning, promotion and support to ensure the success of new projects. And finally Chapter 8 provides a vision for the future, describes how ecological sanitation could work in urban areas, and summarizes its advantages over conventional approaches.

This book is neither a technical nor a policy manual although it does deal with technical and policy issues. It is rather a down-to-earth discussion of the options available. The eco-san concept is particularly relevant to cities where water and money are scarce. But it should not be regarded as a second-rate solution only for the poor. Eco-san options are available for a whole range of socio-economic conditions, as clearly shown in the wide variety of examples offered in Chapter 3.

Chapter 2
SANITIZING HUMAN EXCRETA

One of the main goals of ecological sanitation is to capture the nutrients present in human excreta and recycle them back to agriculture. Thus a key part of an eco-san system is the destruction of most or all disease-producing organisms before re-use of excreta products. Results from scientific studies of pathogen destruction in eco-san systems are now providing us with guidelines for the treatment of urine and faeces before re-use as fertilizer.[1]

2.1 Urine

Urine contains few disease-producing organisms, while faeces may contain many. Storing undiluted urine for one month will render urine safe for use in agriculture. Undiluted urine provides a harsher environment for micro-organisms, increases the die-off rate of pathogens and prevents the breeding of mosquitoes.[1,2]

At the homestead level, where crops are intended for the household's own consumption, urine can be used directly. It is recommended, however, that there should be 1 month between urine application and harvesting.

When urine is collected from many urban households and transported for re-use in agriculture, the recommended storage time at temperatures of 4–20 °C varies between 1 and 6 months depending on the type of crop to be fertilized.

Box 2.1 *Recommended Swedish guideline storage times for urine mixture* [a] *based on estimated pathogen content* [b] *and recommended crop for larger systems* [c].[1]

Storage temperature	Storage time	Possible pathogens in the urine mixture after storage	Recommended crops
4°C	>1month	Viruses, protozoa	Food and fodder crops that are to be processed
4°C	>6 month	Viruses	Food crops that are to be processed, fodder crops[d]
20°C	>1 month	Viruses	Food crops that are to beprocessed, fodder crops[d]
20°C	>1 month	Probably none	All crops[e]

[a] Urine or urine and water. When diluted it is assumed that the urine mixture has at least pH 8.8 and a nitrogen concentration of at least 1 g/l.

[b] Gram-positive bacteria and spore-forming bacteria are not included in the underlying risk assessments, but are not normally recognized as causing any of the infections of concern.

[c] A larger system in this case is a system where the urine mixture is used to fertilize crops that will be consumed by individuals other than members of the household from which the urine was collected.

[d] Not grasslands for production of fodder.

[e] For food crops that are consumed raw it is recommended that the urine be applied at least 1 month before harvesting and that it be incorporated into the ground if the edible parts grow above the soil surface.

2.2 Faeces

The main concerns about the safety of excreta are with the faeces. The most important pathways for the transmission of diseases from faeces are hands, flies, water, soil as well as food that have been contaminated by any of the first four factors. The F-diagram below summarizes these main pathways. (Each of these factors has been given a name beginning with the letter 'F' in order to make it more easily remembered.)

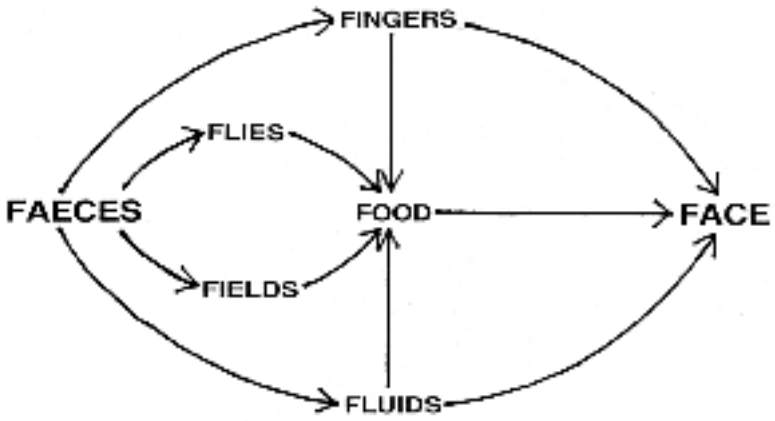


Figure 2.1 *The F-diagram summarizes the main ways faecal pathogens are spread by contaminating fingers, flies, fields, food and fluids and then eventually being swallowed.*

One purpose of an eco-san system is to form a set of barriers between faeces and flies, fields and fluids. This is done by containment of the faeces in a processing chamber or shallow pit where pathogens are reduced to an acceptable level before re-use. Then the contents may be removed for further secondary treatment to make them even safer.

Every eco-san system should also include a device for hand washing in order to block this remaining important pathway for faecal-oral transmission. Every eco-san educational campaign must emphasize not only proper use and management of toilets but also the importance of hand washing after defecation, after helping a child who defecates and before preparing food or feeding a child. (This is of course not unique to eco-san. Hand washing is as important in the use of conventional sanitation facilities.)

2.3 What kills pathogens in faeces?

A number of environmental factors are known to kill off faecal disease organisms. These are increases in storage time, temperature, dryness, pH, ultraviolet radiation, and competing natural soil organisms.

Table 2.1 *Physiochemical and biological factors that affect the survival of micro-organisms in the environment.*[4]

Temperature	Most micro-organisms survive well at low temperatures (below 5°C) and die off rapidly at high temperatures (above 40° C). This is the case in water, soil and sewage and on crops. At temperatures of 55–65°C all types of pathogens (except bacterial spores) die within hours.
pH	Highly alkaline conditions will inactivate micro-organisms. Inactivation is rapid at pH 12 but takes longer at pH 9.
Ammonia	Pathogens in excreta can be inactivated by the addition of ammonia.
Dryness	Moist soil favours the survival of micro-organisms. Dehydration of faeces in an eco-toilet processing chamber will decrease the number of pathogens.
Solar radiation	The survival time of pathogens on soil and crop surfaces will be reduced by UV radiation.
Presence of other organisms	The survival time of micro-organisms may be shortened by the presence of other organisms. Different types of organisms affect each other by predation, release of antagonistic substances or competition for nutrients.
Nutrients	Bacteria adapted to living in the gut are not always capable of competing with other organisms in the general environment for scarce nutrients. This may limit the ability of faecal bacteria to reproduce and survive in the environment.
Oxygen	Most enteric bacteria are anaerobic and thus are likely to be out-competed by other organisms in an aerobic environment.

2.4 Primary and secondary processing

Eco-san systems are designed to use some of the physiochemical and biological factors listed in Table 2.1 to kill disease organisms in faeces. This occurs usually in two steps: primary processing and secondary processing.

Primary processing
The purpose of primary processing is to reduce the volume and weight of faecal material to facilitate storage, transport and further (secondary) treatment. Primary processing takes place in chambers below the toilet (Figure 2.2). Here the faeces are kept ('contained') for a certain period. During this containment the number of pathogens will be reduced as a result of storage time (6–12 months), decomposition, dehydration (ventilation and the addition of dry material), and increased pH (addition of ash, lime, urea) as well as the presence of other organisms and competition for nutrients.

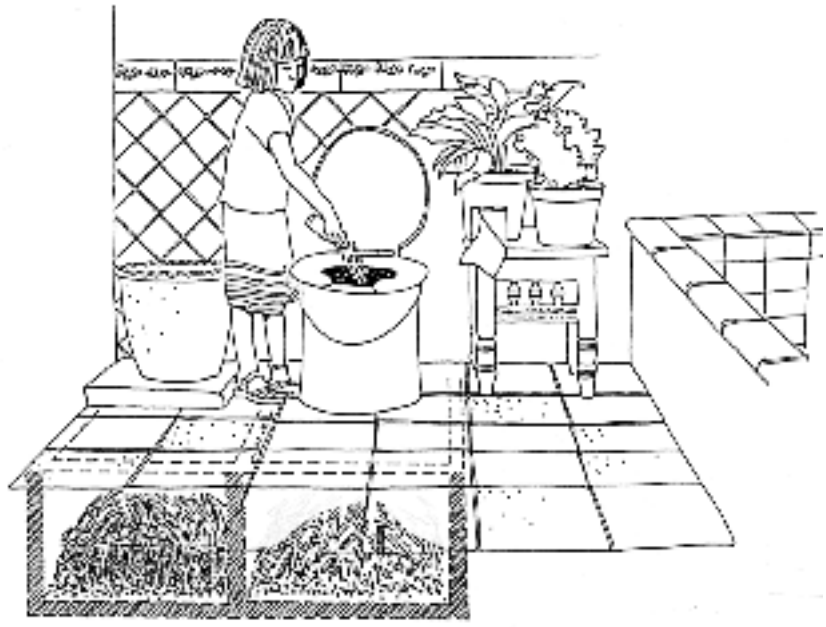


Figure 2.2 *An eco-toilet with processing chambers. The toilet has a moveable seat-riser with urine collector. The processing chambers below the bathroom floor can be emptied from outside. (Design: César Añorve, Cuernavaca, Mexico, 1992).*

In some of the basic models developed in Zimbabwe the processing takes place in a shallow pit beneath the eco-toilet (Figure 2.3).

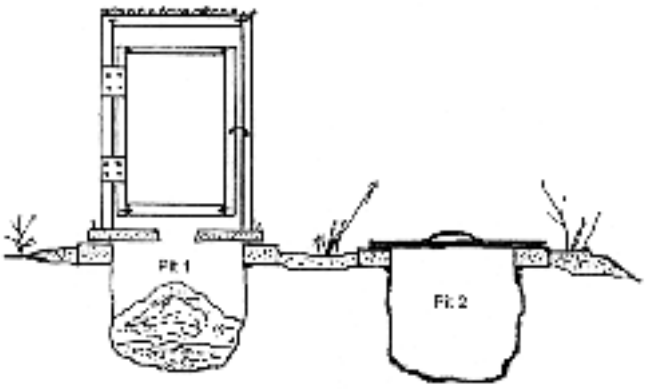


Figure 2.3 *A basic eco-toilet from Zimbabwe with processing chambers in the form of shallow pit. During the first year the squatting slab and superstructure are mounted over Pit 1. Next year they are shifted to Pit 2 (see also 3.1.4). (Design: Peter Morgan, Harare, Zimbabwe, 1998).*

Secondary processing

The purpose of secondary processing is to make human faeces safe enough to return to the soil. Secondary processing takes place either on site – in the garden, or off site – at an eco-station. This step includes further treatment by high temperature composting or pH increase by the addition of urea or lime as well as longer storage time. If a completely sterile end product is required the secondary processing could be carbonization or incineration.

In areas where ambient temperatures reach up to 20 °C , a total storage time of 1.5 to 2 years (including the time stored during primary treatment) will eliminate most bacterial pathogens (if kept dry) and will substantially reduce viruses, protozoa and parasites. Some soil-borne parasite eggs may persist. In areas where the ambient temperatures reach up to 35 °C , a total storage period of 1 year will achieve the same result, as pathogen die-off is faster at higher temperatures.[1]

Where high temperature composting, 50–60 °C , can be carried out, either in an open compost or in a mechanical composting bin (see Figure 8.2) the storage period could be further reduced.

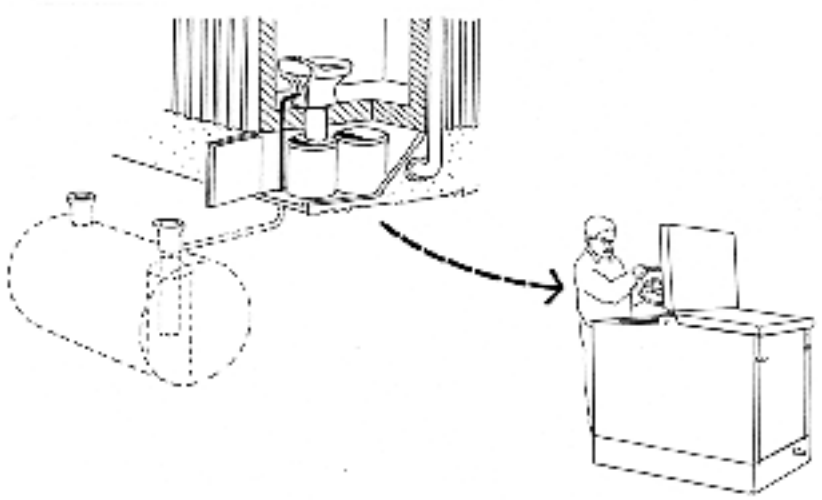


Figure 2.4 *Primary processing in a chamber directly under the urine-diverting eco-toilet followed by secondary processing at an eco-station.*

Treatment with alkaline materials also requires time for pathogens to die off to an acceptable level. A pH over 9 for at least 6 months to 1 year is sufficient in most climates to kill most pathogenic organisms. For additional safety the material can be bagged (in sacks) and stored for a further period. Where there is concern about the persistence of intestinal worm eggs, carbonization or incineration as the secondary treatment will ensure a sterile product.

2.5 Dehydration and composting

Before explaining these pathogen destruction systems in detail, we must step back and explain at this point that there are three main eco-san systems that operate in slightly different ways to achieve more or less the same result. These are dehydrating systems, composting systems, and soil composting systems. These three, and the different toilet designs that go with them, are exemplified in Chapter 3. For now, to understand how pathogens are destroyed, it is only necessary to understand the broad outlines of these systems. Figures 2.4–2.6 show the key points of the three systems.

Dehydration

In a dehydrating system, like those described in Chapter 3, we direct urine away from faeces to keep the processing chamber contents dry and the volume of material small. This also makes it possible for us to use the urine separately as a fertilizer. Faeces are dropped into a processing chamber where they are safely kept out of the environment for a period of 6–12 months, and ash, lime or urea is added after each defecation to lower the moisture content and raise the pH to 9 or higher. The system thus creates conditions of dryness, raised pH and time for pathogen die-off. The partly treated faecal material is then removed from the processing chamber and subjected to one of the four secondary treatments (high temperature composting, alkaline treatment, further storage, carbonization/incineration).

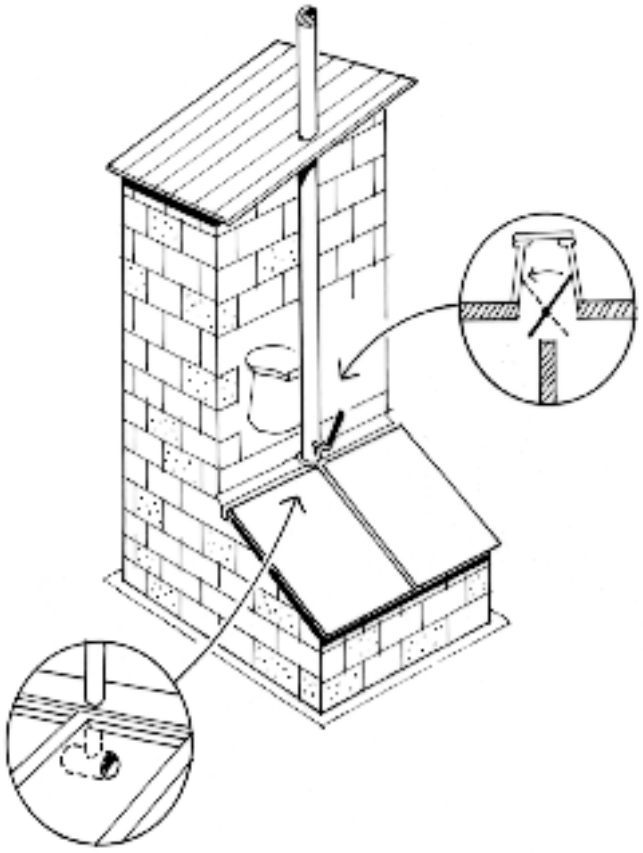


Figure 2.5 *A double-vault composting toilet in Cancun, Mexico [2], see 3.13 Composting toilets – Mexico. (Design: Uno Winblad, Stockholm, Sweden, 1980).*

Composting
In a composting toilet human faeces, or in some cases faeces plus urine, are deposited in a processing chamber along with organic household and garden refuse and bulking agents (straw, peat moss, wood shavings, twigs, etc).

A variety of organisms in the pile break down the solid into humus – just as eventually happens to all organic materials in the natural environment. Temperature, airflow, moisture, carbon materials and other factors are controlled to varying degrees to promote optimal conditions for decomposition. After a certain retention time (normally 6–8 months) the partly decomposed material can be moved to a garden compost or an eco-station for secondary processing through high temperature composting.

Soil composting
In a soil composting system faeces, in some cases faeces and urine, are deposited in a processing chamber together with a liberal amount of soil. There are two main sub-types with slightly different processes: with a shallow pit or a raised processing chamber (see 3.1.4). Ordinary soil is added after each defecation, often with wood ash as well. Most pathogenic bacteria are destroyed within 3–4 months as a result of competition with soil-based organisms and unfavourable environmental conditions.[3] The material is then removed and can be subjected to any one of the same four secondary treatments or, within one family homestead, can be directly spread on fields and worked into the existing soil. A period of 12 months of composting in shallow pits is recommended before application to gardens. There further pathogen die-off occurs because of UV radiation, dryness and competition with other soil organisms. After 1 month, crops that are not eaten raw can be sown with relative safety.[4]

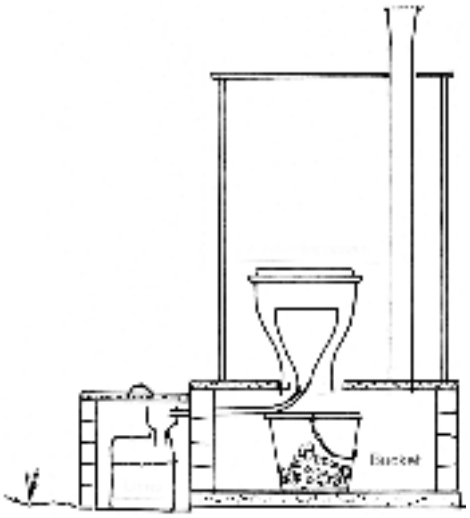


Figure 2.6 *Soil composting in above-ground vault, the 'Skyloo' in Zimbabwe, see 3.1.4. (Design: Peter Morgan, Harare, Zimbabwe, 2001).*

In the shallow pit type (see Figure 2.3) all of the above applies equally except for one design called the 'Arborloo' (see Figure 2.7 and Section 3.1.4) where a homestead owner may plant a tree directly in the shallow pit when it is almost full and has been topped up with soil. In this case no further contact is made with the composted human excreta. The efficient conversion into compost by the addition of other materials to the excreta, and the shallowness of the pits (max 1.5 m deep) reduces the risk of contamination of underground water supplies.[5]

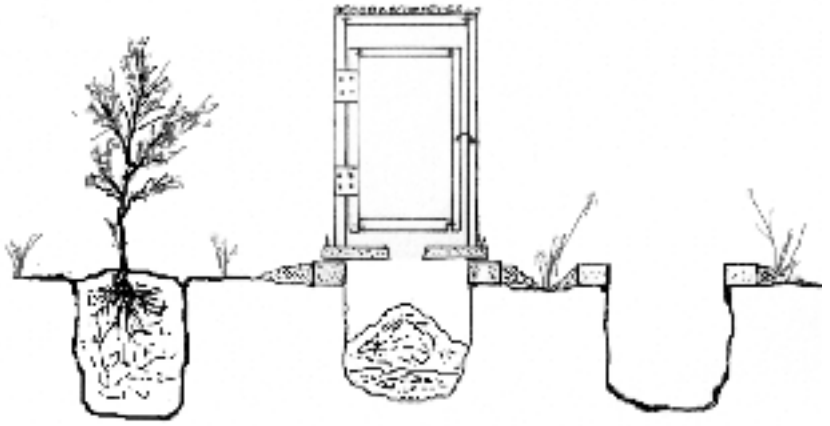


Figure 2.7 *Soil composting in a shallow pit, the 'Arborloo' in Zimbabwe (see 3.1.4). (Design: Peter Morgan, Harare, Zimbabwe, 2001).*

The application of these systems will result in a community environment that is better than the conditions often found in homestead and urban areas where sanitation services are poor and where open defecation may occur. The simple containment of faeces in processing chambers or shallow soil composting pits is a great improvement on open defecation.

2.6 Homestead vs urban systems

Eco-san systems for homesteads and urban areas will be different. In homesteads, households will handle and recycle their own excreta products. In urban areas, these products will be handled and further treated by a communal service, see 4.5.

For urban areas we recommend dehydrating systems with primary and secondary treatment. Municipal authorities will collect all excreta products after primary treatment and take them to a special collection point for secondary treatment (see 4.5.2 and 8.1.3). In homesteads, secondary treatment can be as simple as adding it to a garden compost pile or manure pile, or additional storage for one or two more years. Urine poses little risk and can be used immediately to fertilize crops to be consumed by the family.

2.7 Summary

Urine
In homesteads urine can be used directly. In large-scale systems urine should be stored for about 1 month before use. Don't apply urine less than a month before harvest on vegetables, fruits (except fruit trees) and root crops that are to be consumed raw.

Faeces
Faeces contain most of the pathogens in human excreta and are the main source for transmission of enteric infectious diseases and parasites. Therefore we should treat faeces based on the principles as below:

Keep the volume of dangerous material small by diverting the urine and not adding water to the faeces.

Prevent the dispersal of material containing pathogens by storing it in some kind of secure device (processing chamber, tank)

until safe for recycling.

Reduce the volume and weight of pathogenic material by dehydration and/or decomposition to facilitate storage, transport and further treatment.

Reduce pathogens to a harmless state by sanitization through primary treatment on site (dehydration/decomposition, increase in pH, retention) followed by secondary treatment on/off site (high temperature composting, increase in pH by the addition of lime or urea, and, if necessary, carbonization or incineration).

In properly maintained toilets, there will be no bad smell, wetness or fly breeding. The product is inoffensive and resembles soil, is light and easily handled without producing dust. However, these more pleasant aspects of the product should not be taken as proof of their safety and care should still be taken in handling the product. To further minimize risk, workers could wear gloves when emptying processing chambers or pits and bathe well afterwards – including careful hand washing. However, for a well-managed eco-toilet or processing chamber, pathogen counts should be considerably reduced after primary treatment.[6]

Chapter 3
ECO-SAN EXAMPLES

The purpose of this chapter is to show what eco-san may look like in practice, how eco-toilets function, and how they are operated. We present a number of examples, both ancient and modern. In its own context each of the examples does, to a certain extent, meet the criteria listed in Chapter 1: disease prevention, environmental protection, return of nutrients, affordability, acceptability and simplicity. All of the examples have a great potential for disease prevention and all of them protect the environment and conserve water. The variety of eco-san solutions available today makes it possible, in most cases, to find one that is culturally acceptable. Affordability is relative and while some of the systems described here are high-tech and expensive, others are simple and extremely low-cost.

The examples that follow are organized according to the type of habitat where they may have their main application: homesteads or municipal areas. 'Homesteads' here mean rural or low-density urban habitats where each household has direct access to a yard or garden and where the household itself is responsible for primary and secondary processing and end-use. Under 'municipal areas' we have grouped examples located in or suitable for medium- to high-density development and multi-storey apartment blocks. Here it is not necessary for each household to be directly involved in processing, transport and end-use. All operational and management procedures that take place outside the household's own toilet room can be handled by some kind of community organization as described in Chapter 7.

3.1 Homesteads

3.1.1 Dehydrating eco-toilets

Vietnam

The classic example of an ecological sanitation system is the Vietnamese double-vault toilet. It is widely used in northern Vietnam and over the past 25 years the concept has also been introduced in a number of countries around the world, for example China, Mexico

and Sweden.

In northern Vietnam it used to be common practice to fertilize rice fields with fresh excreta. As this was a dangerous practice, in 1956 the health authorities started campaigns to construct double-vault dry toilets. The campaigns were followed by long and persistent health-education programmes. The objective of the new toilet design was to kill pathogens before the faeces were spread on the fields. [1]

A precursor to the Vietnamese system was developed around 1950 at the Kanagawa Prefectural Public Health Laboratory in Yokohama.[2]

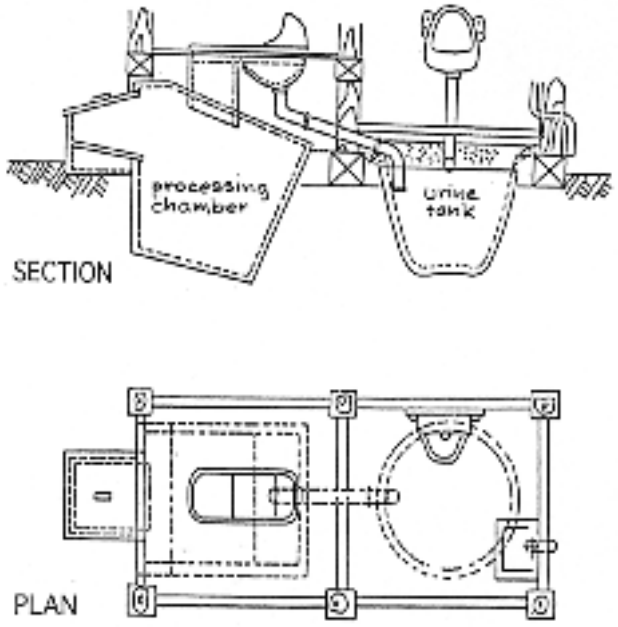


Figure 3.1 *Section and plan of a urine diverting toilet ('Benjo') developed at the Kanagawa Prefectural Public Health Laboratory, Yokohama, Japan, around 1950.*

The Vietnamese toilet consists of two processing chambers each with a volume of about 0.3 cubic metres. The toilet is built entirely above ground with the processing chambers placed on a solid floor of concrete, bricks or clay. The floor is built up to at least 10 cm above ground so that heavy rains do not flood it.

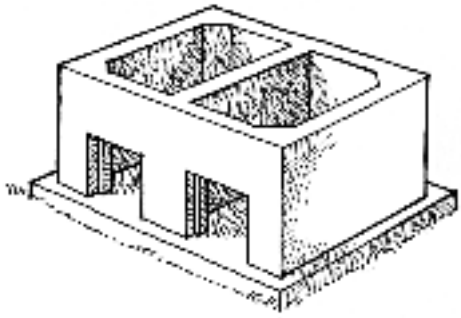


Figure 3.2 *The processing chambers of the Vietnamese double-vault toilet. Each vault is 80 x 80 x 50 cm. The picture also shows the two 30 x 30 cm openings for removal of dehydrated material.*

The processing chambers are covered with a squatting slab that has two drop holes, footrests and a groove for urine. Both holes have tight-fitting lids (not shown in Figure 3.3). At the back there are two openings, 30 x 30 cm, for the removal of the dehydrated material. These openings are kept sealed until it is time to empty one of the chambers.

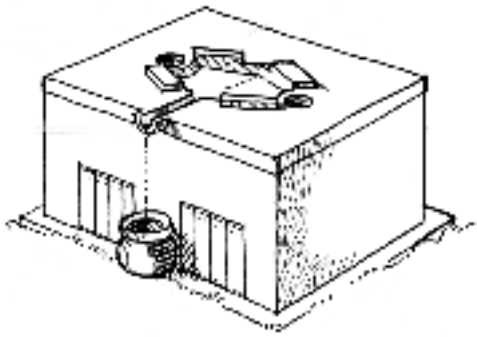


Figure 3.3 *The processing chambers of Figure 3.1 provided with a squatting slab for urine diversion, a pot for collecting urine and doors for the two openings for remoeval of dehydrated material. The drop hole not in use should be closed with a stone and sealed with mud or mortar.*

People excrete in only one chamber until it fills. Before the vault is used for the first time, the household members cover the floor with a layer of powdered earth. The purpose of this earth is to absorb moisture from the faeces and to prevent them from sticking to the floor. After each use people sprinkle two bowls of ashes over the faeces. The ashes absorb moisture, neutralize bad odours and make the faeces less attractive to flies.

Urine drains away through the groove in the slab and collects in a jar behind the toilet. Paper used for anal cleaning is dropped in a box or jar and burnt. Thus in the receptacle there are only faeces, ashes and soil. The contents are therefore fairly dry and compact. The jar for collection of urine can be placed in position either empty or partly

filled with water, lime or ashes. The urine or the urine-soaked ashes are used as a fertilizer.

The first vault can be used for about 4–5 months by a household of 4–6 persons. When it is two-thirds full, someone in the household levels the content with a stick. He or she then fills the vault to the brim with dried, powdered earth, and seals the vault. All openings are tightly closed with lime mortar or clay. The other vault now comes into use instead. When the second vault is nearly full, he or she opens and empties the first vault. The dehydrated faeces, now odourless, are used as fertilizer. The Nha Trang Pasteur Institute recommends a retention time of 6 months and in cool climates 10 months.[3]

In Vietnam the experience of this system is mixed. There is no doubt that it does function well when properly used. A problem in northern Vietnam used to be that some farmers emptied the processing chambers whenever they needed fertilizer, regardless of the retention time. This means that partly processed and even fresh faeces were occasionally spread on the fields. As a result of persistent health education this behaviour is nowadays less common.

China

In 1997–1999 modified versions of the Vietnamese double-vault dehydrating toilet were introduced in several provinces in China by the Sida-funded SanRes programme in cooperation with Unicef and the Chinese Ministry of Health.[4] In Wucun town (Tianyang county, Guangxi province, southern China) the project (managed by the Provincial Health Bureau in Nanning under Ms Li Lingling and Mr Lin Jiang) covered 70 households in Dalu village.[5] The toilets are placed indoors, usually on the second or third floor. Faeces drop through a 20 cm wide PVC chute down to a ground level double-vault processing chamber.

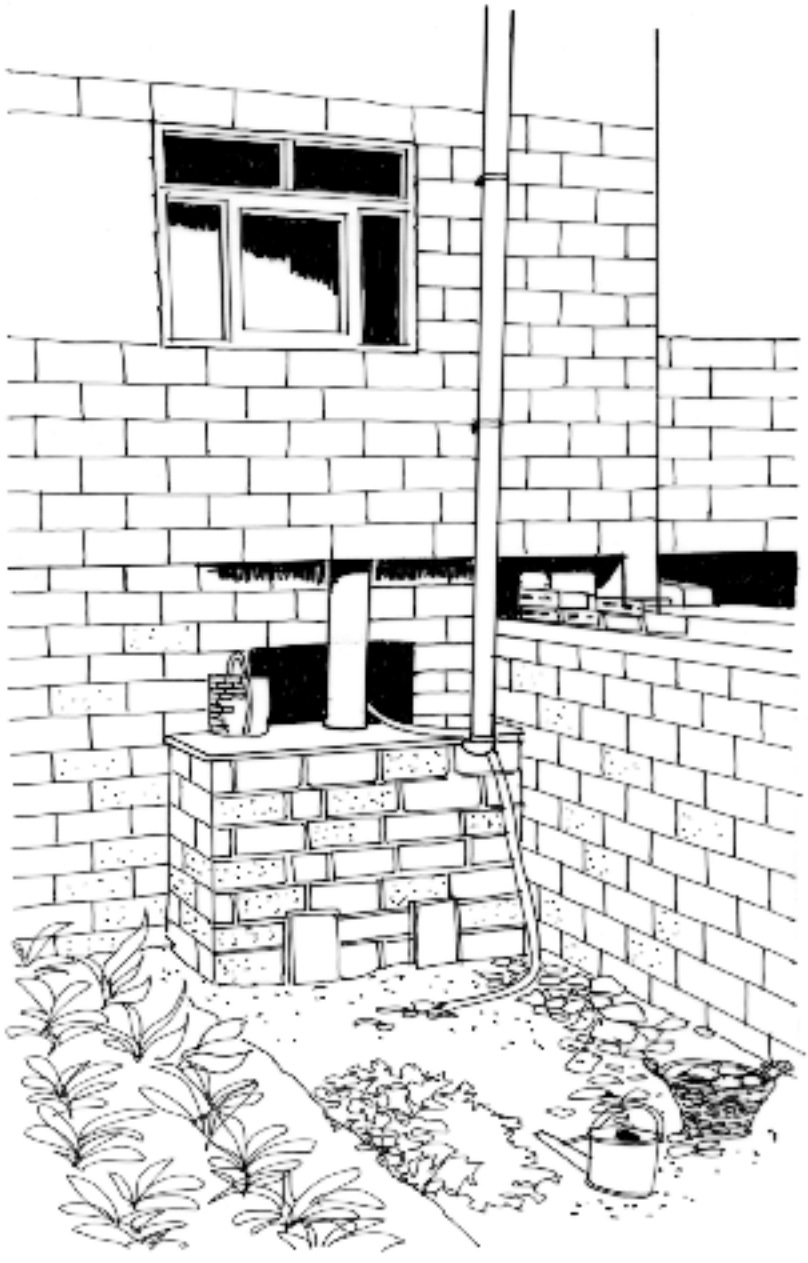


Figure 3.4 *In Dalu village, Guangxi province, China, all households have placed the eco-toilet indoors and upstairs. Faeces drop through a chute into a double-vault processing chamber at ground level. (Design: Lin Jiang, Nanning, China, 1998).*

A baffle, similar to the one shown in Figure 2.5, directs the faeces to one of the vaults. A specially designed squatting pan diverts the urine to a ground level collection point from where it is either fed to the household pigs or used as fertilizer in the household's own vegetable garden. A ventpipe extending above the roof of the building ventilates the toilet room via the processing chamber.

Following the success of the Dalu village pilot project the Yongning county party committee and government in Guangxi province decided to introduce eco-toilets in a comprehensive village environmental improvement programme.[6] By the end of 2000, 45 villages with a total population of nearly 10,000 had introduced the 'eco-village' package, including double-vault eco-toilets with a urine diverting fibreglass squatting pan. School toilets have pedal-operated ash dispensers developed specifically for the programme (see Figure 4.11).[7]

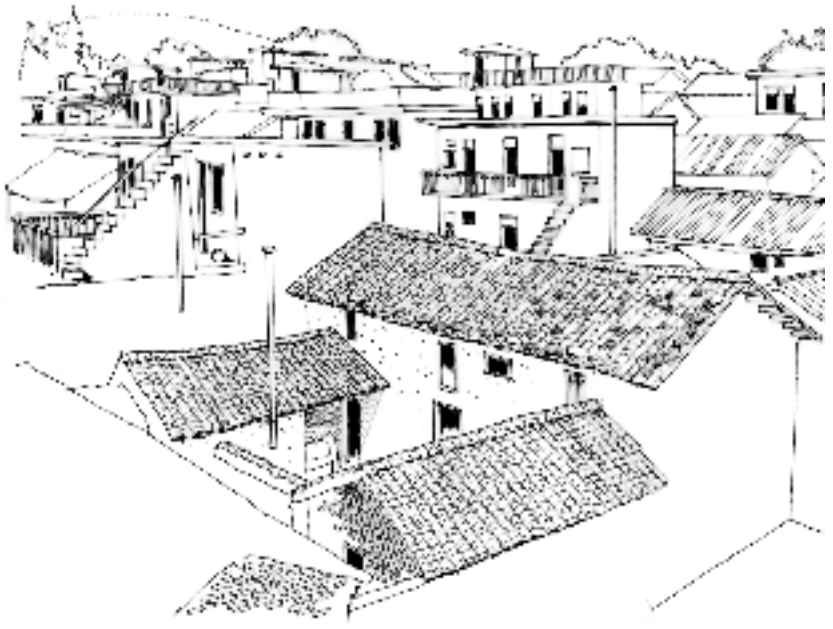


Figure 3.5 *A compact village in Yongning county, Guangxi province, China, where every household has been provided with an eco-toilet.*

Box 3.1 *The Yongning eco-village programme*

The success of the Yongning eco-village programme was, according to Mr Luo Daguang, County Magistrate, Yongning county, due to the following factors:[8]

- political leadership and sound administration;
- collaboration between government departments;
- strong technical guidance and effective use of demonstration models;
- effective mobilization of finance from central government, local government and villagers;
- building on tradition and actual living conditions, solving perceived problems;
- a comprehensive approach linking sanitation, health, agricultural production and domestic and economic improvement.

At the household level the actual construction costs for ecological sanitation are easy to calculate and can be remarkably low. In 2001 the total cost of materials for a typical eco-san toilet in Guangxi province was CNY 284 (= USD 35). This is only a third of the cost of a three-chamber septic tank or a biogas toilet.[9] Private entrepreneurs in different parts of China now produce several models of urine-diverting squatting pans. The pans are made of plastic, fibreglass or porcelain and range in price from USD 5 to 10.

Figure 3.6 *The toilet rooms in the Guangxi province eco-san project have a high standard of finish: a prefabricated squatting pan and tiled floors and walls. (Design: Lin Jiang, Nanning, China, 1999).*

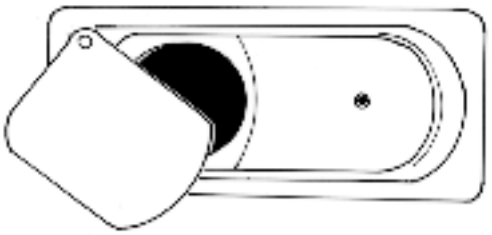


Figure 3.7 *Squatting pan with urine diversion made of plastic. The lid can be pushed aside and closed with the foot. (Design: Lin Jiang, Nanning, China, 1999). This squatting pan is now mass-produced for use all over China and in neighbouring countries.*

The development in Guangxi province in China is an example of the Vietnamese concept brought up to date. As the eco-toilets have a standard of finish equivalent to that of a modern urban bathroom and a ventpipe to reduce odours, most households in Guangxi prefer to place the eco-toilet inside the house. Following the success of the original pilot project more than 100,000 families in other parts of Guangxi province installed urine-diverting, ventilated, double-vault toilets inside their houses between 1998 and 2003.[10] The total number of eco-toilets in China is estimated at 685,000 in 17 provinces (2003).[11]

Central America and Mexico

The Lasf (Letrina Abonera Seca Familiar) is another modified version of the Vietnamese toilet. It was introduced into Guatemala in 1978[12] and over the past 25 years many thousands of units have been built in Central America and Mexico (see Figure 3.8).

Like the Vietnamese original, the Lasf toilet (in Mexico called Sanitario Ecologico Seco) consists of two chambers built above ground, each with a volume of about 0.6 cubic metres. A household of 5–6 persons will produce almost 0.5 cubic metres of dehydrated completely odourless material per year.

The experience of 25 years of use of the Vietnamese double-vault system in Central America and Mexico is positive. Properly managed, there is no smell and no fly breeding in these toilets. They seem to work particularly well in the dry climate of the Mexican highlands. Where the system has failed (wetness in the processing chamber, odours, fly breeding) it was usually due to non-existent, weak or bungled information, training and follow-up.

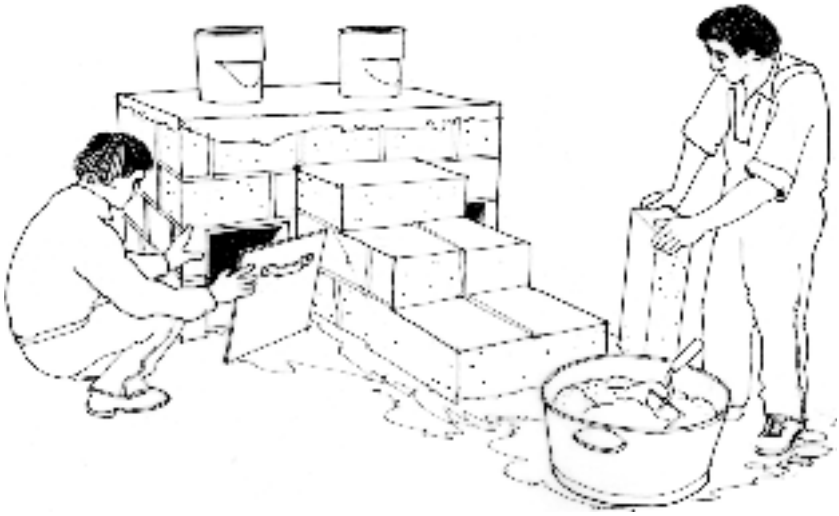


Figure 3.8 *A Lasf toilet under construction in El Salvador. On top of each vault is a seat-riser with a urine collector. The seat-riser not in use is usually covered with a plastic bag.*

3.1.2 Adaptations for 'washers'

India and Sri Lanka

The Vietnamese double-vault toilet was developed for people who use paper, dry leaves etc. for anal cleaning ('wipers'). In some cultures people use water instead ('washers') or a combination of solid material and water ('wipe-washers'). In Kerala, India, a double-vault toilet similar to the Vietnamese one has been redesigned by Paul Calvert (EcoSolutions, Trivandrum, Kerala, India) to suit a population of washers. Not only urine, but also the water used for anal cleaning, is diverted, in this case into an evapo-transpiration bed next to the toilet.[13]

The vault is lined with straw before use. This provides a carbon-rich bed to receive the faeces and also absorbs moisture. A scoopful of ashes is sprinkled over the faeces after each use. Occasionally some straw, leafy material and paper scraps are also added, which means that there is a process of decomposition rather than dehydration. A reduction in volume of the vault contents confirms that decomposition is occurring. Each vault is in use for about a year. The toilet can be operated in both composting and desiccating modes, the choice de-

pending on local conditions and the type of residues available for covering the faeces.

The evapo-transpiration bed, depending on the space available, may also receive shower and kitchen greywater flows and requires little maintenance. This bed is often used for the production of flowers, fruits and vegetables, making beneficial use of the nutrients in urine.

A dry, above-ground toilet was chosen because this coastal part of Kerala has a high water-table and wells have been contaminated by seepage from pit and pour-flush toilets.[14] The new system has been established in over 300 households in urban and rural areas in Kerala, many of them operating since 1995. The design has been replicated in other parts of India such as Madras, and success in India led to its introduction in Sri Lanka in 2000.[15] Many of the toilets are built close to or attached to the house. There are also more refined examples inside urban homes which have been operating successfully since 2000 with the latest designs installed on the second floor of apartments. These toilets are built for the equivalent of between USD 80 and 150 depending on superstructure and standard of finish.[16,17]

This example shows that a dry system of sanitation can work well in a humid climate where the users are washers. It also shows that the device (a double-vault toilet with urine diversion) that works in Vietnam by using dehydration can, with the addition of carbon-rich material work by using a decomposition process instead. The success to date is due to good mobilization of the local population, especially the women, and to effective hygiene education and regular follow-up.

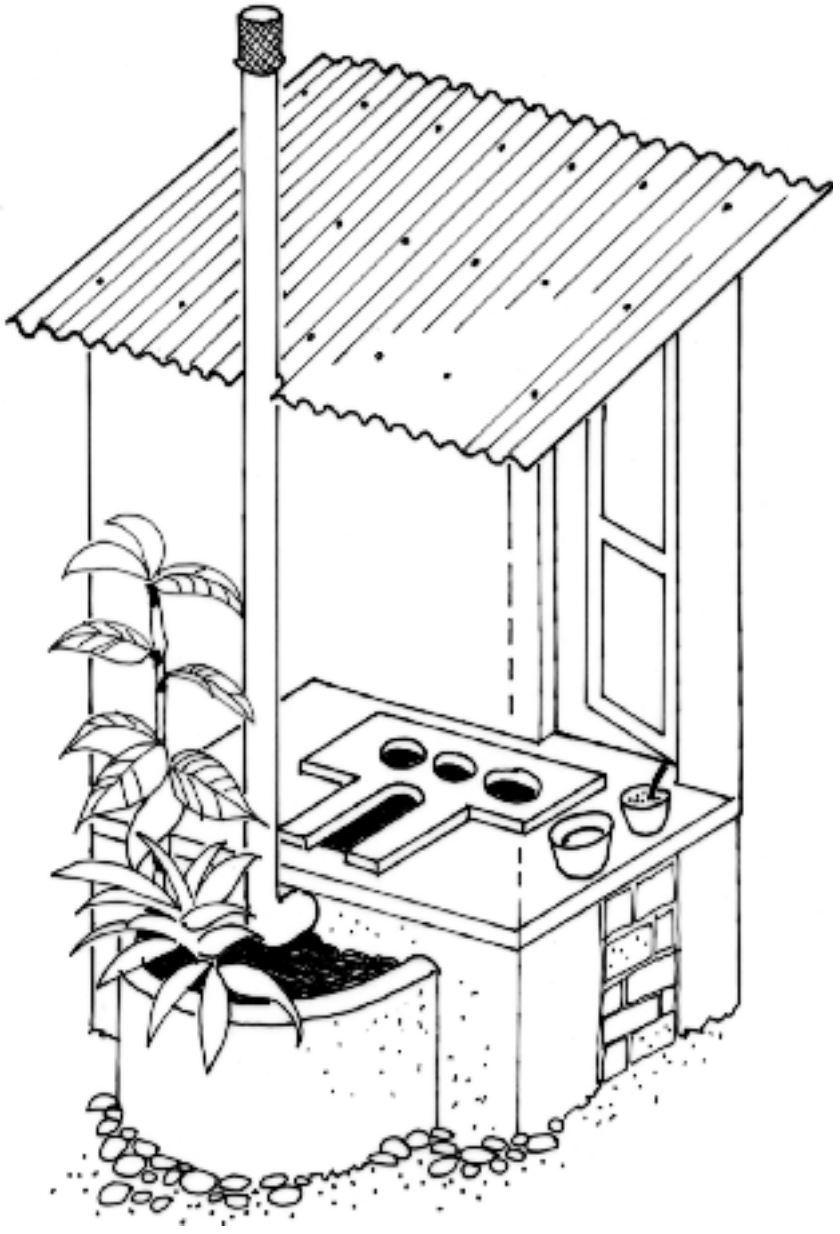


Figure 3.9 *The Kerala double-vault toilet. Over each vault there is a drop hole for faeces and a funnel for urine. Between the two vaults is a trough over which anal cleaning is performed. (Design: Paul Calvert, EcoSolutions, Trivandrum, Kerala, India, 1994). The water used for anal cleaning and the urine flow into the evapo-transpiration bed planted with bitter gourd, plantain or* Cana indicus.

Palestine

Another example of the Vietnamese double-vault toilet adapted to a washer culture (wipe-washers in this case) is from the Hebron area in Palestine. In this extremely hot-dry, water-starved area 28 households, many of them large (>10 family members) were provided with eco-toilets in a Sida-funded project managed by the Palestine Hydrology Group (PHG), Jerusalem, in 2001 and 2002.[18]

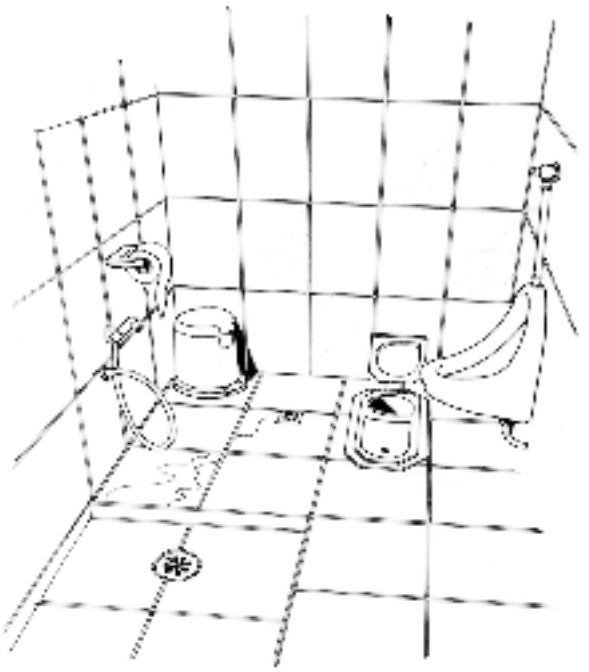


Figure 3.10 *A typical toilet-bathroom in the PHG project, Beni Naim village, Hebron, Palestine. The lid of the squatting pan is open and the drop hole for faeces is visible. To the left of the urine diverting squatting pan is a drain for anal cleaning water. (Design: Yousef Subuh, Beni Naim, West Bank, Palestine, 2000). The low shower on the left is for anal cleaning. On the right is a urinal.*

The eco-toilets in this project consist of a squatting pan for urine diversion, a drain for water from anal cleaning, a urinal, and below the floor a processing chamber with access door and ventpipe. The toilet is thus designed to handle three separate streams: faeces, anal cleaning water and urine.

Toilets on upper floors have a chute down to the single processing chamber. The faeces are collected in a wide, low plastic container. When one is full, an empty container is placed under the drophole

and the full container is stored in the processing chamber until the second container is full.

Operation and maintenance are facilitated by the extremely dry climate of the Hebron area, the good availability of lime as an additive, and the high standard of finishing of the toilet rooms. The total cost of each unit in 2002 was in the range USD 700–1000.

This small, well-conceived, high standard project shows that ecological sanitation could be a serious sanitation alternative for Palestine.

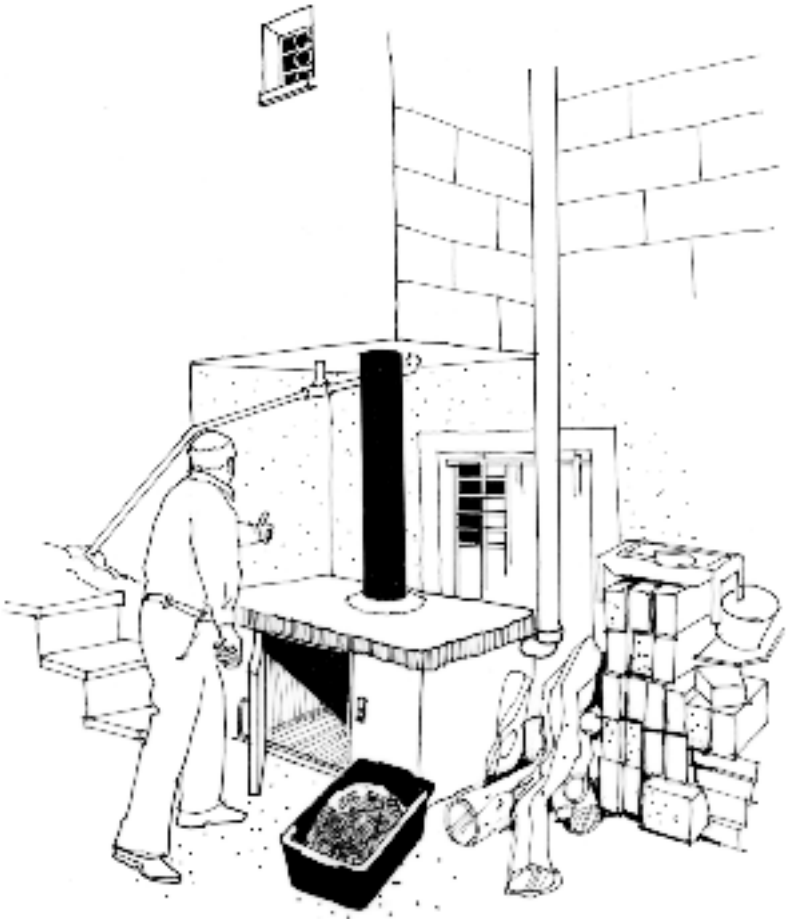


Figure 3.11 *Processing chamber with PVC chute from first floor indoor toilet, West Bank, Palestine. Urine, water for anal cleaning and greywater are treated in a septic tank.*

3.1.3 Composting toilets

Sweden

Composting toilets for use in weekend houses were introduced in Sweden more than 50 years ago. Since then a wide variety of models have come on the market and they are now used in different parts of the world, including North America and Australia. Commercially available composting toilets range from small units, about the size of a standard flush toilet fixture, to larger ones that utilize a simple toilet pedestal in the bathroom connected by a drop chute to a composting vault below the floor.

The example shown below is the classic model, 'Clivus', developed by Richard Lindström, Täby, Stockholm.[19] It is a single-vault composting toilet with combined processing of urine, faeces and organic household residues. It consists of a composting vault with an inclined floor, air conduits and at the lower end a storage space. A tube connects the toilet seat-riser with the processing chamber and there is sometimes a special chute for kitchen refuse. There is a constant draught due to natural convection from an air intake in the composting vault, through the air conduits and out via a ventpipe.

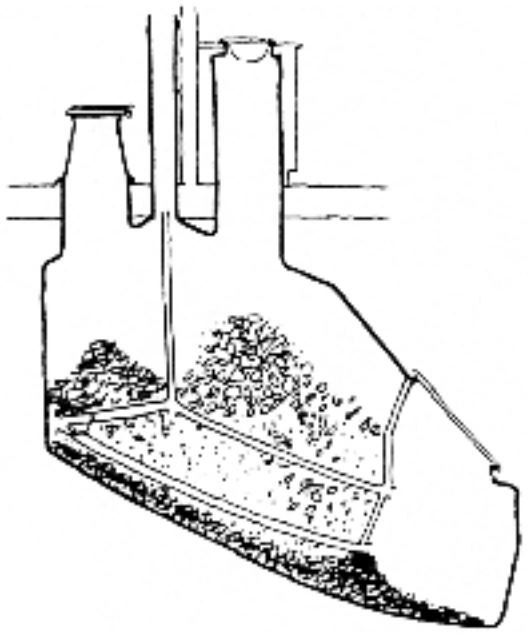


Figure 3.12 *A composting toilet placed in the basement of a house. This model – 'Clivus', the classic model – has a separate chute from the kitchen for food left-overs etc. Perforated pipes bring air into the centre of the compost pile.[20] (Design: Ricard Lindstrom, Tyreso, Sweden, around 1940).*

Into the processing chamber goes not only faeces, toilet paper and urine but all kinds of organic kitchen and household residues: vegetable and meat scraps, peelings, bones, eggshells, floor sweepings, sanitary napkins and grass clippings (but not cans, glass, plastic or large amounts of liquids of any kind).

Because the floor of the processing chamber slopes, the contents are supposed to slide slowly from the upper end down to the storage part of the vault. The process of decomposition reduces the heap to less than 10% of the original volume.

The heap gradually becomes humus: a black, lumpy substance similar to good garden compost. It may take several years until a household has to take out the humus for the first time. After that they may have to remove it once a year. The amount of humus produced varies from 10 to 30 litres per person per year. (The large part of the receptacle is never emptied. Only material that has passed under the partition separating the storage vault from the rest of the receptacle is removed.)

The maximum number of users depends on factors such as temperature, humidity, amount and type of refuse, proportion of urine to faeces, and volume of the receptacle. In most cases the maximum for one Clivus (the classic model in Figure 3.12) in regular, year-round use is 8–10 people.

If the classic model of the Clivus Multrum is properly built and well looked after it can be reasonably nuisance free. But frequently there are problems: liquids accumulate at the lower end of the composting vault, these liquids will carry pathogens from fresh faeces at the top of the pile and contaminate old, already decomposed material at the bottom. (This problem could be avoided if the Clivus was fitted with a urine diverting seat-riser.) Another problem is that the solids often get stuck halfway down the incline. This problem can be avoided if instead of one vault with an inclined floor there are several chambers, as in the following example.

Norway

The Norwegian 'Carousel' has long been one of that country's most popular composting toilets, and about 60,000 units have been installed around the world since 1973. Similar types are also manufactured in other countries.[21]

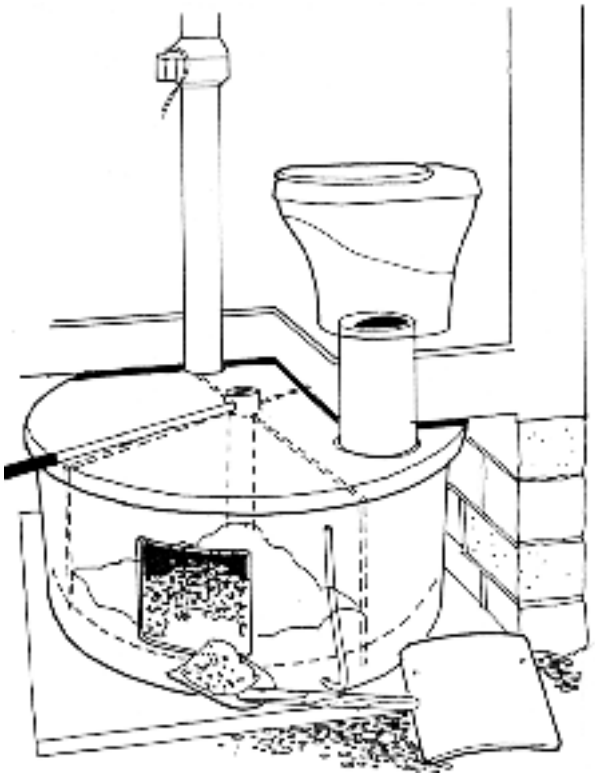


Figure 3.13 *The 'Carousel' composting toilet from Norway.*

The design of the Carousel features a below-the-floor processing vault consisting of a cylindrical outer tank in which a slightly smaller inner tank is able to rotate on a pivot. The inner tank is divided into four chambers (six on some models). The one in use is positioned directly below the drop chute from the toilet in the bathroom. When a chamber is filled, the inner tank is rotated so that the next chamber is positioned below the toilet. In this way each chamber is filled in sequence. The material in the oldest chamber is removed through an access door. Liquid drains through holes at the bottom of the inner tank into the outer one, where it may be collected in a separate container, discharged into an evapo-transpiration bed or evaporated.

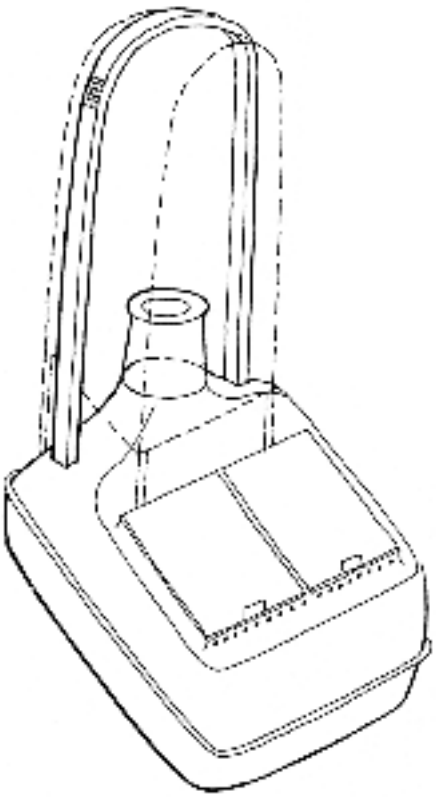
The Carousel can be equipped with either a urine diverting or with a non-diverting seat-riser. Several different size units of varying capacity are available at prices between NOK 14,000 and 20,000 (USD 2000–2800).

Mexico

A prototype double-vault, solar-heated composting toilet was originally developed by Uno Winblad in Tanzania in the mid-1970s and further developed in the early 1980s together with Josefina Mena and Grupo de Tecnología Alternativa in Mexico. Prefabricated fibreglass and polyethylene models (called 'Sirdo Seco') have been in production since 1987.

Like the Vietnamese toilet, this Mexican design has a receptacle divided into two chambers. Above the dividing wall there is a baffle directing the excreta into one of the chambers. When that chamber is full, the excreta are directed into the other chamber (see Figure 2.6). Single-vault models are also available.

The processing chambers extend outside the superstructure and have lids that are also simple solar heaters. If the lids face the sun the evaporation from the chamber and the temperature of the surface of the compost pile will increase.



The prices of a prefabricated seat-riser and solar-heated processing chambers range from MXN 2500 to 3100 (USD 227 to 282) depending on model and of a prefabricated superstructure from MXN 2072 to 2485 (USD 190–226).

Figure 3.14 *The 'Sirdo Seco' double-vault, solar-heated composting toilet in Mexico. The whole toilet, including the superstructure,was originally made of fibreglass but since 1996 has been made of rotomolded polyethylene.*[22] *(Design: Josefina A. Mena, Mexico City, 1987).*

This solar heated composting toilet has been used with good results in Mexico for 20 years. One particular advantage with the light-weight, prefab model is that it is mobile. People living in squatter settlements can be evicted at short notice. If this happens they can arrange to have the toilet emptied and take it with them like a piece of furniture.

Box 3.2 *The Centre for Clean Development (CCD) toilet in Micronesia*

A prototype of the CCD design constructed out of concrete blocks in 1992 by Greenpeace and local participants on the island of Yap in the Federated States of Micronesia was used regularly by four adults and three children for one year. Four slightly modified units were then built by CCD in 1994 on the island of Pohnpei for use by individual families of from 6 to 12 people. Periodic visual inspection indicated that solids in the digestion vault had undergone biodegradation, and that all excess liquids had been evaporated. In all cases the users expressed satisfaction with the toilets and reported no foul odours. This is specially noteworthy given the humid climate of Pohnpei, where the average rainfall is nearly 5000 mm per year. As of May 1997 all four of the CCD toilets were reported to be functioning well based on visual inspection and interviews with the owners by a member of the project team. Remarkably all but one of the demonstration units had gone more than 2 years before switching over to the second digestion vault, indicating greater than expected capacity. The Federated States of Micronesia national government is currently building at least 40 more units in Pohnpei and the state's environmental agency has indicated its intention to require their use in environmentally sensitive areas.

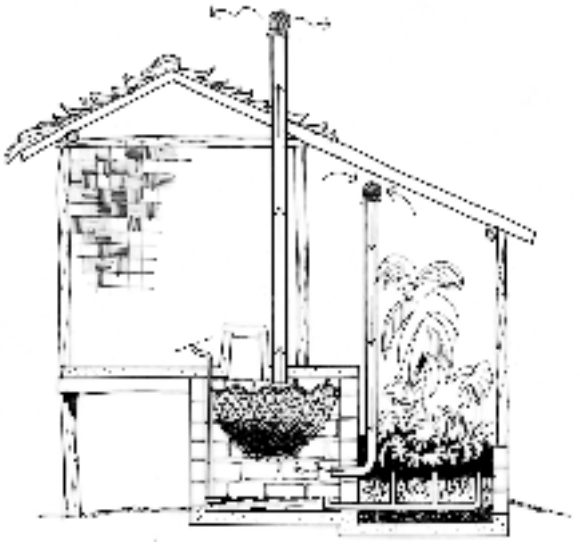


Figure 3.15 *The CCD composting toilet with attached greenhouse and evapo-transpiration bed (Design: David Del Porto, Concord, Mass., USA, 1992).*

3.1.4 Soil composting sanitation systems

Ladakh, India

Ladakh is a dry highland region in the western Himalayas at an altitude of 3500 metres. Most traditional houses have an indoor toilet on the upper floor (see Figure 3.16). Due to an extremely dry climate it is possible to process human excreta indoors without prior diversion of urine, by using a combination of soil composting and dehydration.

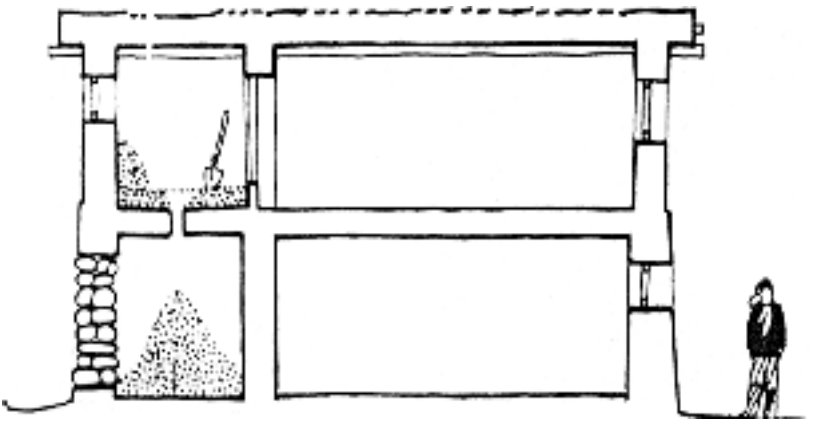


Figure 3.16 *Indoor, traditional dehydrating toilet in Ladakh, India.*

On the floor of a small room next to the kitchen/living room there is a thick layer of soil from the garden. In the floor a drop hole leads to a small ground-floor room. This room can only be reached from the outside. People excrete on the soil which is on the floor. Then they push soil and excreta together down the drop hole. Urine goes the same way. Ashes from the kitchen are added from time to time. The household members bring loads of soil into the room when necessary. For the long winter (September–May) a supply of soil is piled into one corner of the toilet room upstairs. A spade or shovel is also kept in the room. Normally there is no anal cleaning. The decomposed excreta are removed in spring and again at the end of summer and spread on the fields.

As long as the toilet is well maintained and enough soil is pushed down the drop hole every day, there are no odours. In some cases there might be a faint smell of ammonia from urine splashed on the soil-covered floor of the toilet room. There is no fly breeding due to the dryness of the soil/excreta pile. The system has worked well in rural areas for hundreds of years but in recent years there have been

some problems in the central part of the town of Leh where households have no easy access to soil.[23]

Box 3.3 *Nineteenth century earth closets*

During the second half of the nineteenth century there was a fierce contest in Britain between those who favoured water closets and those who favoured earth closets. The first patent for an earth closet was taken out in 1838 by Thomas Swinburne but his device was not widely adopted. The breakthrough came quarter of a century later with the work of Henry Moule. He experimented by burying the contents of his own household bucket toilet in the garden. He discovered that in 3–4 weeks there was no trace of the buried material. Moule went on to design a toilet that deposited a controlled amount of earth on the fresh faeces from a hopper behind the seat-riser. He went on to establish the Moule Patent Earth-Closet Company Ltd and developed luxury models as well as ones designed for barracks, schools and hospitals. Various other inventors patented semi-automatic devices to flush the toilet with earth when the pressure on the seat was released or when a foot pedal was pressed.

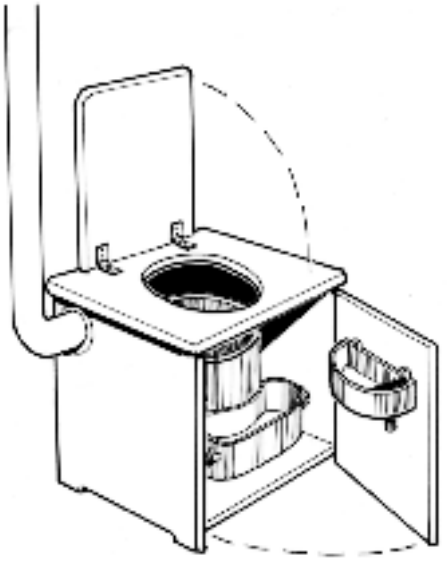


Figure 3.17 *Henry Moule's earth closet, around 1860.*

Henry Moule was an effective publicist and used pamphlets to promote the advantages of earth-based sanitation and the insanity of waterborne sanitation. In 1861 he published a pamphlet called 'National Health and Wealth' which generated widespread support. *The Lancet* of 1st August 1868 reported that 148 of his toilets were used by a military encampment in Wimbledon, London. Forty of them were used daily by 2000 men without any annoyance of odour. In 1860 a number of schools switched from water closets to earth-closets because they were considered more reliable and cheaper to maintain.[24]

Zimbabwe
By applying the eco-san approach to traditional pit-toilets Peter Morgan in Zimbabwe has developed a series of low-cost eco-toilets based on soil-composting. He calls them the 'Arborloo', the 'Fossa Alterna' and the 'Skyloo'.[25] They are intended for use in warm climates.

The Arborloo consists of a shallow pit covered with a squatting pan (see Figure 2.3). Urine and faeces are deposited into the pit and covered with soil after each deposit. The composting process is improved if some wood ash and leaves are also added. The approximate mixture of ingredients is 50% excreta and 50% additions (soil, ash, leaves). When the pit is nearly full, the slab and structure are removed and the pit is topped up with additional soil.

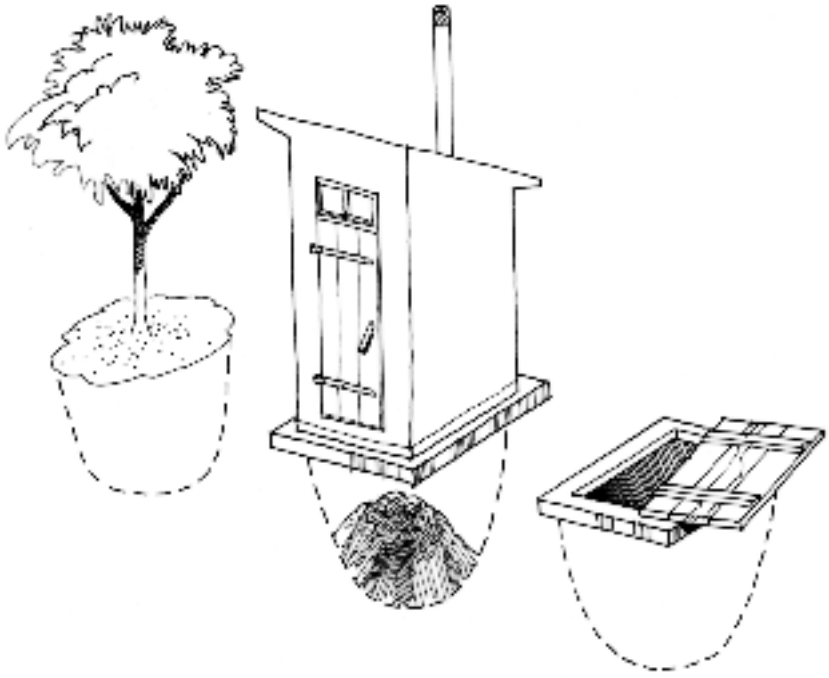


Figure 3.18 *The Arborloo in Zimbabwe. When the first pit is full a tree is planted in it. The superstructure is moved to a new pit and the process repeated.*

The soil is lightly watered and a tree is planted in the top soil that has been added to the pit. The roots of the young tree grow in the plain top soil at first, invading the mix below as it turns into humus. The idea is to use one shallow pit for between 6-12 months, plant a tree, and then move to the next site and repeat the cycle. Each 6-12 months a new pit is added and a new tree is planted, thereby gradually creating an orchard or woodlot.

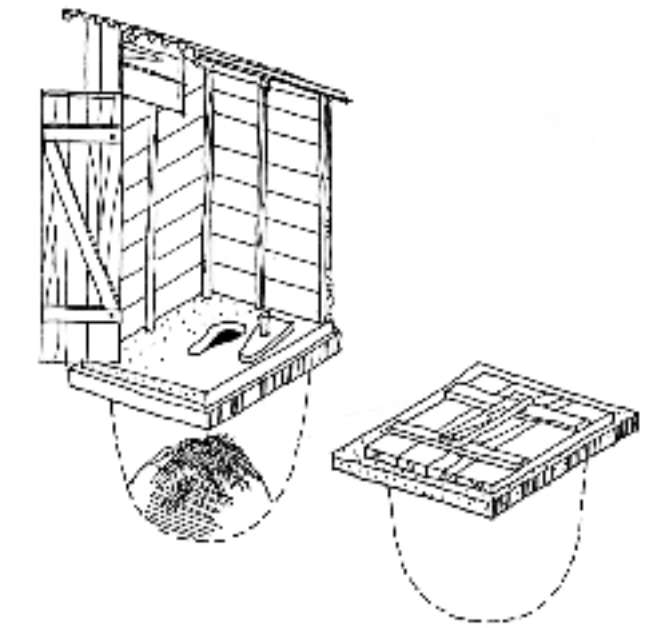


Figure 3.19 *The Fossa Alterna in Zimbabwe. Two shallow pits are dug. When one pit is full the other one is used. When the second is full the first pit is emptied and the contents used as fertilizer/soil-conditioner in the household garden.*

The Fossa Alterna works on a similar principle and consists of two shallow pits dug at the same time and close to one another. One is covered and the other is used for about a year as a shallow pit toilet. As with the Arborloo, urine and faeces are deposited into the pit and covered with soil after each deposit. The regular addition of wood ash and leaves into the pit is also recommended as this produces a better end product. When the used pit is nearly full, the slab and structure are removed and placed on the second pit and the first is topped up with additional soil. After a second year, both pits are full.

The older one is opened and the contents, which have changed into a soil rich in nutrients and soil micro-organisms, are removed. This soil

can be mixed with poor topsoils to considerably enhance their fertility (see also Chapter 5). The toilet slab and structure are then placed back on the original pit. Organisms in the soil break down the excreta and the toilet paper. Peter Morgan recommends that the pit soil is allowed to compost for at least a year before removal.

The Skyloo is a urine diverting system using a single shallow vault in which a removable container, such as a bucket, is placed to collect faeces, toilet paper and a mix of soil and wood ash, which is added after every defecation. Urine is diverted as in the Vietnamese-type toilets described earlier in this chapter. The contents of the bucket are removed at intervals and placed in a secondary composter – a jar or shallow pit where more soil is added and the mix kept damp. A nutrient-rich humus is formed in the secondary composter within months. The secondary composter linked to the Skyloo is normally designed for a retention time of 6–12 months.

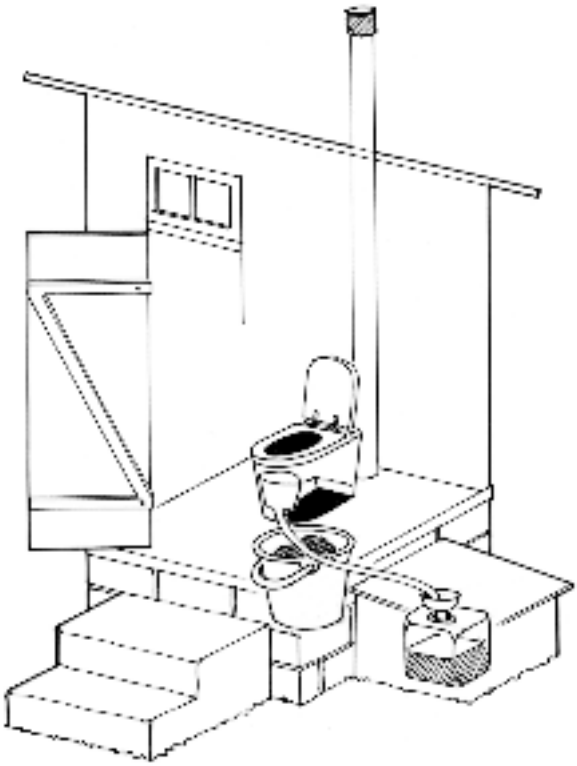


Figure 3.20 *The Skyloo in Zimbabwe. The urine-diverting pedestal directs urine into a pipe which is led to a urine storage container. The faeces drop directly into the bucket in the vault. The users add dry soil and wood ash after every visit.*

3.2 Municipal areas

3.2.1 Double-vault dehydrating eco-toilets

El Salvador

In Mexico and Central America there are many contemporary examples of the urban use of double-vault dehydrating toilets. One example is in El Salvador: Hermosa Provincia is the name of a small, densely built up low-income barrio in the centre of San Salvador. Water is scarce, plots are small and the subsoil is hard. Here all the 130 households built Lasf toilets in 1991. As there is little space between the houses and often no backyards, the Lasf toilet (see 3.1.1 – Central America and Mexico) is usually attached to the house, sometimes even placed inside the house.

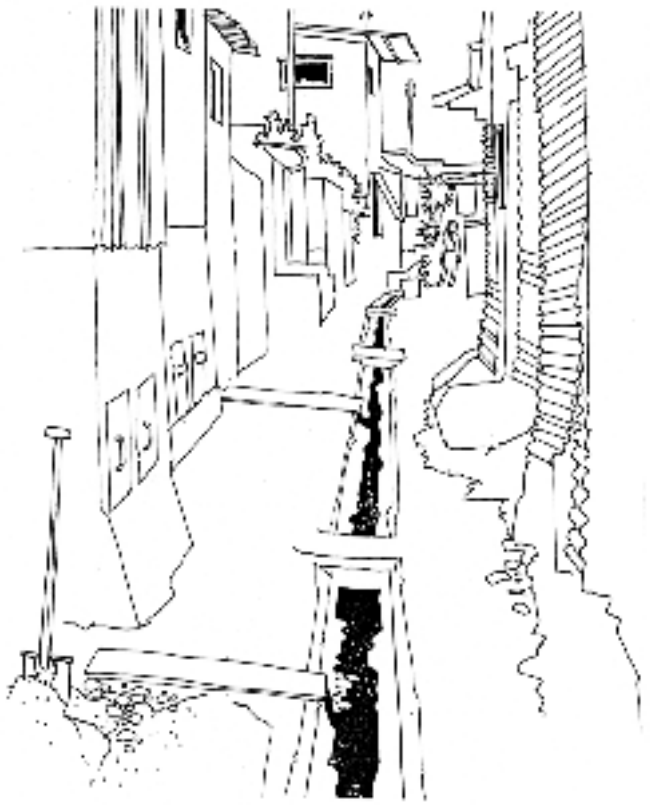


Figure 3.21 *A street in Hermosa Provincia, a high-density squatter area in the centre of San Salvador. Each household has its own Lasf toilet, most are attached to, or placed inside, the house.*

All the units in Hermosa Provincia were 6 years later still functioning extremely well thanks to a high level of community participation. There were no bad odours from the toilets and no fly-breeding in the processing chambers. The dry mixture from the toilets was used to reclaim wasteland or put in bags and sold.

UN-Habitat estimates that the global number of slum dwellers will increase to about 2 billion in the next 30 years, if no firm and concrete action is taken.[26] The Hermosa Provincia example shows that an eco-san system can be successfully used in a poor, high-density, inner-city squatter area ('slum').

Mexico

César Añorve in Mexico has spent the past 20 years promoting the Vietnamese sanitation system. His version of the Vietnamese toilet is a high-standard, in-house solution: a moveable, urine-diverting seat-riser made of fibreglass or concrete (see Figure 2.2).

The 2004 price of a seat-riser plus a urinal in polished concrete is the equivalent of MXN 506 (USD 46). The price of seat-riser and urinal in fibreglass is MXN 1150 (USD 105).

Sweden

A Swedish adaptation of the Vietnamese double-vault dehydrating toilet was developed by professor Mats Wolgast about 20 years ago. Urine is flushed to an underground storage tank with a small flush of water (about 0.1 litre). The volume of the tank is usually 0.5 cubic metres per person. The tank is periodically emptied and the urine transported to a farm for use as fertilizer. Faeces and toilet paper drop down into an insulated vault where they are collected in an 80 litre plastic container. There is a fan to draw air from the bathroom, down the toilet to the processing vault and out through a ventpipe.

When the container is full (after 2–3 months) it is put aside and an empty container is placed under the toilet. The full container is left in the vault for about 6 months. The dehydrated contents can then be further treated (secondary treatment) in a ventilated compost bin (see Figure 2.4), carbonized or incinerated.

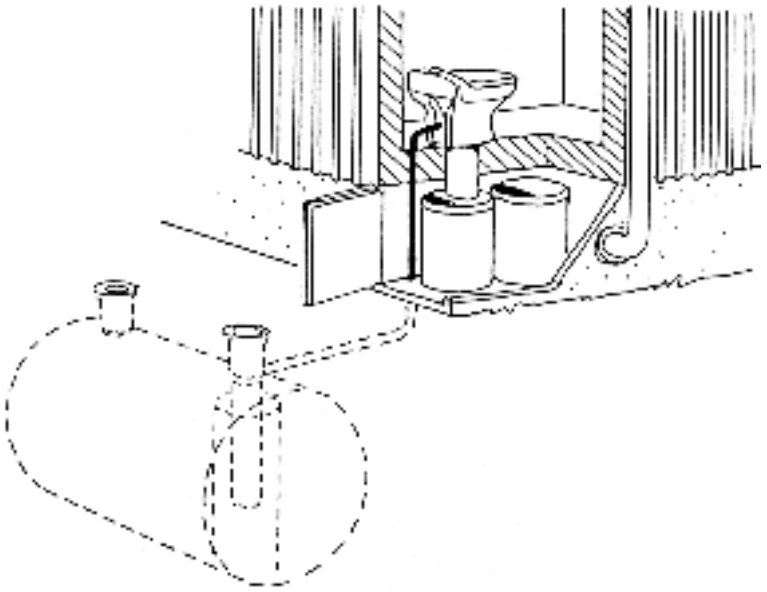


Figure 3.22 *A dehydrating toilet installed inside a house in Sweden. Faeces and toilet paper are dropped in a large bucket. Urine is piped to an underground storage tank. (Design: Wost Man Ecology AB, Stockholm, Sweden, 1991).*

The retail price of the porcelain toilet seat-riser with urine diversion was in 2004 about SEK 3000 (USD 450). The total on-site cost for a toilet like this (seat-riser, fan, processing vault, transport container and a 1000 litre urine tank) is in Sweden SEK 7000–10,000 (USD 1000–1400).

There are at present about 3000 units installed in Sweden: in weekend houses, permanent houses, apartments, industries and institutions.

3.2.2 Long-drop dehydrating

Yemen

In the old parts of the city of Sana'a, as in other Yemeni towns, the traditional houses are tall, rising five to nine stories from narrow streets. A house is usually occupied by one extended family. Each upper floor has one or two toilet-bathrooms next to a shaft (a long, narrow vertical passage). Figure 3.23 shows how this shaft runs from the top of the house to the level of the street.

Each bathroom has a toilet. The urine drains away from the squatting

slab to a groove in the stone floor. From there it goes through an opening in the wall of the house, down a vertical drainage surface on the outer face of the building. The urine evaporates on its way down the drainage surface. The faeces drop through the squatting-hole, down the shaft, to a vault at street level from where the dried faeces are periodically collected, further dried on the roof of the neighbourhood public bathhouse and finally used as fuel for heating water.

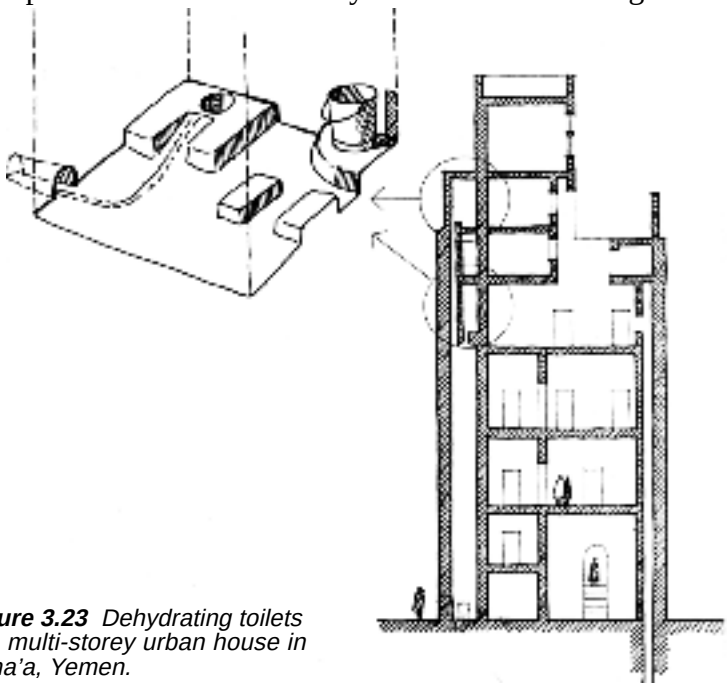


Figure 3.23 *Dehydrating toilets in a multi-storey urban house in Sana'a, Yemen.*

Anal cleaning takes place on a pair of square stones next to the squatting slab. The water used for anal cleaning as well as bath water is drained in the same way as the urine. No liquids are thus led into the long-drop shaft or the vault below. As Sana'a has a hot, dry climate, the faeces quickly dry out.[27]

Next to the toilet there is, during morning hours, a charcoal fire in a bucket. After anal cleaning with water, the Yemenites dry themselves by squatting over the bucket.[28]

This is an example of the eco-san approach to sanitation applied to an urban situation with multistorey housing and communal collection of dehydrated faeces by special staff. It is also an example of a dry sanitation system used in a culture where people are washers. It has been successfully used in the towns of Yemen for hundreds of years.

There is no smell and no fly-breeding. Urine and cleaning water are evaporated. Faeces are sterilized in three steps: first dehydrated on site, then further dehydrated and subject to direct solar radiation at the public bathhouse, and finally reused as fuel. In modern times this age-old system has been replaced by flush toilets. As a result of increased water consumption the water-table in Sana'a is falling by 6 metres a year. The World Bank expects Sana'a to exhaust its remaining water supply by 2010.[29]

Sweden: Gebers, Stockholm

A modern version of the long-drop dehydrating system was built on the outskirts of Stockholm when in 1998 a housing cooperative rebuilt a vacated multi-storey nursing home, Gebers, and turned it into 32 apartments. One of the ambitions of the housing cooperative was to recycle all the nutrients of the human waste to agriculture. The system has now been in use over 6 years and is working well.[30]

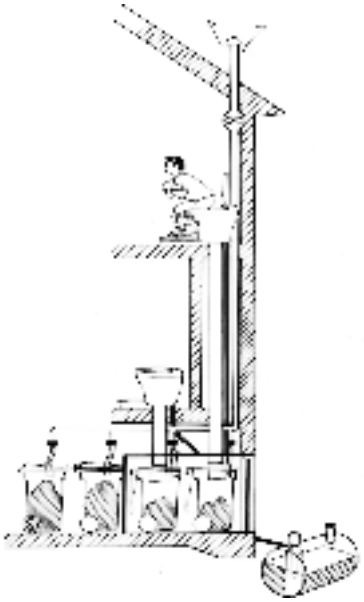


Figure 3.24 *Gebers housing cooperative in Stockholm – an example of adapting an eco-san system to an existing building. (Design: Anders Schonbeck, Lysekil, Sweden, 1996).*

China: Erdos, Inner Mongolia

A solution similar to the one used at Gebers in Stockholm is now being tested in a large pilot eco-san project in Erdos Municipality, Inner Mongolia, China (see 8.1.4). About 2000 apartments and houses under construction (2004–2006) are being provided with dehydrating, urine-diverting toilets and local greywater treatment based on a communal system of collection and management.

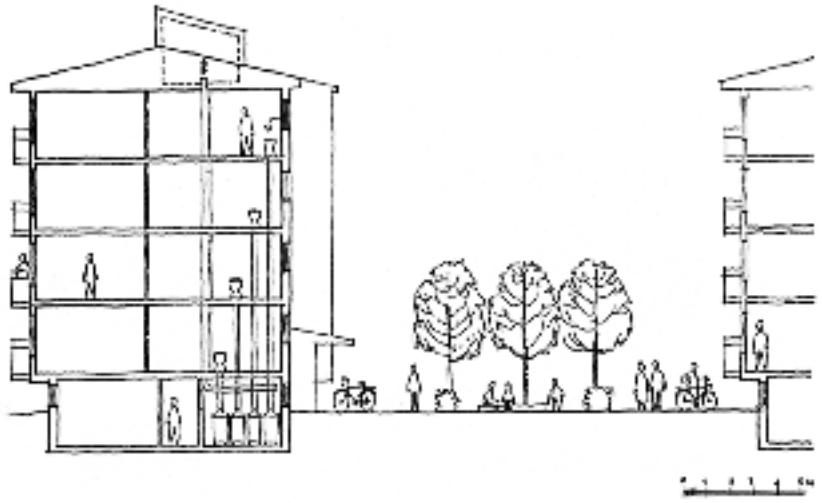


Figure 3.25 *Urine diverting long-drop toilets in multi-storey blocks of flats, China-Sweden Erdos Eco-Town Project, Erdos Municipality, Inner Mongolia, China. The toilet, produced in China, is specially designed for multi-storey buildings. (Design: Uno Winblad and Karl Rydberg, Stockholm, Sweden, 2004).*

Primary treatment of faeces (dehydration, pH increase, retention time) is in moveable processing chambers placed directly under the chute from each toilet. The processing chambers (bins on wheels) will periodically be collected by the municipal staff and transported to a neighbourhood eco-station for secondary treatment. Urine is piped from the toilet to a temporary storage tank in the basement of the building and greywater is treated on site in a vertical soil filter before it is percolated to the groundwater.

3.2.3 Small flush – composting/biogas

Sweden: Ekoporten, Norrkoping

In 1996 the municipal housing company in the Swedish town of Norrkoping renovated an existing apartment building. The objective was to test new technical solutions for resource-saving and recycling. The apartment building was originally constructed in 1967 and is fairly typical for this period. It has 18 apartments on three floors plus a top floor with communal rooms for study and recreation.

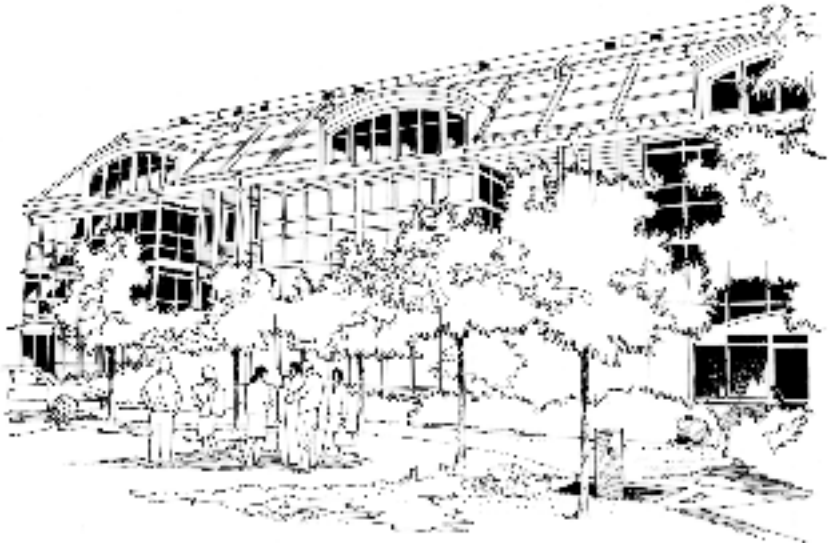


Figure 3.26 *'Ekoporten' in Norrkoping, Sweden, as it looks today. This is a four-storey building with 18 modern, high-standard apartments, rebuilt and retrofitted with ecological sanitation systems for handling urine, faeces, organic kitchen left-overs and greywater. (Design: Krister Wiberg och Johan Morling, FFNS, Stockholm, Sweden, 1994).*

The toilets are designed for urine diversion and with a small flush for faeces removal. Urine is piped into underground tanks and later used as fertilizer by local farmers.

Faeces are separated from flush water in an 'Aquatron' separator (see 4.3.2) and then composted in an automatic composting device together with paper-, kitchen- and garden-waste and wood pellets. The compost product is used by the tenants in vegetable and flower cultivation.

The flush water separated from the faeces in the Aquatron is treated with ultraviolet radiation for disinfection. The flush water is then, together with the greywater, collected in a three-chamber septic tank. From there it is channelled into a reedbed where the plants take nutrients from the water before it is discharged into a small stream.[31]

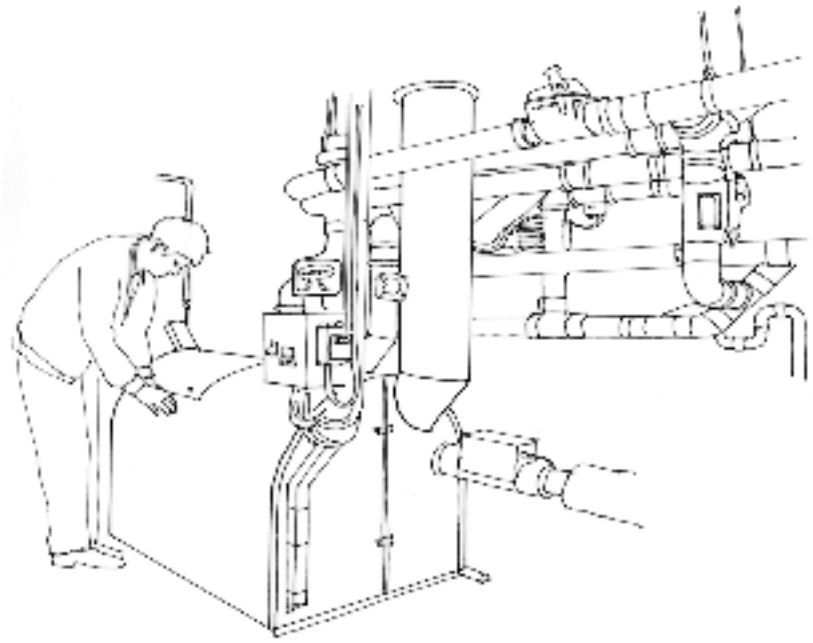


Figure 3.27 *A composting machine serving the 18 appartments in 'Ekoporten'.*

Germany: Flintenbreite, Lübeck

An integrated sanitation concept with vacuum toilets and a biogas plant for blackwater and kitchen refuse has been included in a housing project in the new suburb of Flintenbreite in Lübeck, Germany. The settlement has around 350 inhabitants on 3.5 ha and is a pilot project to demonstrate an example of sustainable sanitation in urban areas. It has been designed by Otterwasser GmbH in cooperation with the Lübeck city council.

The system in Lübeck consists of three water-treatment systems for: (a) blackwater and kitchen refuse, (b) greywater and (c) stormwater. The system involves vacuum toilets (0.7 litres/flush), vacuum blackwater transport, and anaerobic treatment with co-treatment of solid biowaste in a biogas-plant. The output is liquid fertilizer for use in agriculture and biogas for heat and power generation in combination with natural gas. Decentralized treatment of greywater takes place in artificial wetlands (bio-sandfilters). Stormwater is partly collected for reuse; svales take care of retention and infiltration.

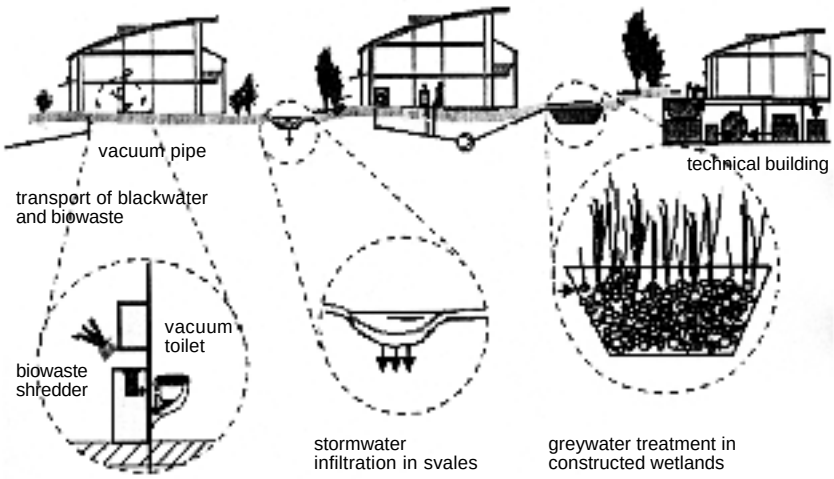


Figure 3.28 *Schematic view of the vacuum–biogas system Lübeck–Flintenbreite. (Design: OtterWasser GmbH, Lübeck, Germany, 1994).*

Costs are similar to those of conventional systems in the region. Money is saved by not needing a central sewerage system, by reduced freshwater consumption and by coordinated construction of all pipes and lines (vacuum sewers, local heat and power distribution, water supply, phone- and TV-lines).

The energy balance of this vacuum–biogas system is positive because of biogas utilization and the substitution for industrial fertilizer. Most of the nutrients can be returned to the land in the form of nitrogen, phosphorous and potassium. Returning carbon to the soil improves soil fertility and counteracts global warming by increasing carbon storage. This increase in soil organic matter reflects healthy farmland.[32]

Chapter 4
DESIGN AND MANAGEMENT FEATURES

The ecological sanitation systems and eco-toilets described in the previous chapter are neither widely known nor well understood. They cannot be replicated without a clear understanding of how they function and how they can malfunction. They have several unfamiliar features, such as urine diverting toilet seats and squatting slabs and pans, which may raise questions about their cultural acceptability. In addition they require more promotion, support, education and training than ordinary pit, VIP, pour-flush or cistern-flush toilets, but the benefits to the environment and to human health are immensely worthwhile.

Much has been learned about ecological sanitation systems from the many units in use in the world today. In China and Vietnam hundreds of thousands of rural households have double-vault toilets and many recycle their products in agriculture. In Latin America there are many thousands of units of similar types. In North America and Scandinavia a large number of eco-toilets of various designs have been on the market for well over a generation (mainly used in vacation houses). In Ladakh and Yemen dry toilets have been used for hundreds of years. In India, and Africa there are growing numbers of eco-toilets in operation. Among these, there are successes and there are failures, and we can learn from both.

In this chapter we describe the design and management features of ecological sanitation toilet systems, so that mistakes can be avoided. The purpose of the chapter is first to provide an overview of the variables that influence the choice of an appropriate sanitation system, then to discuss the possibilities in dealing with liquids and in sanitizing solids, and finally to discuss a number of design options.

4.1 Factors influencing design and management

Many local variables influence the choice of an eco-san system:

Climate – temperature, humidity, precipitation and solar radiation. In dry areas it will be easiest to sanitize faeces through dehydration, whereas composting may be more successful in humid areas.

Population density and settlement pattern – the availability of space for on-site/off-site processing, storage and local recycling.

Social/cultural – the customs, beliefs, values and practices that influence the design of the social components of a sanitation system, its acceptability by a community. (It should be noted, however, that these things are not static, and that new practices are constantly evolving in most societies.)

Economic – the financial resources of both individuals and the community as a whole to support a sanitation system.

Technical capacity – the level of technology that can be supported and maintained by local skills and tools.

Agriculture – the characteristics of local agriculture and homestead gardening.

Institutional support – legal framework, extent of support for the eco-san concept in government, industry, financial institutions, universities and NGOs.

4.2 Dealing with faeces

The primary processing in an eco-san system is generally either through dehydration or decomposition, but a combination of both is also possible. The purpose of the primary processing is to destroy pathogenic organisms, to prevent nuisance and to facilitate subsequent transport, secondary processing and end use.

4.2.1 Dehydration

Dehydration means lowering the moisture content of the material in the processing vault or container to less than 25% through evaporation and addition of dry material (ash, sawdust, husks). No water, urine or moist plant material must be added to the processing chamber. There is little reduction in volume because of the added dry material, and minimal decomposition of organic material because of

the low moisture content. The crumbly pile that remains when faeces dry out is not compost but rather a kind of mulch which is rich in nutrients, carbon and fibrous material.

Dehydration is a way of destroying pathogenic organisms. It does this by depriving them of the moisture they need to survive (see 2.3). At this low moisture content there is little odour and no fly-breeding. As there is so little breakdown of organic material, toilet paper or other things placed in the processing vault will not disintegrate regardless of storage time. Toilet paper must therefore either be handled separately (commonly by burning it) or be composted in a secondary treatment process.

Urine diversion is essential in eco-toilets based on dehydration. Where water is used for anal cleaning, this water should be diverted and can either be treated separately or mixed and treated with the urine (see 4.3.3).

4.2.2 Decomposition

Decomposition ('composting') is a complex natural biological process in which organic substances are mineralized and turned into humus. The speed of decomposition is influenced by a number of environmental factors inside the pile such as the amount of oxygen (aeration), temperature, moisture, pH value, the ratio of carbon to nitrogen (C:N ratio), competition among micro-organisms for nutrients, and the toxic by-products of decomposing organisms.

The following text is based on Chapter 9 in *Sanitation without Water* (1985) by Uno Winblad and Wen Kilama, Macmillan, London.

Aeration

Some of the micro-organisms in the pile need oxygen in order to play their role in decomposition. Such organisms are called aerobic. Others that do not require oxygen are called anaerobic. Many organisms can survive conditions with and without oxygen. Air enters the processing chamber from the outside or is trapped inside the compost heap. Near the surface of the pile the process may be aerobic while in the interior it is often anaerobic. Under aerobic conditions, decomposition is rapid and odour-free. Under anaerobic conditions decomposition is slower and foul-smelling and the heat given off is only a fraction of that under aerobic conditions. Earthworms and insects play an important role in aeration by burrowing

holes through the pile.

Temperature
High-temperature aerobic composting (with temperatures reaching >60ºC) will effectively destroy most pathogenic organisms, but such process temperatures are in practice difficult to reach in a composting toilet. The volume of material is too small, it tends to be too compact and it is difficult and unpleasant to turn the pile to aerate the central part. Occasionally higher temperatures can be found in a small part of the pile. To raise the temperature for faster decomposition and faster die-off of pathogens, there should be a large input (four to five times the weight of faeces) of carbon rich material such as weeds, husks, wood shavings and kitchen waste, combined with occasional turning to ensure a good supply of oxygen to the inside of the pile.

Its important to remember that temperature is not solely important for destroying pathogens. Pathogen destruction is a function of both temperature and time, so that lower temperatures can achieve acceptable pathogen kill if the material is retained long enough. In many cases, this lower temperature/longer time strategy is preferable to more intensive management of the compost pile. Most composting toilets are designed for a retention time of 8–12 months.

Moisture
In a composting toilet we get the best results in terms of pathogen destruction with a moisture content of 50–60%. At a higher moisture content conditions in the material become soggy and compact, and the organisms are deprived of oxygen. A low moisture content, on the other hand, slows down the activity of the micro-organisms, as they are starved for water.

An extremely wet compost toilet may result from a combination of some of the following factors: humid climate, water used for anal cleaning, too much urine has gone in, too many users (too much urine in relation to capacity to handle liquids), no addition of organic refuse, unventilated processing chamber, entry of rainwater, surface water or groundwater. The most common reason for a high moisture content in the pile is too much urine going into the processing chamber. This can be corrected by installing a urine-diverting toilet seat or squatting plate which channels the urine away from the compost pile into a separate container. Another possibility is to have some type of false floor which allows the liquid to seep out, preferably into a place from where it can evaporate.

Ratio of carbon to nitrogen
Micro-organisms feed on organic matter containing, among other nutrients, carbon and nitrogen. Carbon is used for energy and nitrogen is for body building. The optimum carbon to nitrogen (C:N) ratio is within the range of 15:1 to 30:1 in the initial mixture.

Since faeces, and especially urine, are rich in nitrogen, it is best to start a processing chamber with materials rich in carbon such as green grass clippings, vegetable scraps, straw, husks, wood shavings or a combination of these. Addition of these materials to the compost increases the C:N ratio. Excluding urine from the compost has a similar effect, as it lowers the amount of nitrogen in relation to carbon. The addition of layers of finely chopped carbon-rich material also helps to provide oxygen to the pile and to achieve rapid and complete decomposition.

Life in the compost toilet
A rich variety of organisms live in the compost heap and contribute to the breakdown of the excreta. They range in size from viruses, bacteria, fungi and algae to ants, mites, spiders, sowbugs and earthworms. Their activities are responsible for rapid decomposition. Earthworms and insects mix and aerate the pile, tearing apart the contents. If the environment is favourable to them, they will multiply, burrow holes in the pile, eat odorous organic material and convert it all into humus.[1]

4.3 Dealing with liquids

A basic question when designing an eco-san system is whether to divert urine or to mix urine and faeces in a single receptacle. If the latter approach is used, effective processing will, with few exceptions, require later separation of liquids and solids. Thus we start with two basic options: divert urine or mix urine and faeces.

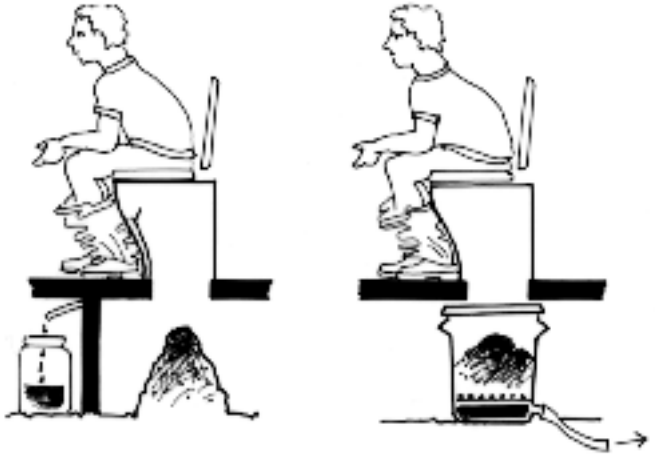


Figure 4.1 *Eco-san systems have two basic options for dealing with liquids: divert urine (left) or mix urine and faeces (right).*

4.3.1 Diverting urine

There are a number of good reasons for not mixing urine and faeces:

- it keeps the volume of potentially dangerous material small;
- the urine remains relatively free from pathogenic organisms;
- urine and faeces require different treatments;
- it simplifies pathogen destruction in faeces;
- it reduces odour;
- it prevents excess humidity in the processing vault; and
- the uncontaminated urine is an excellent fertilizer.

Urine diversion requires a specially designed seat-riser or squatting slab or pan that is functionally reliable and socially acceptable. The basic idea of how to avoid mixing urine and faeces is simple: the toilet user should sit or squat over some kind of dividing wall so that faeces drop behind the wall and urine passes in front of the wall.

The idea of not mixing urine and faeces is not new. In parts of China, in Japan and in other parts of the world simple toilets with urine diversion have been in use for centuries (see Figures 4.2 and 3.16).

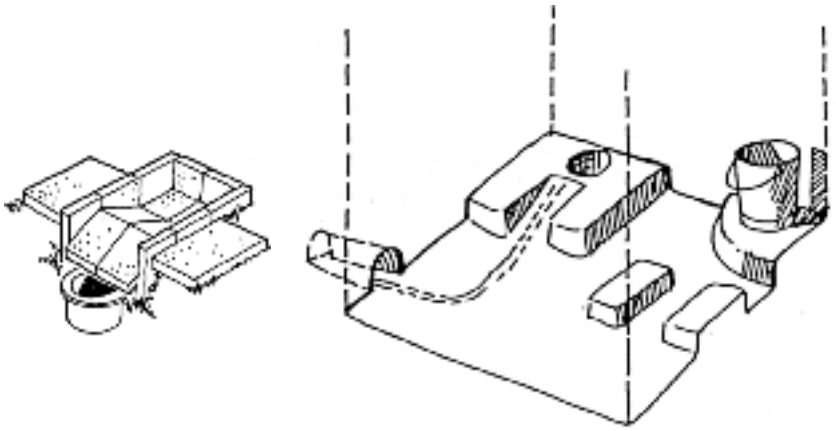


Figure 4.2 *Historical examples of urine diversion. The one from China (left) is emptied every day: urine is used directly as liquid fertilizer and faeces placed in a compost pile together with animal manure.*[2] *In the example from Yemen (right) urine is evaporated and faeces dehydrated and reused as fuel (see 3.2.2).*

In recent years several factories have started producing squatting pans as well as seat-risers with urine diversion. The faeces drop down into either a composting or a dehydrating chamber.

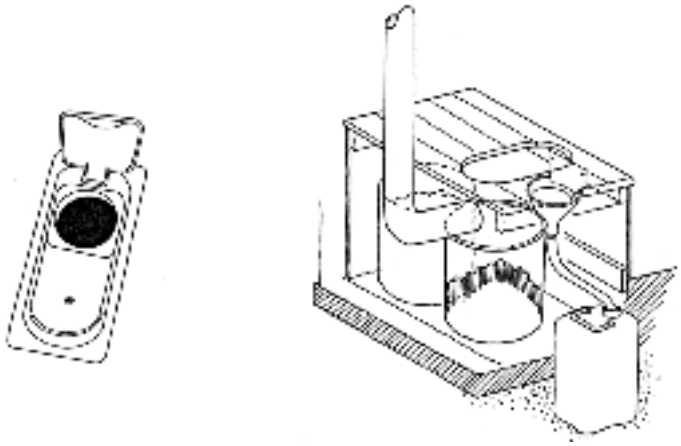


Figure 4.3 *Urine diversion: to the left a prefabricated squatting pan from Yongning county, Guangxi province, China (Design: Lin Jiang 1999), to the right a bench-type seat riser from El Alto, Bolivia (Design: Uno Winblad 1997), built of wood and with a standard plastic funnel as urine collector.*

Once collected the urine can either be used directly in the garden, infiltrated into an evapo-transpiration bed, or stored on site for later collection either as liquid fertilizer or further processed into a dry powder fertilizer.

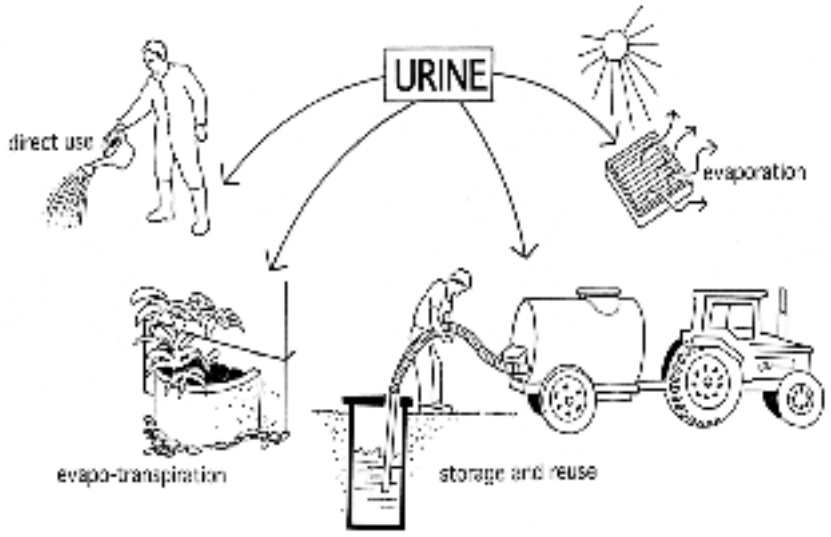


Figure 4.4 *Alternative ways of handling urine diverted from faeces: used directly, disposed of in an evapo-transpiration bed, stored in a tank for later use or evaporated.*

Although urine-diverting toilets have a long history the concept is, in most parts of the world, unfamiliar and many people find it hard to believe that they work properly. Sometimes newcomers to the systems remark that they do not believe they can be used by males. Others question whether they can be used by females.

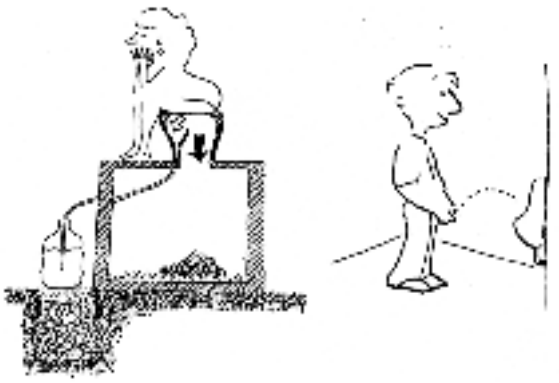


Figure 4.5 *Urine diversion. (Drawings by César Añorve, Cuernavaca, Mexico).*

Experience shows that these designs work equally well for both sexes, as long as they squat or sit. Some communities have designed their toilet units with separate urinals for men so that the main seat-riser or slab does not have to be used by those who prefer to stand when urinating.

The large size of seats and slabs, however, sometimes poses problems for small children, and some options are designed so that a smaller seat can be pulled down over the larger basic seat-riser.

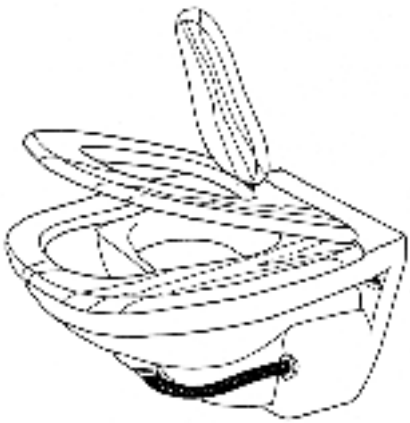


Figure 4.6 *A Swedish toilet with urine diversion, 'Dubbletten', has a lid with a smaller hole for children to use.*

4.3.2 Mixing urine and faeces

Systems based on liquid separation do not require a special design of the seat-riser or squatting plate. Urine, faeces, and in some systems a small amount of water, go down the same hole. Liquids and solids are then separated, for example in an 'Aquatron', fixed on top of the processing vault (see 3.2.3 – Sweden). This device, developed in Sweden, has no moving parts and simply uses the velocity of the flush to send the liquid around the inner wall of a doughnut-like contraption while the solids fall through a hole in the middle.

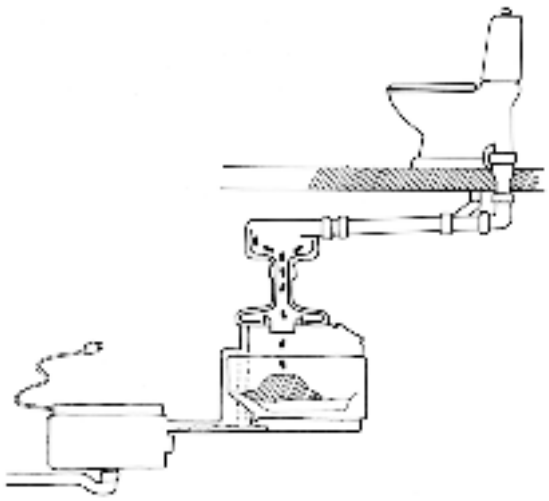


Figure 4.7 *An Aquatron device for separation of liquids and solids from a minimum-flush toilet. The separator is placed on top of a processing (composting) chamber. The liquids are sanitized with ultraviolet radiation in a separate unit.*

Another possibility is to drain the liquid from the processing chamber through a net or a perforated floor as in the example below.

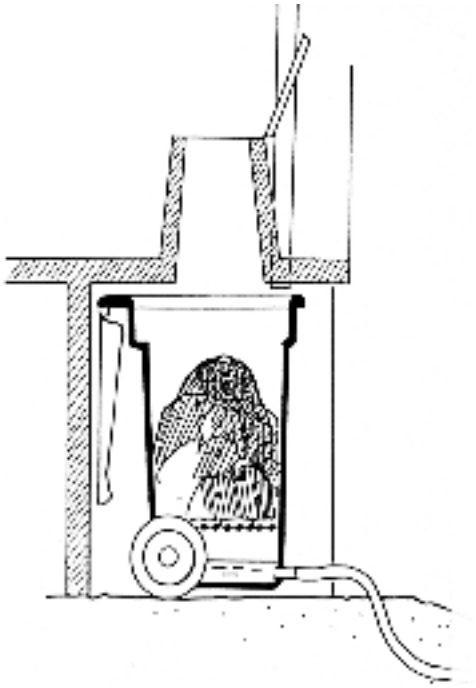


Figure 4.8 *A composting toilet with liquid separation through a perforated floor.*

One of the main points that must be considered in liquid separation systems is that, as the liquids have been in contact with faeces, they must be evaporated, sterilized or otherwise treated before they can be recycled as fertilizer. In rural, basic toilets in warm and dry climate it is possible to process liquids and solids together. Urine and faeces go down the same hole. Dry soil or a mixture of soil and ash are added to the urine-faeces mix in the pit. Biological activity in the combination of excreta and added soil results, over time, in a useful soil conditioner and fertilizer. Since some of the liquids percolate into the soil, these types are not suited to areas with a high water-table.

4.3.3 Water for anal cleaning

In some cultures, washing after defecation is mandated by tradition or religion (see 7.1.1). In some Islamic cultures, for example in Yemen, Zanzibar [3] and in Kyrgyzstan [4] people traditionally wash away from the toilet opening. Our examples from India and Palestine in Chapter 3 show that also where there is no such tradition the required modification of toilet behaviour is indeed possible.

The water used for anal cleaning can be treated in an evapotranspiration bed as in the Kerala example or in a septic tank as in Palestine (see 3.1.2).

4.4 Preventing odours and flies

Sceptics claim that eco-san is an inferior alternative: it will be smelly, fly-producing and incompatible with modern living. This is a valid concern as eco-san systems are sensitive to bad design and careless operation. If they are not designed, built and operated properly, taking into account natural environment, traditional beliefs and the chosen process (dehydration or decomposition), they may indeed smell and can even provide a habitat for flies.

Fly breeding in toilets is basically related to the wetness of the contents of the processing vault. In a properly functioning dehydration system there would be no fly breeding, but if something goes wrong and the contents turn wet, fly breeding might occur. The risk of fly breeding is greater in a composting system for two reasons: it works with a much higher process moisture content and fly eggs may be introduced into the processing vault with kitchen scraps. When a properly selected and well built eco-toilet fails, the most common fault is that the process has turned wet. In a system based on dehyd-

ration the moisture content of the contents of the processing vault should quickly be reduced to less than 25% through the addition of dry additives and ventilation – in some cases helped by the addition of a solar heating device. In a system based on decomposition the corresponding moisture content should ideally be between 50% and 60%. If this is achieved and fresh faeces are covered with an absorbent (see 4.6.4), there is no smell, no fly-breeding and rapid pathogen destruction.[5]

4.5 Household or communal removal and treatment

4.5.1 Household management

Probably the most unfamiliar aspect of ecological sanitation options is that they may require some handling of processed or partly processed human excreta at the household level. In most existing eco-san projects this has been necessary because the projects were small and scattered. Each household therefore had to manage the total system: daily care of the eco-toilet; weekly/monthly emptying of the storage tank for urine; recycling of urine in the garden; monitoring the primary processing chamber for faeces; half-yearly emptying of the processing chamber, secondary processing of chamber content; and the end use of the sanitized material. With proper motivation and instruction this management by the household can work well.

The advantage of this approach is that the user gets a direct feedback and can gradually improve his/her operation: take greater care in not allowing urine and water into the processing chamber, increase the amount of ash/lime, etc.

Problems tend to occur when new tenants/owners are taking over. As eco-toilets are still relatively unfamiliar the risk is that the newcomers do not understand how to use them. And without instruction they would not know why and how to empty urine tank and processing chamber, or about the need for secondary processing, etc.

4.5.2 Communal management

For larger projects, particularly in urban areas, the output from eco-san toilets can be monitored, collected, further processed and sold by a municipal or private service organization.

Secondary treatment can be carried out at neighbourhood or centralized collection centres, called eco-stations with trained personnel (see 8.1.3).

Communal management has two main advantages: it is more convenient for the user and safer for public health. The user only needs to operate and maintain the eco-toilet. Eco-san can therefore offer the same standard of convenience as a conventional WC connected to a centralized sewer. As all handling, processing, transport and sale of the urine and faeces is taken care of by the trained staff of the service organization, end products of a consistent quality can be assured.

4.6 Other technical options

4.6.1 Solar heaters

Solar heaters can be fitted to the processing chambers of the toilet to increase evaporation. This is more important in humid climates and where urine and water are mixed with the faeces. It is also more important in a system based on dehydration than in one based on decomposition.

The main purpose of the solar heater is to increase evaporation from the material in the processing chamber. It is also likely to slightly increase the temperature of the pile in the chamber and there are indications that pathogen destruction is faster in solar heated than in non-solar heated chambers.[6] The increase in pile temperature is, however, unlikely to be high enough for high-temperature composting.[7]

The solar heaters used in some of the eco-toilets described in the previous chapter consist of a black-painted metal (aluminium) sheet covering the part of the processing chamber exposed to the sun. This metal sheet may also acts as an access lid to the processing chamber (see Figures 3.14 and 4.9).

Figure 4.9 *An eco-toilet with solar-heated processing chamber, Nha Trang Pasteur Institute project in Cam Duc commune, Khanh Hoa province, Vietnam. (Design: Uno Winblad and Duong Trong Phi, 1996).*

The solar heater must be fitted so that it prevents water as well as flies from entering the processing chamber(s). It should be tight enough to prevent air leakage.

4.6.2 Single or double vault

Most eco-toilets built so far have two vaults, each with its own seat-riser or squatting slab or with a movable device. The advantage with the double-vault design is that each vault is used alternately for a certain period. When the first vault is full it is left dormant and the second vault is used. The contents of the dormant vault are emptied when the second vault is nearly full. The assumption is that after a specified period (6–12 months depending on climate) without new faecal material added, the contents of the dormant vault should be safe to handle. A single vault toilet with two or more moveable containers would offer the same advantage. For eco-san systems with communal management moveable containers probably offer a more rational solution than fixed vaults or processing chambers.

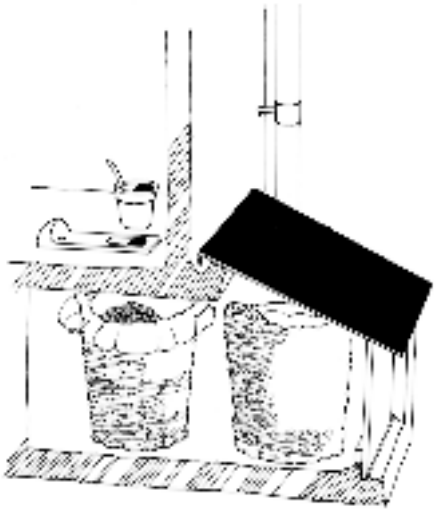


Figure 4.10 *A single-vault, solar-heated eco-toilet with moveable containers, in this case two large baskets. When the first basket is full it is placed directly under the solar heater and remains there until the second basket is full.*

4.6.3 Anal cleaning material

Cultures differ in their use of cleaning materials after defecation. Some use paper, some use vegetable material, mudballs or stones, and others, as mentioned above, use water. The inappropriate disposal of cleaning material in a toilet can cause problems. In some parts of the world the drainage system for WCs cannot cope with large amounts of toilet paper, so this has to be collected separately in a bin for later disposal by burning. Elsewhere WCs have rapidly been rendered useless by people trying to dispose of stones or maize cobs in the toilet.

Dry systems can take all kinds of paper and solid objects and still function well. As mentioned above a dry system can even be adapted to cope with the use of water for anal cleaning.

During the process in a composting toilet paper breaks down, but not in a dehydrating toilet – the paper does not decompose. This paper will, however, break down during secondary processing if the process used is either composting or carbonization/ incineration.

4.6.4 Absorbents and bulking agents

Absorbents such as ash, lime, sawdust, husks, crushed dry leaves, peat moss and dry soil are used to reduce smells, absorb excess moisture, and make the pile less compact as well as less unsightly for the next user. Absorbents should be added immediately after defeca-

tion in order to cover the fresh faeces. They are used in both dehydrating and in composting toilets.

Bulking agents such as dry grass, twigs, coconut fibre and wood shavings are used in composting toilets to make the pile less compact and allow air to enter and filter through the heap.

In the nineteenth century in Europe there were a number of designs for 'earth closets', with a lever-operated mechanical device to sprinkle earth and/or ash on to the faeces. A similar device is used in current eco-san projects in China.

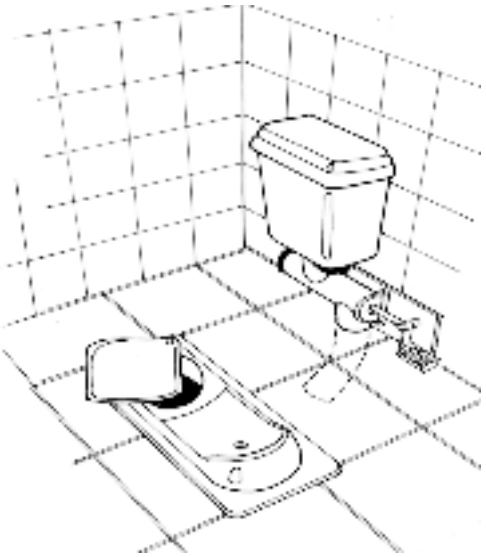


Figure 4.11 *A mechanical, pedal-operated, ash dispenser used for school toilets in the Yongning eco-village programme (see 3.1.1 – China). (Design: Lin Jiang, 1999).*

4.6.5 Ventilation and aeration

Ventilation serves several purposes: it removes odours, it dries out the contents and, in composting toilets, provides oxygen for the decomposition process. A ventpipe is not always necessary: the Vietnamese double-vault toilet and its variations in Central America are usually built without a ventpipe. All indoor models in for example the Scandinavian countries, Mexico, Palestine and China are provided with vent pipe. The need for a vent pipe is determined by climate, wetness of the input into the processing chamber and standard desired. (With a well-functioning vent pipe from the processing chamber, the toilet/bathroom can be completely odour free, as air from the room is evacuated via the drop hole in the seat-riser/ squatting-pan.) A vent pipe should have a diameter of 10 – 15 cm. In

extremely humid climates the diameter could be larger – up to 25 cm as in the example from Micronesia (see Figure 3.15). The pipe should be as straight as possible as bends reduce draft, and reach 50–90 cm above the roof. If necessary the ventpipe can be fitted with a small electric fan.

Composting is basically an aerobic process. Many of the micro-organisms responsible for the decomposition need oxygen. Air must therefore be brought into the pile. In some cases the processing chamber is provided with perforated pipes that bring air into the centre of the pile (see Figure 3.12). Aeration can also be accomplished with the addition of a bulking agent that creates air pockets inside the pile.

4.7 Materials and workmanship

Eco-san is, like any sanitation system, sensitive to poor workmanship and defective materials. But in some ways eco-san systems are less sensitive: the processes involved are dry and the volumes handled comparatively small. Common faults include seepage of water into the processing vault, leaking or blocked urine conduits and blocked ventpipes.

4.8 Maintenance

All sanitation technologies require maintenance to function properly. The amount of maintenance that users of eco-san systems need to do varies a great deal and is influenced as much by the organization of operation and maintenance as by the design of the eco-san devices.

Good system design can minimize the need for intensive maintenance, and the tasks required need not be onerous. For example, systems that rely on composting often require the regular addition of bulking agents and periodic checking to ensure that ventpipes are not blocked by debris, spider webs or nesting insects. Some systems may require the transfer of partially processed solids to a secondary processing area. Many systems require that the toilet seat-riser or squatting hole be in some way closed-off when not in use.

All systems require periodic inspection and removal of the end products. Particularly urine collectors, pipes and containers/tanks

need to be monitored. Urine pipes should be flushed periodically to avoid accumulation of deposits, which can block the flow and generate unpleasant odours.

The major common element in the maintenance of eco-san systems is that the user must ensure that the system is working properly. However, it is important to note that many operation and maintenance functions, such as emptying of toilet vaults, transport and secondary treatment, can be carried out by special service providers, either as a public service or through private enterprise. Service contracts will minimize the burden on households and also enable municipal administrations to guarantee a satisfactory standard of operation and maintenance.

Chapter 5
RECYCLING THE NUTRIENTS

Ecological sanitation regards human excreta as a resource to be recycled rather than as waste for disposal. The use of human excreta for crop fertilization has been widely practised in many regions of the world. The Chinese have been composting human and animal excreta for a few thousand years,[1] and Japan introduced the practice of recycling human faeces and urine for agriculture in the twelfth century and continued until the 1950s.[2] In Europe, until modern times, it was common for farmers to recycle human excreta with animal manure.[3]

The very idea that excreta are waste with no useful purpose is a modern misconception.[4] It is at the root of the pollution problems that result from conventional approaches to sanitation, particularly flush-and-discharge. In nature there is no waste: all the excreta of living things are used as raw materials by others. Recycling sanitized or well composted human urine and faeces by returning them to the soil serves to restore the natural cycling of life-building substances that has been disrupted by our current sanitation practices.[5]

5.1 Why recycle nutrients?

5.1.1 Food security and poverty alleviation

In parts of the world, particularly in sub-Saharan Africa, rural people suffer from periodic famines due to drought, small plot size, soil erosion, poverty (inability to purchase sufficient food) and political factors. In urban areas around the world, poor people also suffer from undernutrition due to poverty, although urban agriculture is a growing phenomenon. However, growing food for the immediate family within confined spaces is a challenge. The products from eco-toilets with their nutrients can be used in rural and urban areas to increase food security for all households, particularly the poor. To ensure that the increased food security results in improved health, it is important that users follow the guidelines given in this chapter.

The products from eco-toilets can be used directly at the homestead level, in backyard gardens. As this chapter shows, about 1.5 litres of

undiluted urine can be used to fertilize 1 square metre of soil. 1.5 litres is the amount produced by one adult in one day. Even without an eco-toilet, people could collect their own urine and use it on backyard gardens to increase yields. However, the fertilizing effect of urine works best in soil with a high organic matter content and this can be increased by adding the humus from eco-toilets and garden composts.

In urban areas, the sanitized humus from eco-toilets can be used as a rich and nutritious soil for planting in pots, and the urine can be used to fertilize the soil before planting and for continued fertilization of plants during growth. This chapter shows that vegetable and fruit crops grown using urine fertilization produce 2–10 times the amount of crop by weight as those grown in unfertilized, poor soil. If people use urine to grow vegetables and fruits, the increased production results in greater food security at virtually no cost. Soil enriched with humus from eco-toilets holds water longer than soils not enriched with compost. Research has shown that plants grown in soils enriched with large amounts of humus require less watering and survive droughts better than plants grown in ordinary soils without this humus.[6] In times of drought, when whole fields of grain may die, backyard crops grown on humus may well survive and produce enough vegetables to help a family through a difficult period. If, over time, families can collect enough humus from their eco-toilet, they may be able to enrich larger and larger areas, leading to increasing food security.

5.1.2 Cost savings to farmers

The formulation of nutrients in urine is similar but not exactly the same as that in commercial fertilizers. But urine and commercial fertilizers give similar result in boosting plant growth. Urine is high in nitrogen and lower in phosphorous and potassium. Some top-up of phosphorous and potassium is often needed to get the best possible use of nitrogen. As faeces and ash are high in phosphorous and potassium, farmers can replace commercial fertilizers with urine and top up with sanitized faeces from eco-toilets at little or no extra cost.

A study in China calculated the cost savings of using urine and dried faecal humus from eco-toilets as a fertilizer in a 3000 square metre greenhouse owned by one farmer in Jilin province of northern China. The farmer not only used the dried faeces and urine from his own household but also purchased additional dried faeces from other homes with eco-toilets and was given their urine free of charge. He

did not calculate the cost of transport of dried faeces (which was transported by tractor) or the cost of transporting urine, which was carried in buckets on shoulder poles. He used to buy 350–400 kg commercial fertilizer per year, but now this has been replaced by the free urine. The farmer calculated his cost savings per year to be the equivalent of CNY 740 (USD 90) per 1000 square metres.[7]

Such calculations could become even more important at the community level, especially where farmers are struggling to make a living. A city of 100,000 people would produce about 500,000 kg of elemental nitrogen, phosphorous and potassium (NPK) per year in excreta. While the cost of commercial fertilizer varies between countries, as does its content of elemental NPK, it is possible to make a rough cost comparison of buying commercial products or collecting and transporting locally produced urine and faeces.

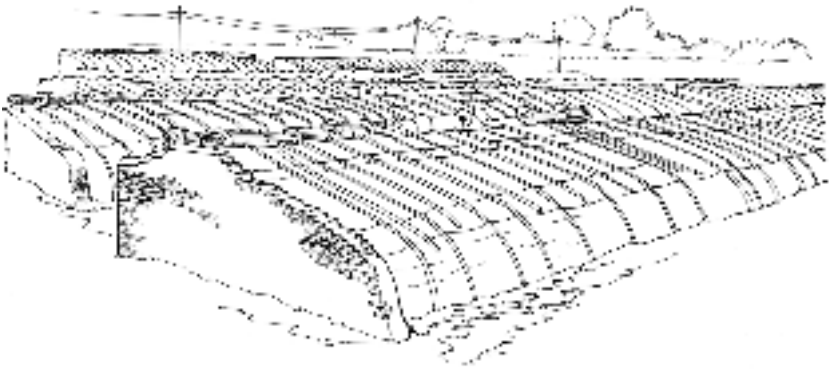


Figure 5.1 *Greenhouse for vegetable production, Jilin province, northern China.*

5.1.3 Preventing nitrogen pollution

Pit toilets as well as sewers are frequently a source of groundwater pollution,[8] especially in areas where the water-table is high. Urine is rich in nitrogen and up to 50% of the nitrogen leaches out of the pit toilet, passes through the soil and reaches groundwater.[9] Water with NO_3 concentration higher than 50 mg/litre is considered to be unfit for human consumption.[10] It is not unusual to find such high concentrations of nitrogen in wells in communities with pit toilets. Recommendations that toilets be sited at least 30 metres from wells are meant to protect well water from pollution, but plenty of experience shows that soil conditions vary considerably and both pathogen and nitrogen pollution can still result.

5.1.4 Restoring lost topsoils

According to FAO, the Earth is losing 25 billion tonnes of topsoil per year because of erosion.[11] Chemical fertilizers, while boosting plant growth, cannot replace topsoil. Topsoil contains humus formed from decayed plant and animal matter and is rich in carbon compounds and micro-organisms necessary for healthy plant growth, which are not found in chemical fertilizers. The addition of humus is therefore necessary to maintain and renew the topsoil. With the loss of topsoil comes the loss of human food security. In many parts of the world people are experiencing reduced productivity on their lands due to loss of topsoils.

5.2 Nutrients in human excreta

5.2.1 Urine

Most of the plant nutrients in human excreta are found in the urine. Based on data from five countries (China, Haiti, India, South Africa and Uganda) we estimate that on average each person produces about 5 kg of elemental NPK in excreta per year, about 4 kg in the urine and 1 kg in the faeces.[12] Urine is therefore worth using as fertilizer, especially as its content of NPK is readily available to the plants.

In Sweden the total yearly production of human urine contains elemental nitrogen, phosphorous and potassium equivalent to approximately 20% of the amounts of these nutrients used as mineral fertilizers in 1999/2000.[13] The concentrations of heavy metal in human urine are negligible – an important advantage over chemical fertilizer.[14]

When urine is collected for use as a fertilizer, it is important that the storage method prevents odours and the loss of nitrogen to the air. Swedish research indicates that most of the nitrogen in urine, which is initially in the form of urea, is quickly converted to ammonia within the collection and storage device (if this device has been used several times and is not more or less sterile). Ammonia loss to the air can be minimized by storage in a covered container with restricted ventilation.[15]

When urine is applied to open soil before planting it can be undiluted. If used on growing plants it can be applied without or with dilution,

typically one part urine to 2–5 parts of water. Care should always be taken to apply the urine to the soil and not on the plants.

Box 5.1 *Swedish research on the recycling of human urine*

A number of research institutions in Sweden studied urine diversion and reuse in two large projects between 1996 and 1999. In the projects, urine was collected from urine-diverting toilets at two housing estates in Stockholm. The urine was stored on-site in tanks at each housing estate before being transported by trucks to a farm south of Stockholm. There it was stored in air-tight containers before being spread on cereal crops as a fertilizer. The overall goal of the project was to evaluate urine diversion as a system for reusing the nutrients in agriculture. Risks of disease transmission, energy usage, potential environmental impact, agricultural value and various technical and social issues were all examined. Among other findings, research demonstrated that the nutrient loss from the urine was negligible during the collection and storage process if appropriate measures were taken. The nitrogen fertilizing effect of the urine was almost as good as that of corresponding amounts of chemical ammonium nitrate fertilizers.[16]

5.2.2 Faeces

Human faeces consist mainly of undigested organic matter such as fibres made up of carbon. Although faeces contain less nutrient than urine, the humus produced from faeces actually contains higher concentrations of phosphorus and potassium. After pathogen destruction through dehydration and/or decomposition the resulting inoffensive material may be applied to the soil to increase the amount of available nutrients, to increase the organic matter content and to improve the water-holding capacity.

The simplest form of recycling is when the individual household can use the product as fertilizer in its own garden or on its own farm land. In urban situations many householders will have neither the land nor the inclination to use the product themselves. Lack of land need not hinder food production as seen in the example from Mexico City in Box 5.3 and the 'vertical garden' in Botswana in Box 5.4.

5.2.3 Nutrients in combined systems

The humus formed in toilets where urine and faeces are combined, such as the Zimbabwean 'Arborloo' and the 'Fossa Alterna', is rich in nutrients. Studies undertaken in Zimbabwe compared major nutrient levels in samples of naturally occurring topsoil and in humus from pits where urine and faeces have been combined and

supplemented with soil and wood ash and allowed to decompose for one year, Table 5.1 below.[17]

Table 5.1 *Comparison of nutrient levels in natural topsoil and humus from Fossa Alterna pits.*[18]

Source of soil	N (mg/kg)	P (mg/kg)	K (mg/kg)
Natural dryland topsoil	38	44	192
Fossa Alterna soil	275	292	1763

5.3 Application of nutrients derived from excreta

Nutrients from human excreta may be applied as two separate products (urine and composted faeces), or as one combined product (composted urine and faeces). When they are applied separately, it is usually because they have been collected separately. When urine and faeces are applied in combination, it is because they have been collected together and composted as a mix, as in the Arborloo or Fossa Alterna.

The most efficient way to recover excretal nutrients, however, is to collect urine and faeces separately. Most toilets collecting urine and faeces mixed allow leaching of the liquid from the toilet, which means that some nitrogen will be lost.

5.3.1 Application of urine

Urine can be applied in a variety of ways:

- Undiluted before or at sowing/planting or to the young plant.
- Urine can be applied in one large dose or several smaller ones during the cropping season.
- As a liquid plant food mixed with water. Diluted urine can be added to the soil where vegetables (and plants like maize) are growing – once a week or even twice or three times a week, provided that the plants are also watered frequently at other times. This addition of urine makes a big difference to the growth of plants.
- Undiluted to soil beds before planting. Bacteria in the soil change the urea into nitrate which can be used by the plants.

- As an 'activator' for compost heaps. The transformed organic nitrogen will be available to plants when the compost has matured.
- Concentrated fermented urine can be applied to beds of dried leaf mold, as a medium for growing vegetables and ornamental plants (see Box 5.3).

A future possibility, when large amounts of diverted urine are available from urban areas, is to use human urine to produce a concentrated fertilizer in powder form.[19]

5.3.2 Application of faeces

Faeces are removed from the vault of dehydrating toilets as a dehydrated, sanitized powder or lumps. This dry material is usually given a secondary treatment (for example in the form of high temperature composting, see 2.4) before being dug into the ground or into flower beds where the material comes into contact with the living soil.

From composting toilets faeces are removed as humus, which is not dry but slightly moist. The same applies to its removal from secondary composting sites, if the partly decomposed faeces, in combination with soil and ash, have been moved from the toilet to be further processed elsewhere.

To make best use of this valuable asset, it can be applied in furrows or holes close to where the plants will later be growing.

5.3.3 Application of humus from urine and faeces combined

In the Fossa Alterna, a mix of urine and faeces, in combination with an almost equal volume of soil, and often combined with wood ash or leaves, is dug out of the shallow pit after 12 months of composting. This material is either bagged awaiting further use or mixed with local topsoil in equal proportions and applied to vegetable gardens, where it enhances plant growth.

5.4 Effects of nutrients on plant growth

Urine can be applied in one large dose for the growing season or once or twice a week in smaller doses to vegetables – with additional watering to keep the plants healthy. With the same total dose of urine during the vegetative part of the growing season, the yield is usually about the same, irrespective of the number of doses.[20]

In a series of experiments carried out in Harare, Zimbabwe, during 2002, it was shown that by adding the 3:1 water:urine mix to vegetables planted in 10-litre containers three times per week, with all other irrigation carried out with water alone, spinach yield was increased up to 6 times, covo yield 1.5–4 times, lettuce yield was doubled and the weight of tomatoes increased up to 3.6 times, compared with similar plants growing in similar soil and similar containers, but irrigated with water only (Table 5.2). Maize production in fields was also increased by between 29–39% by the application of undiluted urine watered with natural rainfall.[21]

Table 5.2 *Plant trials with urine for various crops.*[22]

Plant and growth period	Weight at cropping (water application only) *grams wet weight*	Weight at cropping (3:1 water:urine application 3 x week) *grams wet weight*
Lettuce – 30 days	230	500
Lettuce – 33 days	120	345
Spinach – 30 days	52	350
Covo* – 8 weeks	135	545
Tomato – 4 months	1680	6084

**Covo is a type of spinach used as a salad green.*

Trials on the fertilizing effects of urine have been tried in a number of other countries. The box below summarizes some of the key findings from Sweden and Ethiopia.

Box 5.2 *Results of some agricultural trials using urine as a fertilizer* [1]

Sweden
Tests on barley: 'Results showed that the nitrogen effect of urine corresponded to about 90% of that of equal amounts of ammonium nitrate mineral fertilizers.'

Tests on winter wheat: Three fertilizers were compared: human urine, dried chicken manure and dried meat + bone meal. 'The winter wheat yields were 18 kg grain per kg N for human urine, 14 kg for dried chicken manure and 10 kg for meat + bone meal. These data show that the plant availability of N in urine is higher than in chicken manure and meat + bone meal.'

Tests on leeks: 'Fertilizing with urine gave a three-fold crop yield increase. The nitrogen efficiency …, when using human urine was high, ranging from 47% to 66%. This is on the same level as when mineral fertilizers are used. Nitrogen efficiency for most other organic fertilizers, e.g. compost, is normally between 5 and 30%.'

Ethiopia
Tests on Swiss chard: The crop yields of the fertilized plots were up to four times that of unfertilized.

Urine works better if the soil to which it is added contains humus. Such humus is rich in living material and beneficial soil bacteria, and these convert the urine nitrogen into a form that the plants can use.

With poor soils, the best way of enhancing plant growth using processed human excreta is in two stages. The first stage involves improving the texture and humus content of the soil by combining it with humus formed from processed faeces or faeces and urine. Leaf compost and garden compost can also be used at this stage. The second stage involves enhancing and sustaining the nutrient levels in the soil with urine. It should be noted that during their growth, all plants take up nutrients, and the nutrients removed from the field with the crop must be replaced if the soil is to remain a fertile medium for growing of healthy plants.

It is wise to irrigate the plants most of the time with plain water and to supplement this irrigation with the application of urine or urine and water mix, according to the chosen fertilizing plan. This appears to maintain a healthy soil over the growing period of plants tested. Urine does contain salt, and this must be kept in check (by regular plain watering) if the plants are to remain healthy.

Box 5.3 *Growing vegetables in Mexico City*

In response to rapid inflation, high unemployment and inadequate nutrition, CEDICAR (Center for Rural Development and Training), an NGO based in Mexico City, has perfected a method of growing vegetables in containers using human urine as a fertilizer. The project was launched in Mexico City in 1988 and more than 1200 urban households participated. Other organizations in Mexico have now adopted this approach.

The technology used was selected and adapted to fit the local circumstances, which include no land available for conventional kitchen gardens, participants unable to afford the required investment in containers and fertilizers, and the need for growing containers of lightweight materials to allow rooftop cultivation.

Vegetables are grown in containers (ideally 18–20-litre plastic buckets filled with deciduous tree leaves or grass clippings topped with a 15-centimetre layer of soil). This soil can be made from the bottom layer of plant material from the previous year's containers, which has composted into rich humus, and household organic waste, which has been composted with worms. A drainage hole is made in the side of the container, 5–10 centimetres from the bottom, depending on the type of plant to be grown, so that there will be a permanent reservoir of water and fertilizer. Urine, which has been stored in 2–5-litre containers for 3 weeks is applied to the containers after dilution with water on a 1:10 ratio.

- Plants fertilized with urine grew more rapidly, larger and healthier than those grown with conventional agricultural techniques – and less water was needed.
- Plants that produce edible leaves (for example spinach, Swiss chard, parsley, as well as nopal, a nutritious, widely available cactus) performed particularly well. Leaves were large and dark green in colour.
- Some fruit-bearing plants grew well and produced abundantly, particularly chillies, the hot peppers essential in the Mexican diet, although they were not as hot as those grown conventionally.
- All of the plants proved remarkably resistant to insect pests and disease.

5.4.1 Effect of urine and faeces combined

Humus derived from Fossa Alterna pits (where urine and faeces are mixed) contains about eight times the amount of N, P and K found in poor local topsoils in Zimbabwe.[24] These combined products, therefore, can make a valuable addition to poor soils and result in improved vegetable production. The improvement in vegetable yield depends on the state of the original soil. If the soil is poor, significant increases in vegetable growth are possible. In fact, the weight of vegetables grown on the mix of soils can be many times the weight of vegetables grown on the poor soil alone. The Fossa Alterna soil behaves like a good compost or fertilizer and improves soil texture.

In a series of informative experiments undertaken in Harare, Zimbabwe during 2002, vegetables like spinach, covo, lettuce, green pepper, tomato and onion were grown in 10-litre buckets or basins of very poor soil from Epworth or Ruwa, and their growth was compared with plants grown in similar containers filled with a 50:50 mix of Epworth (or Ruwa) soil and Fossa Alterna soil. In each case the growth of the vegetables was monitored and the crop weighed after growing for a certain number of days. Table 5.3 shows the results of these trials. The significant increases in vegetable production are due entirely to the nutrients available in the Fossa Alterna humus.[25]

Table 5.3 *Plant trials with Fossa Alterna humus.*[26]

Plant – *Top soil type* – Growth period	Weight at cropping (top soil only) *grams*	Weight at cropping (50:50 top soil:FA* soil) *grams*
Spinach – *Epworth* – 30 days	72	546
Covo – *Epworth* – 30 days	20	161
Covo 2 – *Epworth* – 30 days	81	357
Lettuce – *Epworth* – 30 days	122	912
Onion – *Ruwa* – 4 months	141	391
Green pepper – *Ruwa* – 4 months	19	89
Tomato – *Ruwa* – 3 months	73	735

*FA denotes soil taken from Fossa Alterna pits.

All these results clearly show a dramatic and meaningful increase in vegetable yield resulting from the enhancement of poor soil (*Epworth* and *Ruwa*) with the Fossa Alterna humus.

These are significant increases in vegetable production. However the volume of humus formed per year is relatively small, about 500–600 litres per family unit, so it will not go far on a big field. The humus has so far often been mixed with other soils in equal proportions (50:50 mix) and used on backyard vegetable gardens at a rate of 1 part humus to 2 parts topsoil (about 35 litres humus per square metre garden). The yield can be increased further by using diluted urine as a fertilizer (see above).

These trials were conducted in 10-litre cement containers. Fifty containers can be made from a single 50 kg bag of cement. Each container is, with the addition of urine and eco-toilet humus, capable of

yielding 14 kg of onions in 6 months. Approximately 300–350 grams of spinach per month can be produced per container. Some containers produce a crop of spinach of up to 700 grams per month. Where space is limited, this may be an economic way of using limited volumes of eco-humus. Once the crop has been harvested the soil is recycled and reconstituted by adding more humus, leaf compost and/or compost.

5.5 Conclusions and recommendations on use of urine and faeces in agriculture [27]

Urine and faeces are each fertilizers of high quality and with low levels of contaminants such as heavy metals. The best fertilizing effect is achieved if they are used in combination with each other, but not necessarily used in the same year in the same area. Composted faeces are an important soil conditioner, improving the nutrient content and the water retention capacity of the soil and providing a substrate/food for beneficial soil organisms.

Urine is a quick-acting nitrogen-rich complete fertilizer. Its nutrients are best utilized if the urine is applied from before sowing and up until two-thirds the way through the growing period.

Urine can be applied diluted or undiluted. Nitrogen concentrations in urine can be estimated at 3–7 grams per litre. For estimating the amount needed per crop, one could follow the recommendations given for chemical nitrogen fertilizers. In the absence of other guidelines, the urine collected from one person in a year is sufficient to fertilize 300–400 square metres of crop. This can be applied undiluted or diluted, before planting or during plant growth.

For most crops and under most circumstances, the total yield of a crop is the same whether the urine is applied in one large dose or in several smaller ones. For crops with a small root system, it might be advantageous to divide the application, into smaller doses applied more frequently. Also for plants grown in small pots, i.e. with limited root volume, it might be wise to dilute the urine and apply it in smaller doses.

Faecal matter is especially rich in phosphorous, potassium and organic matter. Dehydrated or composted faeces should be applied and mixed into the soil before cultivation starts.

Both organic matter and ash, which are often added to composting or dehydrating faeces, improve the pH and nutrient content of the soil. Organic matter also improves the structure and the water-holding capacity of the soil.

Box 5.4 *Vertical gardens in Gaberone, Botswana* [1]

A Swedish horticulturist, Dr Gus Nilsson, who has lived in Botswana since 1967, has developed a container gardening system for dry areas. It is based on walls with built-in growth boxes made of hollow concrete blocks.

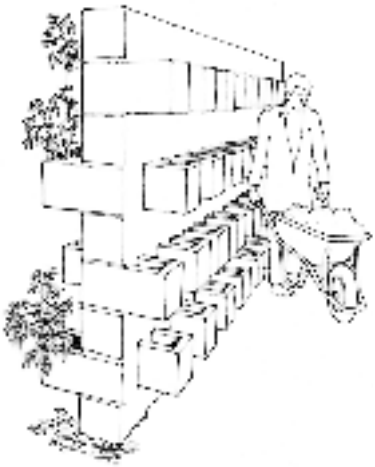


Figure 5.3 *In Botswana Gus Nilsson has developed a system of intensive horti-culture for dry tropical areas, based on walls with built-in containers.*

When building the wall some of the blocks are turned through 90 degrees and the protruding hollow part is provided with a floor and a small hole for drainage. The core of the wall is filled with a weak concrete mixture. The protruding containers are filled with sand on top of a layer of fertilizer. The containers can be arranged in various patterns and the wall can be provided with containers on one or two sides. In the tropics the containers may face any direction and the walls can be quite closely spaced (1.2–1.5 metres).

On the walls surrounding the demonstration homestead in Gaberone, Botswana, there are 2000 containers. Also the tanks for storage of rainwater are made as container walls.

A variety of vegetables and ornamentals are grown in the containers. Dr Nilsson is able to produce 2 kg of tomatoes per container four times a year. The retail price of the tomatoes produced on 1 square metre during one year is roughly equivalent to the cost of building 1 square metre wall so cost is recouped quickly and profit can be made.

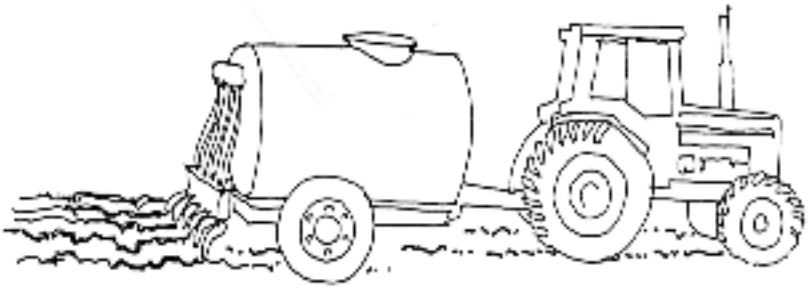


Figure 5.2 *In current R&D projects in Sweden human urine is stored in tanks on site, periodically collected by farmers and applied to their crop land with mechanized equipment.*

Chapter 6
GREYWATER

6.1 Introduction

The wastewater from kitchens, baths and laundries is known as greywater. In eco-san systems greywater is not mixed with toilet water containing human excreta. This significantly reduces the hygiene and environmental problems associated with wastewater management. But greywater still has to be managed in some kind of technical system where it can be returned to Nature in a responsible way.

The objectives of including greywater systems within the context of eco-san can be summarized as:

- To use greywater as a resource for plant growth, ground water reclamation and landscaping.
- To avoid damage to buildings and surrounding areas from inundation, waterlogging and freezing.
- To avoid the creation of bad odours, stagnant water and breeding sites for mosquitoes and other insects.
- To prevent eutrophication of sensitive surface waters.
- To prevent contamination of groundwater and drinking water reservoirs.

In rural areas the handling of greywater is seldom a major problem. Volumes are small and the content of hazardous or infectious substances is low. Greywater can be infiltrated into the ground or used for irrigation of trees.

In urban areas, the situation is different. Consumption of water and the use of household chemicals are greater than in rural areas. More buildings per unit of surface area limit the space for processing the greywater and increase the risks of environmental problems and human contact with polluted water. Urban areas require carefully designed and well-maintained systems for collection, treatment and discharge of greywater.

The design and operation of technical systems for greywater management depend on a number of factors: climate, land-use pattern, existing drainage systems and pollution load. The choice of treatment is also affected by how greywater is regarded by the community. The best system must therefore be found by considering local conditions and potential risks of alternative options.

The aim of this chapter is to give an overview of planning strategies and techniques for greywater management, with a focus on urban conditions. Our knowledge and experience of greywater treatment in urban areas and in different climates is still scant and mostly from cold regions. The current rapid development of urban eco-san will probably give us new insights in this field over the coming years.

6.2 Greywater characteristics

6.2.1 Water amounts

The amount of greywater produced varies between households. While the water consumption in poor areas may be as little as 20–30 litres per person a day, a person in a richer area may use several hundreds of litres a day. Water consumption can be reduced with the introduction of water-saving devices and a payment system based on the amount of water consumed.

Examples from Germany, Norway and Sweden show what can be achieved. In the ecovillage of Flintenbreite in Lübeck (see 3.2.3), where water-saving equipment has been installed, the mean greywater production is no more than about 60 litres per person a day.[1]

6.2.2 Biodegradable compounds

The composition of greywater varies greatly and reflects the lifestyle of the residents and their choice of household chemicals for dishwashing, laundry, etc. A characteristic of greywater is that it often has high concentrations of easily degradable organic material like fat, oil and other substances from cooking, as well as soap and tensides (surfactants) from detergents.

6.2.3 Pathogens

The content of pathogens in greywater is low. The risk of infection is related to its faecal contamination. As source-separated greywater normally contains no faeces it is often regarded as harmless.[2] Still, many public authorities around the world regard greywater as a health hazard. One explanation for this is that there may be high numbers of indicator bacteria in greywater. Recent research has shown that enteric coliform bacteria tend to grow in greywater because it contains easily degradable organic compounds. The use of coliform bacteria as bacterial indicators therefore tends to overestimate the faecal load and the potential risk posed by greywater. The fact that greywater easily turns anaerobic and creates bad odours may contribute to the belief that it is a health hazard.

In recent years other methods have been developed to assess the hygiene quality of water. By measuring chemical biomarkers, such as faecal sterols, a more accurate estimate of the faecal contamination can be made. Studies of a local treatment system in Vibyåsen, north of Stockholm, concluded that conventional measurements using traditional bacteria indicators overestimated the faecal load by 100 – 1000 fold as compared with measurements using chemical biomarkers. Using new methods (with coprostanol as a biomarker) the faecal load in the greywater in Vibyåsen was estimated at 0.04 grams per person a day.[3] (A normal faecal load in mixed toilet- and greywater from households is about 150 grams per person a day.)

The important conclusion is that untreated greywater is likely to contain far lower densities of pathogens than effluent water, even from an advanced wastewater treatment plant.

6.2.4 Nutrients

Greywater normally contains low levels of nutrients compared with ordinary wastewater from water-borne systems. The biochemical oxygen demand (BOD) of wastewater in Sweden is 60–70% of that in normal mixed wastewater. Nitrogen is 5–10% of that in normal mixed wastewater and phosphorous is 5–50%. Levels of nitrogen and other plant nutrients are always low but in some greywater high concentrations of phosphorous are found.[4] This phosphorous comes from detergents, where it is used for softening the water. Phosphate-free detergents are available on the market. In general these are as cheap and as good as those containing phosphorous. If people were to use only phosphorous-free detergents, the phosphorous content in

greywater would be reduced to levels lower than that normally found in wastewater after advanced treatment. Some countries in Europe and some cities in East Asia have banned phosphorous-containing detergents to protect freshwater bodies. This explains why the levels of phosphorous in greywater in Norway are only 10–20% of those normally found in Sweden.

6.2.5 Heavy metals and other toxic pollutants

The content of heavy metals and organic pollutants in greywater is generally low but can increase as a result of addition of environmentally hazardous substances.

The levels of heavy metals in greywater are, for most substances, approximately the same as in mixed wastewater from a household. However for some metals such as zinc and mercury the levels are lower.[5] Metals in greywater originate from the water itself, from corrosion of the pipe system and from dust, cutlery, dyes, and household chemicals.

Most organic pollutants in wastewater are in the greywater fraction, hence the levels are in the same concentration range as in mixed household wastewater. Organic pollutants are present in many of our ordinary household chemicals, e.g. shampoos, perfumes, preservatives, dyes and cleaners.[6] They are also in fabrics, glue, detergents and floor coating.

By using environment friendly household chemicals, and by not pouring hazardous substances such as paints and solvents into the sink, the levels of metals and organic pollutants in greywater will be kept low.

6.3 Components in greywater management

Successful management of greywater involves proper design, and taking into account the size of the different technical components involved. Also the 'soft' aspects of the system, such as user participation in running and maintaining the system, are important.

Rural greywater can be managed using relatively simple household-based methods like soil infiltration and evapo-transpiration beds.

When planning greywater systems for urban, high density locations

the following collection and treatment components should be considered:

- control at source
- pipe systems
- pre-treatment
- treatment
- end uses

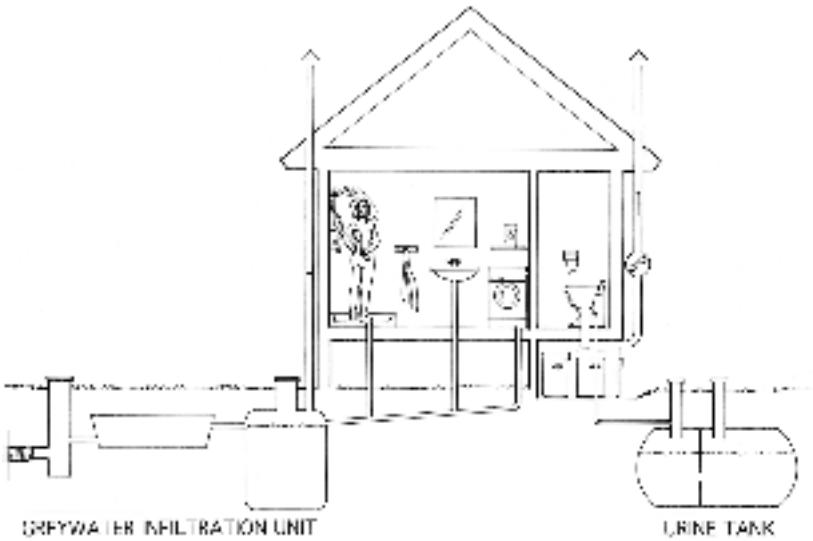


Figure 6.1 *A house with on-site greywater management. On the right-hand side is a urine-diverting toilet and a urine tank.*

6.3.1 Control at source

Any strategy for managing greywater will be made easier by water-saving measures as well as attention to reducing the use of household chemicals.

Technical components for a greywater system such as septic tanks, sand filters, soil infiltration systems and other treatment applications are designed in relation to the amount of water and BOD. Reducing these parameters at the point of origin gives us more options for cost-efficient and volume- and space-saving solutions. Source control makes the maintenance of the system more robust and efficient in terms of purification.

To reach and maintain a conservative use of water, experience shows

that water-saving equipment installed in households should be combined with economic incentives, i.e. a fee system based on water consumed. By combining technical and economic tools for water saving, greywater production can be reduced significantly without jeopardizing comfort and hygiene standards for the users.

Box 6.1 *Decrease in water consumption*

By using water-saving equipment such as mixer taps and water-saving shower nozzles, water consumption as well as energy for producing hot water is reduced. In Sweden the average water consumption has decreased from 220 litres per person per day in 1965 to 180 litres (150 litres in new houses per person per day mainly as a result of the development of washing machines and dishwashers that use less water.

The BOD load should be controlled at the household level. Such control includes information on proper behaviour and appropriate design of systems. In industrialized countries overdosing with household chemicals is common and is responsible for the increased levels of BOD often observed in wastewater during recent years. Correct use of such products is therefore an important part of greywater management. BOD levels in greywater are also a function of grease and oil used in food preparation.

Larger particles, fibres and grease should be removed at source to prevent clogging of the pipe system. Outlets from kitchen sinks, showers, bathtubs, washing machines and other fixtures and appliances should therefore be fitted with appropriate screens, filters or water traps. For greywater from restaurants and in households where large amounts of grease and oil are handled, special grease traps may be necessary to protect the pipe system from clogging.

As mentioned above, high levels of organics, phosphorous, organic pollutants and some of the heavy metals found in greywater come from household chemicals. Greywater management should therefore promote the use of environment-friendly household chemicals.

6.3.2 Pipe systems

A pipe system is needed to collect and transfer water to where it will be treated and used. Design and plumbing for greywater collection systems are similar to those for mixed wastewater. In eco-san, as there is no need to flush toilet waste, smaller pipes can be used

compared with mixed wastewater (flushing-and-discharge) systems. All pipe systems must have evacuation of air and odours. Normally a self-ventilating pipe arranged as a chimney above the roof is enough. Bad odours will sooner or later arise in the collecting systems. All pipe connections in the house must therefore be equipped with water traps. In extensive pipe systems, special consideration needs to be given to the problem of toxic and corrosive hydrogen sulphate produced from anoxic conditions.

Clogging from grease is a potential risk that must always be considered in greywater management, especially when the pipe system is extensive. Pipes must be laid straight with a gradient of at least 5 mm per meter. Pipe systems need to have flushing pipes and/or traps for use in case clogging occurs.

In smaller systems direct treatment and use is often the most appropriate option. In these systems, greywater is led directly to a mulch-bed where water is used for growing plants or trees. Such a system must be designed and sized so that also big particles can be digested by the soil ecosystem. The most appropriate solution is to connect each source of greywater to an individual mulch bed. Then the pipe system can be simple, and no flow splitter needs to be used. In countries with cold winters and water shortage, as in the Erdos project in China (see 8.1.4), a summer/winter system can be used. Such a system can be operated for direct use in summertime and for treatment and percolation in wintertime.

6.3.3 Pre-treatment

Pre-treatment is needed as soon as greywater is collected in larger pipe systems or stored for longer periods. Without such pre-treatment fats and other biodegradable organic compounds will clog the system or create bad odours. In pre-treatment suspended solids are removed mechanically by gravity, screens, seals or filters. The need for removal of suspended solids depends on how the water will be treated and used. The septic tank concept is an efficient and reliable technique that is useful in most treatment systems in rural as well as urban areas.

Septic tank

A septic tank is used for separation of particles and water. Floating particles are collected in the scum at the top of the tank and sinking particles are collected as sludge at the bottom. Transporting grey-

water in a pressurized system may have a negative effect on this separation.

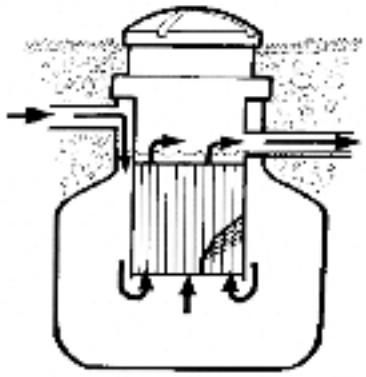


Figure 6.2 *Septic tank for greywater. (Design: WM-ekologen / P. Ridderstolpe).*

Untreated greywater should never be stored in open ponds. Such ponds will create odours and nuisance for people and provide a perfect site for the increase of bacteria and other organisms that thrive on organic carbon.

Screens, seals and filters

Different pre-treatment devices based on screens, seals and filters are available commercially. Prefabricated devices are useful in large wastewater systems and in special applications such as drip-irrigation systems. For ordinary home-applications they will seldom be cost-efficient and reliable enough.

Homemade seals or filters based on gravel may be appropriate in small-scale systems. In rural areas in warm climates an open gravel filter combined with soil infiltration can provide full treatment.

6.3.4 Treatment

Section 6.2.3 above explains how, from environmental and hygiene points of view, greywater is relatively harmless compared with mixed wastewater. Besides, greywater problems tend to have only local impact. But if not managed properly, greywater may turn mal-odorous. We must therefore reduce the high levels of easily degradable compounds that are responsible for the bad smell. This should be done right away as anaerobic conditions and odours develop within hours if the weather is warm. Wherever greywater is exposed to the atmosphere, it should first be treated to ensure that BOD does not cause anaerobic conditions.

We also want to reduce levels of micro-organisms, organic pollutants and heavy metals. This is especially important when greywater is infiltrated to groundwater or used for irrigation.

The most appropriate method for achieving the above targets is to use *attached aerobic biofilm techniques*. In these techniques, the biological degradation of organics typically takes place in aerated conditions. The treatments range from extensive land applications to intensive applications, such as trickling filters and biorotors (see Figure 6.3).

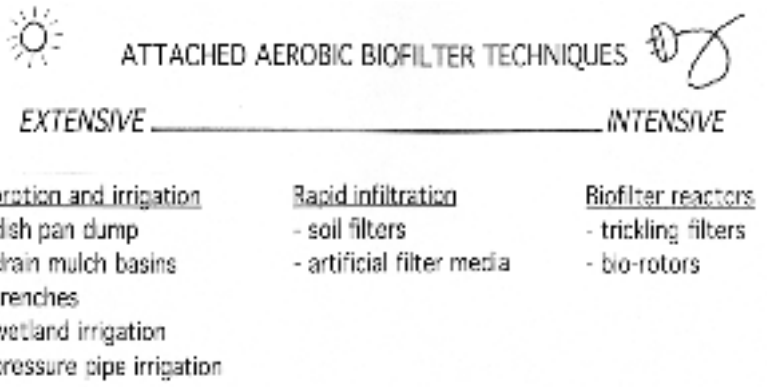


Figure 6.3 *Examples of attached aerobic biofilm techniques. On the left are extensive applications that require little technical input, but often a large land area. On the right are intensive applications that require more input of technique and energy, but less land.*

Where climatic conditions are favourable, aquatic systems, such as ponds and wetlands, can be used for greywater management. But such systems may not be appropriate for wastewater in cold climates and where water is scarce.

All aerobic attached biofilm techniques trap suspended solids in a filter medium, and then they are digested by micro-organisms well supplied with air. The most appropriate solution for greywater treatment is to filter it through soil.

Sorption and irrigation

Sorption and irrigation systems (slow-rate systems) use a soil filter to convert polluted water into a valuable plant asset. These systems should therefore be designed according to the water requirements of the plants. The amount of water that can be applied to an area varies typically from 2 to 15 litres per square metre per day depending on

the local evapo-transpiration rate.

Figure 6.4 illustrates direct application of greywater to a mulch bed. The bed is constructed by filling an excavated area beside a tree or a bush with gravel, bark or wood chips. The application device and the design of the bed must ensure that water is spread all over the area without clogging the inlet or water logging the soil used for plant growth. Water often flows to the mulch bed by gravity but pressurized systems can also be used.

Figure 6.4 *An example of direct use. The water is piped to a bed where it is applied below a mulch surface and is available for plants or trees.*[7]

Vertical soil filters

Soil filters can be used for greywater treatment. In the literature various terms are found for these systems: rapid infiltration, high-rate or vertical soil-filter systems.

Appropriately designed and operated, a soil filter has high removal efficiency for suspended solids and organic compounds. Removal efficiency for suspended solids and BOD is typically around 90–99%. Removal of bacteria and viruses is also high: 95–99% removal can be expected for most pathogens.[8,9,10] The treated greywater from a vertical soil filter thus has low levels of pathogens compared with mixed wastewater.

In natural soil-filter systems, phosphorous and heavy metal removal is significant. Depending on soil properties, depth of unsaturated zone and wastewater load, removal efficiency of phosphorous in a soil filter has been estimated to be 30% to 95% over its lifetime (25–30 years). Also, nitrogen is reduced in a soil filter bed by nitrification and denitrification. Soil filters fed by mixed wastewater typically show a nitrogen removal efficiency of about 30%.

The design of vertical soil filters is based on wastewater load and

BOD load. Typical loads for soil infiltration filters are 40–80 litres per square metre per day, or 4–6 grams BOD per square metre per day. The soil in the filter must be neither too coarse nor too fine. If the natural soil is not appropriate for infiltration, its capacity can be improved by using filter sand as an infiltration layer. A soil filter with special filter sand, and a bottom drainage layer for collection and discharge of treated water, is called a sand filter.

Vertical soil filters can be constructed in many ways. The challenge is to find a practical way to treat as much water as possible without clogging and saturating the soil with water. To achieve this, water must be distributed evenly over the filter surface. In gravity systems, so-called 'controlled clogging' has proved to be a feasible method: water is distributed over clogged bottoms (e.g. a narrow trench) while infiltration takes place through the walls. Techniques for spreading water in pressurized systems can be divided into surface flooding techniques, application through perforated horizontal pipes, and spraying or sprinkling systems.

Trickling filters and biorotors

These systems purify water by using attached biofilm in filters with a high water load. In a trickling filter, the water is spread over the filter medium by rotating arms or nozzles. The filter is filled with a strong filter medium with a large surface area and large pores so that it is not clogged by biofilm. Earlier applications used brick towers filled with round stones but nowadays, prefabricated plastic materials are used.

By using a trickling filter or other more intensive applications (e.g. biorotors, or activated sludge) the space needed for treatment is reduced. Drawbacks of these systems are that they need electricity and that they produce sludge.

Semi-wet wetland systems

By semi-wet wetlands we mean artificial wetlands to which water is intermittently loaded and drained. The idea behind this concept is to promote efficient spreading of water over the surface where filtering of suspended solids and sorption mechanisms take place. During the periods of drainage biodegradation and chemical sorption mechanisms are promoted because of the air contact.

In overland flow systems, water is flooded over a gentle slope typically covered with grass. In many countries the technique is frequently used in rural areas for fertilizing pastureland or for irrigating meadows for hay production.

An overland flow system for wastewater treatment is typically constructed on soil with a low capacity to absorb water (loam or clay soils). The load of water may range between 50 and 200 mm/day. To prevent soil erosion, the slope should not be steeper than 8–10 degrees.

During the last 10 years the overland flow technique (as well as impounding wetlands, i.e. shallow dams that can be filled with water and drained) has been used as the biological step in municipal wastewater treatment plants in Sweden. These systems are easy to construct and operate and have a high capacity.

In the smallest on-site applications these systems can be constructed as shallow open ditches, but in larger applications they may need a more sophisticated construction, for example an artificial wetland.

Ponds and aquaculture

Ponds and wetlands differ from the techniques described above in that they use a medium continuously saturated with water. Such conditions are normally unfavourable for oxygen-consuming processes, as gas movement is slow in water. Also movement of air by dispersion is slow in water. This explains why anaerobic conditions occur easily in water but never on land. It also explains why aquatic media in conventional biological treatment have to be aerated to work.

In warm climates, use of oxygen produced by growing plants can save the cost of aeration. Such systems use the symbiotic relationship between heterotrophic bacteria that produce carbon dioxide and micro-algae that produce oxygen. To prevent secondary pollution from the micro-algae that are produced, or oxygen depletion and a release of sorbed phosphorous following plant die-off, the plant biomass has to be removed from the system. This can be done by harvesting plant biomass directly, or transforming it via the food chain into secondary or tertiary production that can be harvested later. Examples of pond systems using primary production directly are the so-called high-rate ponds where, typically, bluegreen algae are cultivated for single-cell protein production.[11,12,13] Well-developed techniques for carp fish polyculture production are found in several countries in Asia. In other parts of the tropical world, a grass-eating fish, tilapia, is used as a biomass converter in wastewater aquaculture.[14,15]

There are many examples in the world where manipulated pond ecosystems are used for wastewater treatment without producing any

valuable crops. Especially in urban areas in cold climates, these systems are seldom appropriate since large areas are needed and treatment results are uncertain. In arid climates, use of these systems should also be questioned, as a large amount of valuable water is lost by evapo-transpiration.

6.3.5 End uses

After treatment, water is used for irrigation or returned to nature. The following recipients (end uses) can be identified:

- discharge to surface water
- percolation to groundwater
- use in irrigation

Discharge to surface water
Discharge to surface water is often the easiest and most natural way to return treated greywater to the environment. If the water is treated in a soil filter or a trickling filter, it can normally be discharged in open ditches and drained away together with stormwater. Treated greywater can be used for landscaping, like the creation of wetlands and dams in parks. The water may, however, in spite of treatment, still contain oxygen-consuming substances or nutrients that are too high to produce attractive and stable aquatic ecosystems. In this case, the treated greywater would have to be given a second treatment, for example by letting water trickle through the root zone in a trench before it is discharged into a pond.

Percolation to groundwater
When treated greywater is returned to groundwater the following precautions should be taken:

- Use only reliable methods that include the removal of suspended solids, BOD and bacteria.
- After treatment let the water percolate through the ground in an unsaturated zone of 1 metre depth or more. The subsoil should consist of sand.
- Leave a safety zone between percolation fields and wells. The extent of the safety zone must be determined according to local soil and groundwater conditions.

Use in irrigation

When greywater is used for irrigation special precautions are required. The following recommendations should always be followed:

- Method of application: Water should be applied to the soil or sub-surface rather than sprinkled.
- Choice of crop: Crops where leaves or stems are not eaten directly as well as fruit trees and bushes are most suitable for greywater irrigation.
- Waiting period: When irrigating edible crops, a certain waiting time between irrigation and harvest should be observed.

Chapter 7
PLANNING, PROMOTION AND SUPPORT

Eco-san systems may, for the user, seem more complex than conventional sanitation systems, and they do usually place more responsibility for appropriate functioning on individual families and local communities. Users must become aware that, despite potential health benefits, improper use of any toilet may turn it into a nuisance, threaten public health, and pollute the environment. These problems can best be avoided by adopting the appropriate behaviours from the outset. In addition, special care is required to take full advantage of the significant resource potential of the recycled plant nutrients.

At the household level individuals and families must understand how the eco-san system works, what can go wrong, and have the commitment and skills to manage it correctly. For large-scale application, it is also essential that a significant part of the local community shares this understanding and commitment.

In urban areas the fundamental issue of eco-san is how to establish a full-scale operation. It is one thing to operate scattered eco-san devices spread over a large rural area; it is a different matter to make thousands of eco-san devices work properly in a densely populated urban area.

This chapter will examine issues related to planning, promoting and supporting eco-san systems on a larger scale in urban and rural areas. Urban and rural planning, promotion and support will have fundamental differences, and thus this chapter is divided accordingly. We open this chapter, however, with the cultural factors affecting acceptance of eco-san and a paradigm shift in thinking that is often required at all levels for eco-san to be accepted and applied.

7.1 Cultural factors and facilitating change

7.1.1 The faecophilia–faecophobia continuum

One of the key obstacles that a new eco-san programme must overcome is the understandable and in some ways rational fear of human excrement, which we might refer to as 'faecophobia'. Faecophobia is a personal or cultural response to the fact that human faeces are malodorous and potentially dangerous.

In some cultures this response has been codified into concepts of 'clean' and 'unclean'. Hinduism is the prime example. A traditional upper caste Hindu would have nothing to do with human faeces, not even his own. This is not because they are malodorous but because they are perceived as unclean. Anyone touching them also becomes unclean. The only people supposed to handle human excreta and to clean toilets are the 'untouchables'. Even today this is a reality in both traditional villages and major cities.

Faecophobic attitudes are also common in Africa south of the Sahara. Here many farmers have until recently been practising shifting agriculture. There was no need for them to recycle human excreta and as shifting agriculture often meant a semi-nomadic life there was no tradition of building permanent wells and toilets. Faeces were dropped on the ground and the smell of other people's faeces was perceived as a warning signal.

In contrast, on the densely settled flood plains of China farmers have for a few thousand years had to fertilize their fields. Traditionally in China all human excreta was returned to the soil, fresh or composted. In China human excreta was therefore considered a valuable product.[1] Even today the rural Chinese have no problems talking about it, smelling it or handling it. Such a culture can be called 'faecophilic'.

Faecophilia thus represents one extreme point of a continuum where the other extreme is faecophobia. This model can be used to describe and understand a complex and changing reality. Indeed, most cultures – or sub-cultures – are somewhere in-between the extremes.

It took the AIDS pandemic to convince society that sexual behaviour is a topic to be discussed in social gatherings, educational institutions and public places. Are the global water, environmental and agricultural crises enough to convince us that it is now time to talk about

human excreta and how we handle them?

7.1.2 Participatory methods to facilitate change

For many cultures and for many leaders and families, acceptance of eco-san with its new toilet designs and new behaviours will require a paradigm shift in the way they think about and talk about sanitation. To ensure that the eco-san users can integrate the system into their local culture, including the capacity to set up, operate and maintain an eco-san system, it is usually necessary to train facilitators. These facilitators are likely to be more effective when they are attached to existing programmes, such as water, health, agriculture or environment.

To equip the team of eco-san facilitators adequately, a balance of three complementary educational strategies should be considered: *participatory learning*, *sharing information* and *skills training*. The degree of emphasis towards one approach or another will depend on the specific culture. For example, the use of participatory learning methods will be essential where urine diversion and the concept of recycling are unfamiliar or unacceptable. On the other hand, highly motivated cultures, with few or no basic resistances or taboos may simply require information on the options available and specific skills training on how to construct the units and monitor their operation. Whatever the combination, it is especially important to maintain a holistic, interdisciplinary approach, which will permit the users to integrate eco-san into their local culture and lifestyle.

The effective use of participatory methods can be vitally important to the success of eco-san programmes, as well as to hygiene and sanitation programmes in general. These methods involve users in the overall identification of problems and needs, in planning and finding solutions, and in monitoring health and environmental impact. User participation is essential to make necessary adjustments to the system.

The various participatory learning methods useful for sanitation programmes include 'Sarar' and 'Phast'. Sarar is a participatory non-formal education and training method, developed by Dr Lyra Srinivasan and associates in the 1970s.[2] It is a human growth-oriented approach for enabling individuals and groups to assess their situation, problem-solve, seize opportunities and plan creatively – realizing their full potential in the face of life's challenges. Sarar seeks to stimulate a process of dynamic transformation based on: personal

growth and confidence, group process and leadership skills, resourcefulness, creativity, planning for practical applications, action planning, commitment to sustainable improvement and responsibility for follow through.

In 1992 the World Bank Water and Sanitation Programme and WHO joined forces to produce better methods for hygiene education by adapting the Sarar method to stimulate sanitation and hygiene behaviour improvement. The result was the Participatory Hygiene and Sanitation Transformation initiative (Phast).[3] Phast provides a simple step-by-step process and tools to map local resources, explore the linkages between health and sanitation, assess people's knowledge gaps, promote discussion around the problems they identify and begin to develop strategies to address these problems.

7.2 Eco-san in urban areas

7.2.1 Planning

Planning for urban eco-san systems takes place in much the same way as planning for conventional sanitation systems has taken place in the past. The town or city must consider the quantity and quality of its water resources, its existing sanitation systems, and its storm drainage. It must consider whether the city floods periodically in the rainy season, or has serious water shortages either during the dry periods or permanently. It also has to consider what kind of sanitation the city can afford and how it wants to move forward with regard to sanitation over time.

Like all other city development planning, decisions as to whether to incorporate eco-san options into the existing system, or to maintain and extend an aging sewerage system, are normally taken by the city council or other governing body of the city.

7.2.2 Promotion, education and training

Promotion of eco-san at the urban level usually begins with educating the city staff and developers on the benefits and costs of this new approach to urban sanitation. This may require visits to urban or rural communities that have adopted eco-san so that staff and leaders can see eco-san in operation for themselves. Once city staff and city leaders are convinced that eco-san would be good for their town or city, the next step is to make a preliminary plan for the city and then

bring that plan to the public.

Before any plan is finalized, there may be a period of further studies on different aspects of eco-san for the urban setting, such as the best ways to collect, store and utilize urine and how to transport it to farmers. Studies on alternative greywater systems may be required. The city would also need to look into setting up new types of urban services and training for its workers, and this might need a period of research or trials (see 8.1.5).

Promotion to the public in an urban setting might involve meeting with smaller political units within the city to seek their feedback on the proposal and to determine what further information campaigns will be required for the public in general. Urban ecological sanitation systems will be managed less by households and more by urban services. Households will need to know how their new system works, how to use the eco-san devices properly and how much they need to pay. They will probably not be involved in any aspect of collection of urine and sanitized faecal products from household toilets.

A public education campaign needs to be designed and implemented before construction begins. Demonstration units should be built within neighbourhoods so that households can see what is coming. All sorts of civil institutions could be targeted such as men's and women's organizations, schools and religious institutions. Radio, television, newspapers and magazines can be used extensively to publicize the message.

Large-scale urban eco-san systems require training at various levels:

- Key local authorities and field staff must be properly trained in the principles, technical solutions, comparative advantages and limitations of eco-san systems and may also need training in community empowerment methods.
- Builders need to understand the basic principles of eco-san in addition to practical training in eco-san specific construction and installation.
- The staff responsible for collection, transport and secondary treatment must have a good understanding of sanitation-related public health, eco-san principles and practical issues related to eco-san operation and maintenance.
- Household members must know how to operate and maintain the eco-san devices in their homes.

7.2.3 Institutions

An urban eco-san system may involve creating new institutional arrangements. Since the system will not be water-borne, the city may wish to create a new department separate from the water and sewerage authority. It may wish to create an institution that links the eco-san products with rural and urban end users.

7.2.4 Financial aspects

The financial arrangements for a large new urban eco-san system may be similar to those for urban sewerage systems. In developing countries the new eco-san system may require a loan from an international bank, in which case the bank might be involved in planning and decision making. Smaller urban and peri-urban projects might be financed from local resources and involve more community participation in planning and implementation.

The introduction of eco-san systems is bound to lower the total costs of urban sanitation. Conventional sewers, treatment plants and sludge disposal arrangements will cost several times as much as an eco-san system. This is particularly important for developing countries, where public institutions face stringent financial limits. Eco-san systems require much less investment as they need no water for flushing, no pipelines for the transport of sewage, and no treatment plants and arrangements for the disposal of toxic sludge.

However, urban eco-san systems will involve costs for information, training, monitoring and follow-up that are greater than corresponding costs for conventional sanitation systems. In principle and in most cases, during the early pilot project phase, the organization funding an eco-san project may need to pay the entire cost of holding workshops and courses, and building demonstration toilets, greywater systems and eco-stations. But once the project has been initiated and the local work teams have been set up along with national and international experts, the scale-up costs need to be covered by the local authorities and the users/beneficiaries. A good example is what is happening in China since Sida and Unicef in 1998 funded a small pilot project in one village in Guangxi province: 5 years later more than 100,000 households have installed eco-san toilets (see 3.1.1–China).

Successful urban sanitation relies on sound finances. In principle, households should fully repay investment and operational and main-

tenance costs to ensure the sustainability of the system. In practice, pilot peri-urban sanitation programmes involving free or highly subsidized demonstration models are likely to fail in the long run when false expectations have been raised regarding the cost of the system. Furthermore, an urban eco-san system will generate additional costs that are not usually present in small rural eco-san projects, such as the safe handling, transportation, storage of urine and dehydrated or composted material from many devices. On the other hand, the economic (and ecological) value of the fertilizers produced could be significant.

As in all other urban services such as water supply, sewerage and electricity, payment for services is an accepted fact. The city could continue and if necessary upgrade whatever payment system it now has in place for water and sanitation.

7.2.5 Codes and regulations

Ecological sanitation is so new that few cities and towns today have any regulations that refer to eco-san systems. Existing regulations pertaining to water-borne sanitation systems are not appropriate. New regulations will be required.

When eco-san is to be introduced on a large scale there is a need for specific regulation of the use of human excreta, and sometimes also greywater, as inputs for agriculture. Such recognition is important because it is the starting point for eco-san to become the object of plans and programmes, financial incentives, tax exemptions, specific grants etc.

It is important that new regulations in this area do not specify which techniques are to be used. Today regulations are often written so that they exclude systems that are not based on using water for transporting human excreta. The ideal is to have regulations based on technology-neutral functional criteria. These regulations should state in qualitative terms the required performance of the sanitation system to achieve societal goals.

Urban eco-san toilet systems have four main features: urine diversion, containment, sanitization and recycling. Regulations based on required performance criteria for each of these are necessary. Guidelines on the health aspects of eco-san systems and the environmental aspects for reuse of urine and faeces are outlined in Chapters 2 and 5. These are the foundations to performance criteria and the

development of codes of practice.

7.3 Eco-san in small towns and rural areas

7.3.1 Planning

Typically in the past, planning for sanitation and water supply systems in rural areas and small towns took place at higher levels of government, at state, provincial and municipal levels, and decisions were communicated to the administrative levels below. However, in recent years there has been recognition that, when planning begins at the local level and moves upwards, and when communities have more choice, there is a greater chance of achieving sustainable systems. This is because the systems are planned in accordance with local ecological conditions and local cultural practices.

Community management of rural and small town water supply systems is now common in many parts of the world. Water committees are formed at the start of new projects and they participate in the design of the new scheme. Experience shows that sustainability is more likely when users feel a sense of ownership of the systems because they selected the design, participated in construction and made key decisions along the way.

The same principle can be applied to eco-san systems. Local government authorities and local community groups should form partnerships to lead sanitation programmes. Sanitation committees can be formed in communities to lead in the planning and implementation and to develop a sense of ownership and responsibility for community sanitation.

7.3.2 Promotion, education and training

A sure recipe for failure of a rural ecological sanitation programme is to put it in place without the participation of the intended users and without proper instruction. This is clearly illustrated by the example in Box 7.1.

Box 7.1 *The FIS project in El Salvador*

In 1992–94, in a project financed by IDB, the government of El Salvador built 50,263 LASF toilets (see 3.1.1). The total investment at that time was USD 12.5 million. The toilets were built by contractors without community participation and little or no community training.

A sample survey of 6,380 families carried out in 1994 showed that 39% of the toilets were used adequately, 25% were used inadequately and 36% were not used at all.[1]

These findings led to the development of a hygiene education strategy that focused on personalized education for all family members through home visits, participation of organized women in the implementation of the whole educational process, education materials and user-friendly monitoring and evaluation. After the completion of the first education module, the percentage of proper use increased to 72%, and the toilets that were being used improperly or were not being used at all decreased to 18% and 10%, respectively.[2]

The lesson learnt from this whole process was that the problems of non-use or improper use are not because of the technology itself but because of the interaction between technology and user. Promotion should therefore be on a personal and family basis, in order to provide advice on the spot. The need for behavioural changes, proper use and maintenance should be stressed.

Women

It is particularly important that women are included in the empowerment and promotion process right from the beginning. Women are the ones normally responsible for the household water supply, sanitation, hygiene and food preparation. They generally also play a major role in the education of the children in regard to health and hygiene issues. Their views and concerns must be expressed and integrated into the programme design as well as in detailed design decisions. Special effort should be made to assure that the toilet designs take into account women's special privacy and security requirements and are ergonomically appropriate for women, men and children.

Key or 'model' families

No matter how effective the eco-san system may seem, its long-term success will depend on the credibility it enjoys with potential users. For the system to become an integral part of local culture, it must first be shown to work and it must be acceptable to respected local leaders and opinion makers. A visit to a well-functioning eco-san toilet in a neighbour's home is one of the best ways to convert non-believers.

Local grassroots organizations
It is generally best to work through local organizations that are successful and well known within the community. Such organizations might include community water committees or health committees.

Local government
In the long run the support of local government will be essential for designing and installing the necessary infrastructure for supporting eco-san systems on a meaningful scale. Indeed, enlightened political commitment has been perhaps the principal common critical element in the start-up of key urban eco-san pilot programmemes, such as that in China. It can be well worth the investment to take community leaders on study tours to other communities and countries so that they can see for themselves and be convinced that eco-san systems do work.

Pilot projects
The history of technology transfer has many examples of programmes that went wrong when planners or politicians tried to go too fast without adequate attention to user participation and understanding. Eco-san is no exception.

It is advisable to begin with experimental small-scale pilot projects through which different eco-san devices may be assessed. During this phase the social aspects of the approach can be refined while demonstrating to a broader audience that the technology works. Broad dissemination requires in addition that hardware, if any, should be available in the market. In the pilot phase, regular follow-up at the household level is required.

7.3.3 Institutions

Institutional arrangements for sanitation vary from country to country. Very often rural sanitation is the responsibility of health authorities. What seems to be universally true is that sanitation lags behind all other sectors in development and often gets the poorest budget and has the weakest strategy.

Eco-san offers an opportunity to strengthen the sanitation sector in rural development by forming an alliance with rural agriculture, rural development and, in some countries, food security bureaus, and by offering more toilet choices to rural households.

Rural eco-san programmemes are much more focused around the

household, and thus within one rural community households may choose different eco-san systems for themselves depending upon their preferences. Households with plenty of space may choose the Arborloo (see 3.1.4, Zimbabwe) in order to gradually establish a small orchard. Households lacking spacing and wanting indoor toilets may choose double-vault desiccating toilets with urine diversion. Other households may want to stick with a pit latrine but collect their urine for fertilizer. Whatever the choice, the institutional arrangement should provide back-up and support for families in implementing their choices. At least one local institution should have a field agent capable of visiting households, speaking at schools and rural organizations, such as farmer's associations or women's clubs, and providing information and answering questions. There should also be arrangements for continuous monitoring and evaluation of the eco-san systems in operation for safety and to record benefits.

7.3.4 Financial aspects

Eco-san systems need not be expensive to build because:

For dehydrating and composting types:

- The entire device is built above ground – there is thus no need for digging and lining of pits.
- As urine is diverted and no water is used for flushing the volume of the processing chambers is small.
- The contents of the processing chambers are dry, which means that there is no need for expensive water-tight constructions.

For the soil-composting types:

- The pits are only 1.0–1.5 m deep since they need only hold excreta for about a year;
- The shallow pits are generally not lined and often only require a ring beam at the top;
- Special pans or seat-risers are not required.

Eco-san systems are usually cheaper than flush toilet systems built to the same standards of quality, as the example from Kosovo in Box 7.2 illustrates.

Box 7.2 *The cost of eco-san and flush toilets in Kosovo Schools*

In 2000 and 2001 Unicef helped to rebuild schools in Kosovo that had been destroyed during the 1999 war. At the start of the project most rural and some urban schools had only pit toilets that were full and unusable and with superstructures in a bad state of repair. As the Unicef programme offered only flush toilets, schools without water supply received no upgrades. In order to test the viability of the eco-san concept for schools in Kosovo a block of four eco-toilets was built at one school. The school well was upgraded to supply water for hand washing.

The cost of the new eco-san toilet block and the upgraded well was compared with similar facilities built for similar-sized schools that received flush toilets. The eco-san toilets cost 26% less than flush toilets, even taking into account the upgraded well and not considering the cost of obtaining new water supplies in the other schools (a cost that varied tremendously from school to school). These savings were due to pipes, toilet flushing tanks, a septic tank and labour not needed in the school with eco-san toilets. The school would realize other savings in years to come on maintenance and repairs of pipes and fittings and on not having to empty a septic tank regularly. The most appealing cost savings to the school was the fact that, unlike their pit toilets that lasted less than 10 years, this new toilet block was permanent!

Experience from rural sanitation programmes around the world indicates that subsidies are often an impediment to progress in getting sanitation coverage. Either all households should be subsidized or none should be. Subsidies frequently indicate that households cannot afford to build the type of toilet that has been selected (without community involvement) by authorities from outside the community.

Eco-san offers a variety of options costing different amounts of money. Families should be able to select an option that they can afford. Costs can be influenced by the type of toilet system, choice of building materials, financing arrangements, as well as whether paid labour or self-help owner constructed.

7.3.5 Codes and regulations

Although rural areas of developing countries may have codes and regulations for sanitation from colonial times, they are rarely enforced. In many developing countries sanitation coverage is so poor that governments are still working on getting any hygiene improvements no matter how simple.

Some countries may have regulations against the recycling of human excreta in agriculture. This might be the one and only regulation that would need to be addressed in a new rural eco-san programme.

7.4 Hygiene education and behaviour change

Every responsible sanitation programme has a hygiene education and behaviour change component. Previous sections describe the great importance of community participation in planning for services, and during this planning phase users will learn a great deal about disease transmission and how to block transmission. However, this is unlikely to be enough to bring about and sustain behavioural changes that are required to break the cycles of disease from faecal–oral contamination.

The key hygiene behaviours for breaking the cycle of faecal–oral diseases are:[6]

- Consistent use of toilets to keep faeces out of the environment;
- Hand washing after using the toilet, after cleaning up the faeces of children or helping children to use the toilet, and before food preparation or feeding children;
- Measures to keep drinking water clean;
- Hygienic food preparation and storage and reheating.

All of these behaviours need to be promoted in eco-san programmes.

Eco-toilets often also require new behaviours that people need to adopt. In urine-diverting toilets for example, people must be instructed to use these new toilets so that no urine enters the processing chamber and no faeces get into the urine collector. In cultures where water is used for anal cleaning people must be instructed to wash only over the drain designed for that purpose and not so that water gets into the processing chamber. In double-vault toilets people must be instructed to let the contents of the processing chamber not in use rest for 6–12 months before they are removed. These examples show that an eco-san hygiene education programme needs to be tailored around key hygiene behaviours as well as the behaviours particular to the new eco-san system chosen by the users.

A good communication programme begins with a study of current practices and the main local channels of communication within the community.

In any programme where the population is highly mobile, new families will be moving in who need to learn how to use existing eco-

san toilets. A system needs to be in place to instruct these new families in the proper use of their eco-toilet.

7.5 Monitoring and evaluation

Every eco-san project, whether urban or rural, should include a mechanism for monitoring and evaluation. Some indicators for monitoring and evaluation can be determined by a local community group (such as a water and sanitation committee or health committee) that has participated in planning the new sanitation system. Government authorities and/or NGOs involved in the project should carry out further monitoring and evaluation, using their own indicators.

The WaterAid-supported programmeme in northern Mozambique, described in Box 7.3, has been especially effective in demonstrating the value of ongoing community-based monitoring.

Box 7.3 *The WaterAid monitoring and evaluation system in Mozambique* [7]

The WaterAid monitoring and evaluation system is designed to assess whether the eco-toilets in the programme are being used effectively and hygienically, and whether they in fact are creating the necessary conditions for improved health. In other words, they recognize that the number of toilets built will have little long-term impact unless they are also able to demonstrate that the toilets are 'used by all and in a hygienic manner'. The monitoring and evaluation system is focusing on:

- Signs of faeces and urine around the drop hole;
- Presence of handwashing facilities (water, soap etc) and evidence that they are used;
- Presence of flies and odour (as indicators of excess humidity and/or insufficient ash/soil application); and
- Family perception of the toilet.

The primary conclusion for the monitoring exercise was that the programme had been overemphasizing sanitation at the expense of the hygiene programme. A better strategy might be to strengthen the hygiene effort, in order for the community to drive the sanitation solu-tion. Monitoring activities had also shown that greater attention should be placed on gender and control issues, since it was discovered that the other members of the household were unwilling to move the slab to the alternate pit (an essential maintenance activity) in the absence of the male head of household.

By placing monitoring and evaluation at the centre of its programme, WaterAid/Mozambique has learned to ask hard questions, stimulate learning, improve programme support and guarantee greater, sustainable acceptance of eco-san.

Chapter 8
A VISION FOR THE FUTURE

8.1 A vision

This book sums up state-of-the-art ecological sanitation at the beginning of this century. We have outlined the global sanitation challenge; explained how human excreta can be sanitized for use as a fertilizer; described a variety of eco-toilets and eco-san systems; discussed the key design and management features that designers need to consider when adapting the concept to different environments and cultures; discussed the main concerns these systems raise in the minds of policy-makers; and provided cautions against failure. We have described how the plant nutrients in human urine and faeces can be safely recycled to agriculture and the great benefits these nutrients have for plants and food production. We have offered options for urban greywater management, as the eco-san concept implies that traditional, centralized sewerage systems will no longer be required. We have outlined our experience on working with urban and rural local governments and communities and what we consider to be the 'recipes for success'. Now it is time to look ahead into the future. Have these efforts in eco-san over the decade been a fad, soon to disappear? Or can we turn eco-san into a force able to transform our increasingly urban future?

8.1.1 The next 50 years

Ecological sanitation today is at the same developmental stage that aeroplanes were at when Louis Bleriot in 1909, a few years after Wilbur and Orville Wright's pioneering first flight, flew his monoplane across the English Channel from Calais to Dover.[1]

Today, everyday, we have thousands of aeroplanes flying the skies of the world, on every continent, each carrying hundreds of passengers. Air travel, so primitive a hundred years ago, in 50 years has become a major form of transport. A key reason for its success was that governments and industry saw its potential benefits to society and invested large sums of money for its development and infrastructure. The same story could be told about the development of the auto-

mobile and telephones in the last century. Both were primitive inventions in 1900, but by 1950 they had been turned into transport and communication systems that transformed our lives. Both benefited from substantial public subsidies for research, development and infrastructure. People a hundred years ago could not imagine that we would fly across continents in one day, make a phone call from Africa to North America in a matter of seconds, and that in many countries most families would own a personal car that they could freely drive anywhere within their own country and beyond without worries about where to get fuel, repairs, or suitable road surfaces.

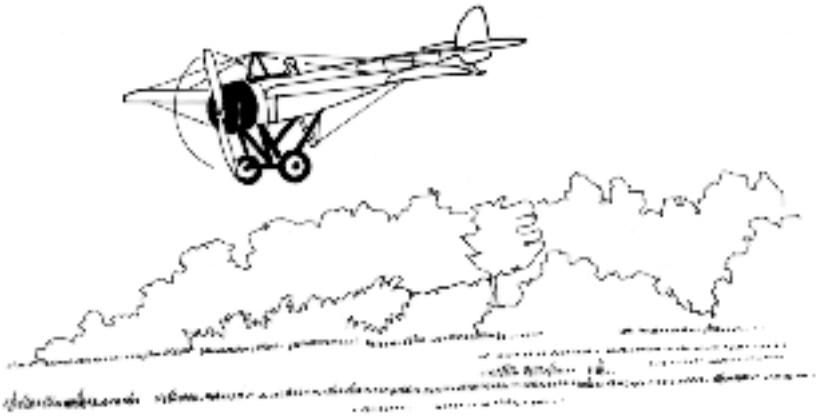


Figure 8.1 *Louis Bleriot's monoplane.*

The future of ecological sanitation, therefore, lies in seeing its potential and investing further in its research, development and infrastructure. We cannot easily imagine the eco-san systems that may exist 50 or 100 years from now. They will no doubt be much more sophisticated than those we have described in this book. However, even in the future, the eco-san principles of containment, pathogen destruction and recycling of nutrients may remain much the same, as these are biological principles.

We envisage eco-san of the future being applied to various ecological, cultural and population-density conditions using technologies not yet invented or not yet applied to sanitation. We see planners of new towns basing their master plans and building designs on ecological principles, including ecological sanitation. And we see existing cities served by old and decaying sewerage systems being retrofitted with ecological sanitation systems. We see government agencies and non-governmental organizations offering eco-san options to rural communities and small towns as alternatives to today's conventional

approaches based on drop-and-store or flush-and-discharge.

Within the next 50 years the world will rebuild or build new urban sanitation infrastructure for an expected 6 billion urban dwellers. Much of that could be ecological sanitation.

8.1.2 Eco-cities and eco-towns

Gradually, since at least 1950, planners and ordinary citizens have been awakening to the fact that we must live in an ecologically sustainable way. We must take into consideration our local and planetary eco-systems when we modify nature to improve our lives. If we continue on our current path of development resulting in increasing air and water pollution and destruction of natural habitats for varieties of species, we will seal our own doom, for a healthy eco-system is fundamental for all life on the planet.

Today that awareness is slowly being transformed into action. Pioneers of eco-living concepts are considering how to reduce our dependence upon automobiles, with all their impact on air quality and urban design and living. They are involved in 'green building', creating buildings that require less energy to heat, cool and light. They are trying to build communities on a human scale where we can walk to school, work and play. They are encouraging more green spaces, trees and other plants in urban areas and more forests in agricultural areas to enhance the chances for biodiversity. They are advocating locally-grown food to reduce dependence on food transported by highly polluting fossil fuels. Eco-san fits well into this overall framework for future ecological living.

The most demanding eco-san challenge in the coming years is to develop and implement systems for urban areas. Urban populations are expected to grow from 3 billion today to 5 billion in about 20 years time, 40% of them living in slums.[2] Can eco-san systems be used to serve some of these urban populations? – We think so but have yet to prove it.

Around the world there are already examples of eco-san applied to urban areas and densely built-up villages, but the projects are small and scattered. The first major effort to implement a fairly large, comprehensive pilot urban eco-san project in a new town is under way in Erdos municipality in Inner Mongolia, China (see 8.1.4). Another project, emphasizing retrofitting rather than new construction, is under preparation in Tepoztlán municipality in the state of Morelos,

Mexico (see 8.1.5).

Urban or rural – the basic eco-san approach, sanitize-and-ecycle, remains the same. The differences are in the technical solutions required for multi-storey buildings, difficulties of reaching large, fluctuating populations with information, the challenges of communal collection systems, and the need to store, transport and treat large volumes of urine, faeces and greywater on-site or within the neighbourhood. Some solutions do exist and have been tested in smaller projects in Sweden, Germany and China. Other solutions are being developed and tested in the current China-Sweden Erdos Eco-Town Project.[3]

8.1.3 Eco-stations

An evolving concept in ecological sanitation is the 'eco-station'. This is a place within an urban area for recycling of solid wastes and secondary processing of human excreta from eco-san toilets. There might be smaller, intermediate eco-stations for groups of houses or apartments and a larger one serving the neighbourhood or town.

In an eco-station the three types of source-separated outputs from the households: the yellow (urine), the brown (faeces), and the grey (greywater), plus source-separated domestic solid waste, are collected from homes and neighbourhoods and transferred to a place (an eco-station) for further processing. At the eco-station the partly sanitized faeces, together with household organic waste, will go through secondary treatment consisting of high temperature composting.

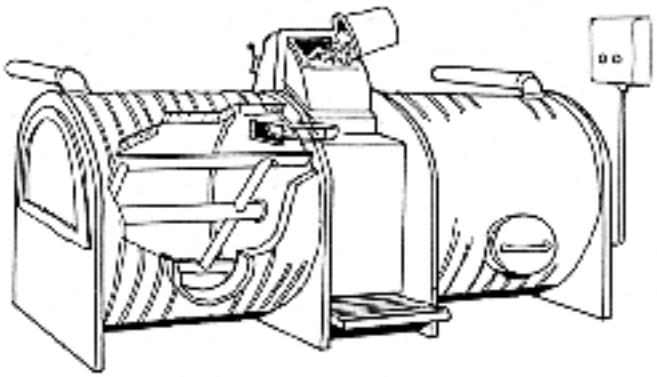


Figure 8.2 *A mechanical composter serving 50–80 households. This example is from Sweden ('Jora Kompost 1400') and can handle 450 litre compostable refuse per week.*[4]

The purpose of secondary treatment is to further break down the organic material (including toilet paper), further reduce volume and weight and reach an acceptable level of pathogen destruction. If the end-product must be totally sterile, the material could be carbonized or incinerated rather than composted. The urine can be used for the household's own garden or rooftop container garden, but excess urine, and urine from households that do not want it or have no garden, is stored in tanks until sanitized and then sold as a liquid fertilizer to market gardeners and farmers in and around the city. During the cold season there is still a demand for urine fertilizer from farmers who produce vegetables in greenhouses. (Another possibility is to turn the urine into a powder fertilizer.[5])

Urine can be sold as a fertilizer and sanitized faeces as a fertilizer and soil conditioner. The price paid by farmers and urban horticulturalists will meet part of the staff costs of the eco-station, so that households may have to pay less for collection. The sorted non-biodegradable solid waste is recycled to industry. Each eco-station thus creates a number of jobs for local residents.

The introduction of the eco-station concept must be supported by an education and training programme. Collection workers are trained in instructing and following up households. If at the time of collection they see a problem in the household's sanitation unit, it is their job to discuss the problem with the owner and try to correct it on the spot. In addition, the municipal government has instituted regular monitoring of the neighbourhood eco-stations and the fertilizers being produced. There is periodic testing of both urine and sanitized faeces for public health safety. A bonus of the new sanitation system's educational programme is that a range of hygiene behaviours are addressed as never before. Hand washing, food hygiene and the care of infants and toddlers to prevent diarrhoeal diseases receive greater attention.

Municipal solid waste

Municipal solid waste is a huge and growing problem in cities around the world. In industrialized countries, the production of municipal wastes has increased by several factors as their economies have grown. Developing countries are now following this pattern which is resulting in 'mountains' of garbage piling up on the outskirts of large cities and much waste going uncollected, clogging streets and water courses.

Municipal governments normally need a comprehensive plan for waste reduction and recycling before the problem is properly

managed. Many of these wastes are in chemical forms that do not easily allow for recycling, such as most plastics and discarded electronic components which contain harmful heavy metals that require complex and expensive processes to extract and contain. Most cities of the world collect municipal solid waste and dump it in landfills or on top of the land in open fields. These mountains of mixed waste produce large amounts of methane gas, and release pollutants into the soil and groundwater. It is clear that continuing in this way is unsustainable. A more sustainable approach is a system whereby wastes are reduced, re-used, recycled and raw materials and energy are recovered.

One of the main problems with the way municipal solid wastes are handled today in most cities and towns of the world is that they are mixed. Solid wastes are usually a mixture of wet biomass, combustibles (paper, plastics, wood and textiles), minerals and metals. The proportions vary with the society and its consumption habits, but the result is much the same around the world. Putting all of these mixed materials into landfills or garbage mountains results in an 'uncontrolled bio-chemical reactor' and its effect on the local environment is unpredictable.[6] What is known is that the amount of chemicals released by landfills into the atmosphere and groundwater and surface water is huge and has both local and global effects. Thus, an immediate objective of the solid waste management of an eco-town is to stop the mixing of solid wastes. Biomass can be composted and used to enrich soil, combustibles can be incinerated for energy, and metals need to be recovered.

Municipal solid wastes fall into 12 main categories: reusable items, paper, plant debris, putrescibles, wood, ceramics, soils, metals, glass, polymers, textiles and chemicals.[7] In addition to these we may add a 13th category: dried human faeces from ecological toilets. For the human excreta products of eco-toilets, professional house-to-house collection will probably be the preferred method and offer the most public health safety advantages.

All eco-stations would have safe working conditions for employees, including facemasks, protective clothing, and sturdy gloves. The transport of the human urine and dried faeces would become a municipal responsibility and they would be collected on a regular schedule using modern equipment for the protection of workers.

Planning and costs

Waste issues should be addressed in a more sustainable way, and

points to be considered when establishing eco-stations include: the cost-benefit analysis; the household behaviours that need to be adopted or changed, such as household separation of refuse into categories; community education: and the need for community compliance. The cost-benefit analysis needs to take into consideration the cost of continuing with the present waste-handling systems ('business as usual'), whatever they may be, including potential existing harm to the environment, and environmental clean-up. Muni-cipal officials and citizens may object to the eco-station concept on the grounds of cost, but until a complete cost-benefit comparison is undertaken, the true cost remains unknown.

As for community education, the programme needs to include education on harm to the environment. Another important message to be conveyed is for consumers to reduce the amount of waste they generate by avoiding excessive packaging, buying products that are easily recycled, and buying products that they can first reuse in their own homes.

Eco-stations can provide new employment opportunities to local communities. In many cities of the world, solid waste is collected and sold for recycling by scavengers, usually the poorest of the poor who have few opportunities for other employment. Their work conditions are usually unsafe and unhealthy. The World Bank estimates that globally there are over 800 million people unemployed or underemployed and perhaps 200 million 'on the move' looking for work. Therefore, there should be no shortage of potential workers for eco-stations.

8.1.4 Erdos: planning a new town

The China-Sweden Erdos Eco-Town Project (EETP) is an ambitious attempt to generate the data, technologies and policies required to bring about a major change in the way human settlements relate to the environment. The project is in Dongsheng town of Erdos municipality in the Yellow River basin, in the southwestern part of Inner Mongolia, northern China (latitude 40° north, altitude 1500 m). This part of China is semi-arid with an annual rainfall of 300–400 mm. The spring season is dry and often windy (sand storm days average 19 in the city area), summers are warm and often wet, autumns cool and winters long and cold. Cold air masses frequently invade from the north and winter lasts for 6 months. The record low air temperature is 32.6°C below zero. The number of frost-free days is on average 135.

Dongsheng is a rapidly growing town with a population of 300,000. Out of the 60,000 households only one-third have flush toilets. The remaining 40,000 households share 370 public toilets. (This sanitation situation is typical for China.) The main source of drinking water in Dongsheng is from underground aquifers. In some parts of the town water is available only three times per day for periods of 30–90 minutes.

The new eco-san neighbourhood is under construction (beginning in June 2004, to be completed by December 2006) on the outskirts of the present city. The project area will accommodate 2000 households on a 50-ha site, most of them in apartments in 4- and 5-storey buildings and the rest in 1- and 2-storey houses. There is already a large primary school on the site. Nursery schools and cultural and commercial facilities will be added.[8]

The major ongoing research/design issues in the EETP are:

Providing eco-san solutions for multi-storey buildings and 1–2 storey houses

Toilet systems with urine-diversion are the chosen alternative. A urine-diverting toilet for use in multi-storey buildings has been developed and is now in production.

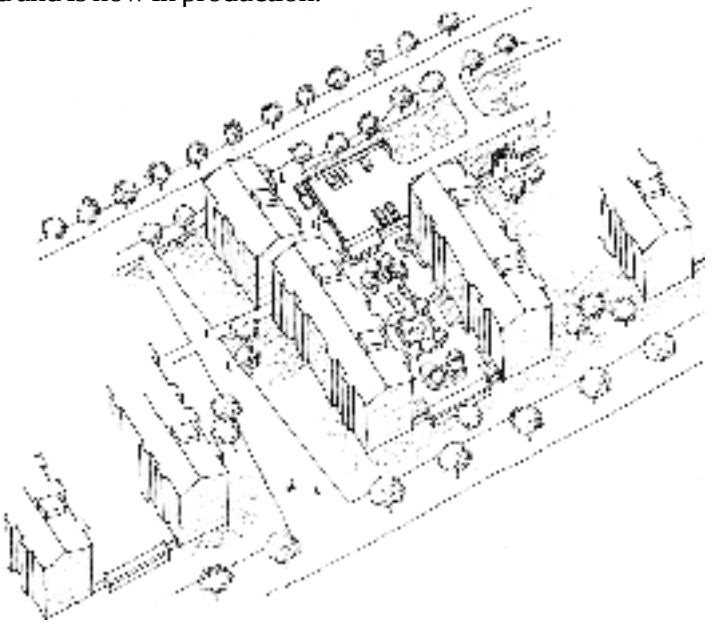


Figure 8.3 *Group of apartment buildings with 'mini eco-station', EETP, China.*

Providing eco-san solutions for greywater management

A variety of solutions have been designed and are now (2004) under construction. They are to be tested both under laboratory conditions and in real-life situations: small, family-size evapo-transpiration beds, larger units serving clusters of buildings, and constructed wetlands serving whole neighbourhoods. (A complicating factor in Erdos is the winter conditions and freezing of the surface soil drainage down to 1.5–2 m depth.)

Figure 8.4 *Greywater treatment for a group of apartment buildings, EETP, China.*

Providing eco-san solutions for solid and organic household waste management

Source-separation models used in some Swedish municipalities have been adapted to Chinese conditions and will be tested in the project. These solutions include the design of hardware for household use and the development of hygienic, cost-effective collection systems as well as a major and sustained education programme to promote source separation in all households and places of work.

Figure 8.5 *Household source separation of solid waste.*

Establishing eco-stations

Eco-stations for composting of household organic wastes and secondary treatment of faeces are to be developed together with test procedures for handling the different flows of these outputs and turning them into recyclable, marketable substances (see 8.1.3). The project's hypothesis is that this can be accomplished in a cost-effective way by source separation at the household and workplace level and bringing the residual products to the eco-stations serving a group of households or an entire neighbourhood.

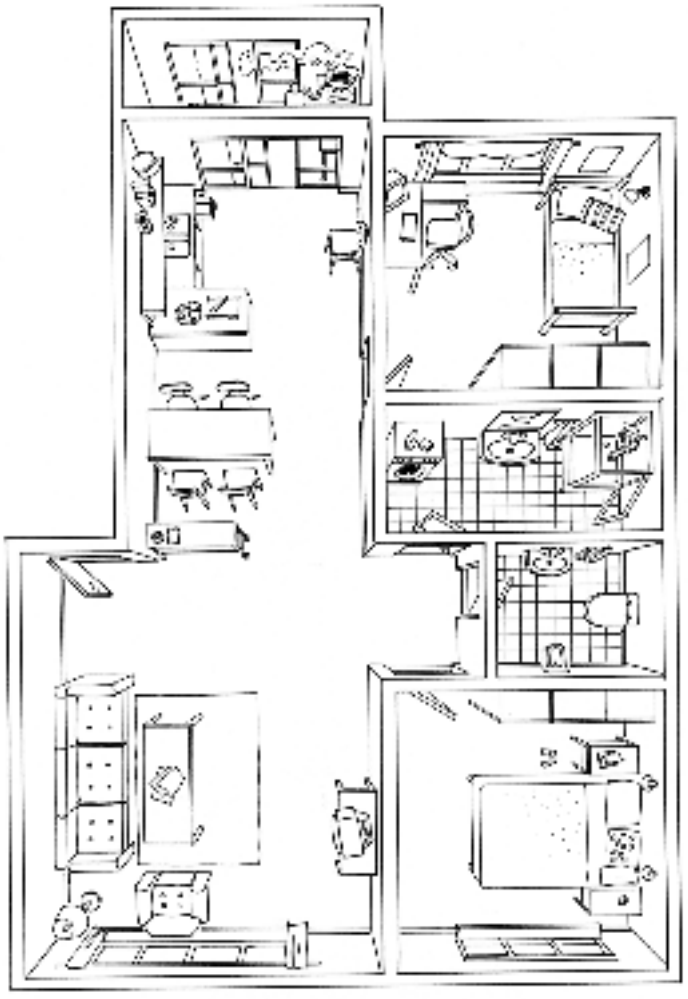


Figure 8.6 *2-bedroom apartment, EETP, China. The toilet rooms in all apartments have a separate urinal next to the urine-diverting toilet.*

Cost-effective design, production and operation
The houses and apartments are built according to good Chinese standards and will be sold to the public. Financial aspects are of central concern and the alternative systems developed in the project will be costed and compared with conventional systems.

8.1.5 *Tepoztlán: planning for sanitation expansion in a small town*

Tepoztlán is a small town about an hour from Mexico City. It has a population of about 34,000 and is similar to thousands of district or municipal small towns in Latin America. Since 2002 the local government in partnership with a private management firm has been planning an ecological sanitation pilot programme aiming at expanding and improving sanitation coverage within the town and surrounding peri-urban areas. Because of the new focus on ecological sanitation many of the conventional practices of centralized urban planning do not apply. Any expansion based on ecological sanitation principles must take into account the existing sewerage system serving the central business district and try to make it more eco-friendly. Experience to date has shown that a combination of political advocacy, multistakeholder bio-regional planning, decentralized community-based consultation, educational programmes, and social marketing has the best possibility of integrating the needs and expectations of both urban and peri-urban populations.

The 'TepozEco Eco-san Pilot Project' in Tepoztlán is one of the few examples of a holistic approach to eco-san covering both urban and peri-urban settings, poor and better off areas, and different eco-san technologies. A key strategy of the programme is to focus on creating the conditions that will guarantee the acceptance of sustainable water management and ecological sanitation approaches among a socio-economically diverse population, as well as the longer-term sustainability of the systems.

The project to date has focused on applied research and development activities that will be critical to the ultimate success and sustainability of the programme. These are:

Designing a range of eco-san toilet options
Eco-toilets must be sufficiently attractive, comfortable and nuisance free to compete with conventional WCs. The project is therefore designing urine-diverting toilets that will function well for men as well as women and for children as well as adults. There will be double- and

single-chamber options, models with moveable containers to facilitate handling and passive solar design for improved drying. Costs and effects of different dehydrating mixtures will be studied as well as the use of alternative building materials. Low-cost options will being considered for the more marginal peri-urban communities.

Developing urine-harvesting systems

Tepoztlán experiences peak demands on its water and sanitation systems due to weekend and public holidays tourism. To save water, the project is developing public waterless urinals for both men and women. This offers a special opportunity for harvesting significant volumes of urine to meet the fertilizer needs of local farmers. The programme is also testing improved low-cost, low-maintenance odour traps for public urinals. As for household urine collection, research is underway on combined urine and greywater drainage.

The urban agriculture component of TepozEco has worked closely with local producers to demonstrate the potential of urine as a substitute for conventional chemical fertilizers. Special emphasis has been given to use of urine on local food products like *nopal* cactus, avocado, maize and tomato and on nonfood cash crops such as flowers. Studies are also being conducted to compare the use and effects of fermented and non-fermented urine, especially for home garden uses.

Establishing eco-stations

Since mid-2003 a municipal composting center receives and processes the organic fraction from municipal and private solid waste. The project includes ongoing research on urine application to compost and secondary processing of fecal output from dry toilets.

Addressing the greywater challenge

As part of a household-centered approach the project is encouraging horizontal reed-bed bio-filters at household level and interconnected systems for groups of households with constructed wetlands for collective greywater discharges. Regulatory reforms are underway so that responsibilities are clearly spelled out for each level: household, neighborhood and municipality.

Advocating sustainable wastewater management

Tepoztlán, like many municipalities in Latin America, has begun to install a sewer system for the town center to deal with the high volume of wastewater. The eco-san project has used this to raise ecological awareness in the town and to gain support for the creation of a comprehensive municipal water and sanitation programme with a sustainable end-of-pipe alternative wastewater treatment for the town center, including a constructed wetland.

Developing municipal environmental & sanitation regulations
A major thrust of the programme has been to work with local and regional authorities to develop realistic and enforceable municipal environmental sanitation regulations based on a thorough analysis of a recent study carried out by the EcoSanRes programme.[9]

Conducting environmental communication and education
A variety of communication tools and media have been used to promote eco-san in Tepoztlán: participatory stakeholder workshops; an environmental sanitation diploma course to recruit community eco-san advocates and community promoters; participatory approaches and tools (primarily Sarar) for work with local communities; and information dissemination and promotion through public and electronic media.

8.2 Advantages of ecological sanitation

If this vision of ecological sanitation could be realized, then it would confer a great many advantages to the environment, households and families and to municipalities. To close our book we summarize these advantages below.

8.2.1 Advantages to the environment and agriculture

If ecological sanitation could be adopted on a large scale, it would protect our groundwater, streams, lakes and the sea from faecal contamination. Less water would be consumed. Farmers would require less expensive commercial fertilizer, much of which today washes out of the soil into water, thereby contributing to environmental degradation. Eco-san allows us to make use of the high fertilizer value of urine and the soil-enriching properties of dried or composted faeces.

Urine is rich in nitrogen, phosphorous and potassium. Urine can be diluted with water and put directly on vegetable gardens and agricultural fields or saved in underground tanks for later use.

Human faeces can be turned into a valuable soil conditioner rich in carbon, providing both good soil structure and a good medium for essential soil micro-organisms. With eco-san we can replenish the world's soils, both for agricultural use and to restore wasteland, and continue to enrich those soils more and more over time. Returning

human urine and sanitized faeces to soils on a regular basis has the potential to replenish soil nutrients to levels at which productivity will become sustainable.

Recycling human excreta would reduce the greenhouse effect if practised on a large scale as part of a comprehensive programme to increase the carbon content of soils. Most efforts to address the atmospheric build-up of carbon dioxide (CO_2), which is believed to be causing climate change, have focused on reducing the CO_2 emissions from fossil fuel burning and the clearing of rain forests. However, scientists have recently begun to focus on the ability of soils to serve as a sink for excess atmospheric carbon. (In soils carbon is stored in the form of humus and decaying organic matter.) A number of factors influence the accumulation of carbon in soils. Returning sanitized human excreta to degraded lands would play a significant role in this process by increasing the amount of carbon in the soil, enhancing soil fertility, increasing plant growth and hence the amount of CO_2 fixed from the atmosphere through photosynthesis. A modest doubling of the amount of carbon in non-forest soils, from the current low level of 1% (as a result of erosion) to 2% over the course of 100 years would balance the net annual increase of atmospheric carbon over that time.[10]

8.2.2 Advantages to households and neighbourhoods

No matter how unpleasant the immediate environment may be, individual households can improve their conditions considerably by adopting an eco-san system. Many of the options available are relatively inexpensive and not difficult to build. Households can immediately have the privacy, convenience and aesthetic advantages of an odourless and flyless toilet, attached to or even built right into their homes, however small. This is of course particularly important for women. Groups of households with access only to public toilets and open defecation can improve their neighbourhood dramatically.

The health benefits of toilets are usually not an important selling point for consumer acceptance. However, some consumers may find it attractive to know that if a large area of their community can be made more sanitary, the likelihood of diarrhoea and worm infections will decrease, leading to overall better health and better study results for school children.[11]

The nutrition of families would also improve if urine and faeces were

recycled to grow additional vegetables in garden plots, on rooftops and balconies or even on walls (see Boxes 5.2 and 5.3). The fertilizer value of recycled urine and the soil-improving properties of decomposed faeces produce excellent crops even from poor soil or soil-less horticulture.[12]

Some designs of eco-san toilets are lightweight and movable. The urban poor usually do not own the land on which they live and do not wish to invest money in structures they cannot take with them. With the eco-san approach it is possible for them to have a prefabricated toilet unit that can be moved. This has proved to be an important selling point for the prefabricated toilets produced by Tecnología Alternativa SA in Mexico City (see 3.1.3 – Mexico).

The emptying of ordinary pit toilets and the sludge removal from septic tanks is messy, expensive and technically difficult. In many informal settlements, the vacuum trucks needed for the process cannot negotiate the narrow streets and the steep slopes. If contents are removed by hand, the sludge is smelly, wet and dangerous to the workers. Eco-san systems based on dehydration or decomposition reduce the volume of material to be handled and transported and result in a dry, soil-like, completely inoffensive and easy-to-handle product. As the toilet is built completely above ground there is easy access to the sanitized faeces for recycling and easier management of contents for pathogen destruction.

A great problem of building toilets in some areas is the subsoil and groundwater conditions. In some areas the ground is too hard for digging. In other areas the water-table is close to the surface. Both conditions prevent or make difficult the construction of pit toilets, VIP toilets or pour-flush toilets. As eco-san toilets can be built entirely above ground, they allow construction anywhere a house can be built, they do not collapse, they do not destabilize the foundations of nearby buildings and they do not pollute the groundwater.

The majority of eco-san toilets described in this book do not require expensive or high-tech equipment. Jobs can be created for builders and for collectors of urine and sanitized faeces. These products can be sold to farmers or households could use them to grow food. An entire mini-economy could potentially develop around eco-san systems, especially in urban areas.

8.2.3 Advantages to municipalities

More than half the world's population live in urban areas, a number projected to reach 5.1 billion by 2030; about 98% of the increase will occur in developing countries.[13]

Municipalities all over the world are experiencing greater and greater difficulty in supplying water to households and neighbourhoods. In many cities water is rationed and supplied only a few hours a day. Wealthier households collect this water in large tanks while the poor queue up at public taps to receive their daily ration. Eco-san systems reduce the use of these scarce water resources and may result therefore in a more equitable allocation of water to rich and poor households.

A major advantage of eco-san systems is that they have the potential to increase sustainable sanitation coverage of the unserved more quickly than any other method. Municipal governments are under increasing pressure to provide sanitation coverage for the entire urban population. Even if there is political will, the options available are severely limited owing to lack of water and/or money (for flush-and-discharge systems) and lack of space and/or difficult ground or groundwater conditions (for drop-and-store systems). The Millennium Development Goals will spur on the building of millions of toilets in the developing world over the next few decades. But the tendency will be to fall back onto conventional practices such as deep pit toilets and pour-flush cess pits if eco-san is not promoted. Modifying these installations so that they do not contaminate the subsoil and groundwater requires capacity building that remains to be developed. The eco-san options, outlined in Chapter 3, are in general affordable to the poor and have almost no recurrent costs for operation and maintenance. In most cases eco-toilets require no excavation; do not depend on water and pipe networks; can be used even in congested areas; and, as the units have no odour when properly looked after, can be placed anywhere (even inside a house and on upper floors). Eco-san is an inexpensive and attractive alternative to expansion of sewerage systems.

Finally, eco-san systems allow, even favour, decentralized urban waste-to-resource management. The burden for guaranteeing a well-functioning urban sanitation system is taken from the municipal government and transferred to the neighbourhood level where citizens can monitor conditions and take direct action when necessary. The role of municipal government then becomes regulatory with

the goal of safeguarding public health.

Figure 8.7 *A neighbourhood with an ecological sanitation system. Each household has its own dehydrating or composting toilet attached to the house. There is urine diversion and the processing chamber is solar heated. Municipal workers collect urine, primary processed faeces and kitchen wastes and take them to the neighbourhood's own eco-station.*

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The Sphere Project

Humanitarian Charter and Minimum Standards in Disaster Response

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The Sphere Project

The Sphere Project is a programme of the Steering Committee for Humanitarian Response (SCHR) and InterAction with VOICE and ICVA. The project was launched in 1997 to develop a set of universal minimum standards in core areas of humanitarian assistance. The aim of the project is to improve the quality of assistance provided to people affected by disasters, and to enhance the accountability of the humanitarian system in disaster response. The Humanitarian Charter and Minimum Standards in Disaster Response are the product of the collective experience of many people and agencies. They should not therefore be seen as representing the views of any one agency.

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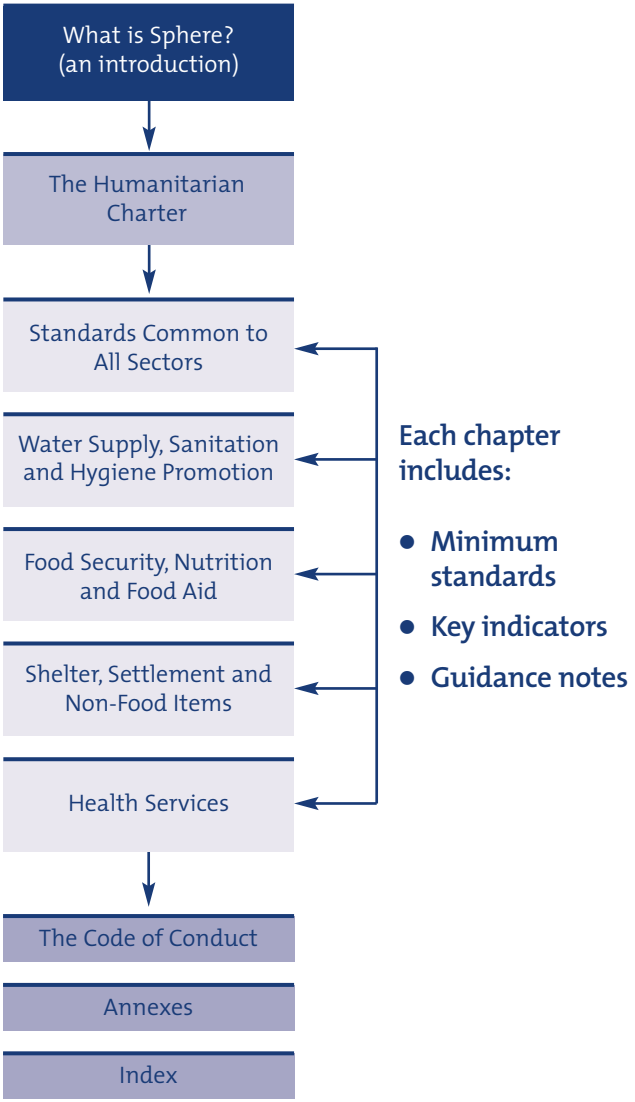

What is Sphere?

Sphere is based on two core beliefs: first, that all possible steps should be taken to alleviate human suffering arising out of calamity and conflict, and second, that those affected by disaster have a right to life with dignity and therefore a right to assistance. Sphere is three things: a handbook, a broad process of collaboration and an expression of commitment to quality and accountability.

The initiative was launched in 1997 by a group of humanitarian NGOs and the Red Cross and Red Crescent movement, who framed a Humanitarian Charter and identified Minimum Standards to be attained in disaster assistance, in each of five key sectors (water supply and sanitation, nutrition, food aid, shelter and health services). This process led to the publication of the first Sphere handbook in 2000. Taken together, the Humanitarian Charter and the Minimum Standards contribute to an operational framework for accountability in disaster assistance efforts.

The cornerstone of the handbook is the Humanitarian Charter, which is based on the principles and provisions of international humanitarian law, international human rights law, refugee law and the *Code of Conduct for the International Red Cross and Red Crescent Movement and Non-Governmental Organisations (NGOs) in Disaster Relief*. The Charter describes the core principles that govern humanitarian action and reasserts the right of populations affected by disaster, whether natural or man-made (including armed conflict), to protection and assistance. It also reasserts the right of disaster-affected populations to life with dignity.

The Charter points out the legal responsibilities of states and warring parties to guarantee the right to protection and assistance. When the relevant authorities are unable and/or unwilling to fulfil their responsibilities, they are obliged to allow humanitarian organisations to provide humanitarian assistance and protection.

The Minimum Standards and the key indicators have been developed using broad networks of practitioners in each of the sectors. Most of the standards, and the indicators that accompany them, are not new, but consolidate and adapt existing knowledge and practice. Taken as a whole, they represent a remarkable consensus across a broad spectrum, and reflect a continuing determination to ensure that human rights and humanitarian principles are realised in practice.

To date, over 400 organisations in 80 countries, all around the world, have contributed to the development of the Minimum Standards and key indicators. This new (2004) edition of the handbook has been significantly revised, taking into account recent technical developments and feedback from agencies using Sphere in the field. In particular, a sixth sector, food security, has been added and integrated with those of nutrition and food aid. Another new chapter details a number of process standards common to all sectors. These include participation, assessment, response, targeting, monitoring, evaluation, and staff competencies and management. In addition, seven cross-cutting issues (children, older people, disabled people, gender, protection, HIV/AIDS and the environment) with relevance to all sectors have been taken into account.

When to use this book

The Sphere handbook is designed for use in disaster response, and may also be useful in disaster preparedness and humanitarian advocacy. It is applicable in a range of situations where relief is required, including natural disasters as well as armed conflict. It is designed to be used in both slow- and rapid-onset situations, in both rural and urban environments, in developing and developed countries, anywhere in the world. The emphasis throughout is on meeting the urgent survival needs of people affected by disaster, while asserting their basic human right to life with dignity.

Despite this focus, the information contained in the handbook is not prescriptive. It can be applied flexibly to other situations, such as disaster preparedness and the transition out of disaster relief. It is not designed for use in response to technological disasters, such as those involving transport, industrial, chemical, biological or nuclear

calamity. However, while not addressing these types of disaster specifically, it is relevant to situations where population movements or other consequences triggered by such an event create a need for humanitarian assistance.

Timeframe

The timeframe in which the handbook is used depends largely on the context. It may take days, weeks or even months before agencies are able to achieve the Minimum Standards and indicators specified in a particular sector. In some situations, the Minimum Standards may be achieved without the need for external intervention. A timeframe for implementation needs to be agreed in any given situation. Where relevant, guidance notes suggest realistic timescales for the implementation of the standards and indicators.

There are different approaches among humanitarian agencies as to how to carry out relief activities, based on differences in identities, mandates and capabilities. These differences point to the concept of complementarity, which means that humanitarian agencies use different modes of action or techniques in fulfilling their responsibility to provide assistance. In all contexts, disaster response should support and/or complement existing government services in terms of structure, design and long-term sustainability.

How to use this book

There are already many field manuals that offer practical guidance to humanitarian workers. This book is not a 'how to' manual. Instead, it offers a set of Minimum Standards and key indicators that inform different aspects of humanitarian action, from initial assessment through to coordination and advocacy. The standards are general statements that define the minimum level to be attained in a given context; the indicators act as 'signals' that determine whether or not a standard has been attained; while the guidance notes provide additional information.

Each of the four technical chapters – water supply, sanitation and hygiene promotion; food security, nutrition and food aid; shelter,

settlement and non-food items; and health services – has its own set of standards and indicators. The initial chapter on common standards sets out guidelines for programme design and implementation, which are applicable to all sectors. This chapter should be read first, before turning to the relevant technical chapter.

The guidance notes in each chapter relate to specific points that should be considered when applying the standards in different situations. They offer advice on priority issues and on tackling practical difficulties, and may also describe dilemmas, controversies or gaps in current knowledge. Guidance notes always relate to a specific key indicator, and the link is signalled in the text. Key indicators should always be read in conjunction with the relevant guidance note.

Each chapter also contains a brief introduction setting out the major issues relevant to that sector and appendices containing select lists of references detailing further sources of technical information, assessment checklists and, where relevant, formulas, tables and examples of report forms. It is important to remember that all the chapters are interconnected, and that frequently standards described in one sector need to be addressed in conjunction with standards described in others.

The difference between standards and indicators

The standards are based on the principle that populations affected by disaster have the right to life with dignity. They are qualitative in nature, and are meant to be universal and applicable in any operating environment. The key indicators, as measures to the standards, can be qualitative or quantitative in nature. They function as tools to measure the impact of processes used and programmes implemented. Without them, the standards would be little more than statements of good intent, difficult to put into practice.

The standards for the different sectors do not stand alone: they are interdependent. However, there is inevitably a tension between the formulation of universal standards and the ability to apply them in practice. Every context is different. In some instances, local factors may make the realisation of all standards and indicators unattainable. When this is the case, the gap between the standards and indicators

listed in the handbook and the ones reached in actual practice must be described, and the reasons for it and what needs to be changed must be explained.

Recognising vulnerabilities and capacities of disaster-affected populations

In order to maximise the coping strategies of those affected by disasters, it is important to acknowledge the differing vulnerabilities, needs and capacities of affected groups. Specific factors, such as gender, age, disability and HIV/AIDS status, affect vulnerability and shape people's ability to cope and survive in a disaster context. In particular, women, children, older people and people living with HIV/AIDS (PLWH/A) may suffer specific disadvantages in coping with a disaster and may face physical, cultural and social barriers in accessing the services and support to which they are entitled. Frequently ethnic origin, religious or political affiliation, or displacement may put certain people at risk who otherwise would not be considered vulnerable.

Failure to recognise the differing needs of vulnerable groups and the barriers they face in gaining equal access to appropriate services and support can result in them being further marginalised, or even denied vital assistance. Providing information to disaster-affected populations about their right to assistance and the means of accessing this assistance is essential. The provision of such information to vulnerable groups is particularly important as they may be less able to cope and recover than others when faced with the erosion or loss of their assets, and may need more support. For these reasons, it is essential to recognise specific vulnerable groups, to understand how they are affected in different disaster contexts, and to formulate a response accordingly. Special care must be taken to protect and provide for all affected groups in a non-discriminatory manner and according to their specific needs.

However, disaster-affected populations must not be seen as helpless victims, and this includes members of vulnerable groups. They possess, and acquire, skills and capacities and have structures to cope with and respond to a disaster situation that need to be recognised and supported. Individuals, families and communities can be remarkably

resourceful and resilient in the face of disaster, and initial assessments should take account of the capacities and skills as much as of the needs and deficiencies of the affected population. Irrespective of whether a disaster is of sudden onset or develops gradually, individuals and communities will be actively coping and recovering from its effects, according to their own priorities.

The key vulnerable groups are women, children, older people, disabled people, PLWH/A and ethnic minorities. This is not an exhaustive list of vulnerable groups, but it includes those most frequently identified. Throughout the handbook, when the term 'vulnerable groups' is used, it refers to all these groups. There may be circumstances in which one particular group of vulnerable people is more at risk than another, but at any time of threat to one group, it is likely that others will also be at risk. In general, the handbook avoids specifying between different vulnerable groups. When any one group is at risk, users are strongly urged to think clearly of all the groups mentioned in this list.

Cross-cutting issues

In revising the handbook, care has been taken to address a number of important issues that have relevance to all sectors. These relate to 1) children, 2) older people, 3) disabled people, 4) gender, 5) protection, 6) HIV/AIDS and 7) the environment. They have been incorporated into the relevant sections of each chapter, rather then being dealt with in parallel. These particular issues were chosen on account of their relation to vulnerability, and because they were the ones most frequently raised in feedback from users of Sphere in the field. The handbook cannot address all cross-cutting issues comprehensively, but it recognises their importance.

Children Special measures must be taken to ensure the protection from harm of all children and their equitable access to basic services. As children often form the larger part of an affected population, it is crucial that their views and experiences are not only elicited during emergency assessments and planning but that they also influence humanitarian service delivery and its monitoring and evaluation. Although vulnerability in certain specificities (e.g. malnutrition,

exploitation, abduction and recruitment into fighting forces, sexual violence and lack of opportunity to participate in decision-making) can also apply to the wider population, the most harmful impact is felt by children and young people.

According to the Convention on the Rights of the Child, a child is considered to be an individual below the age of 18. Depending on cultural and social contexts, however, a child may be defined differently amongst some population groups. It is essential that a thorough analysis of how a client community defines children be undertaken, to ensure that no child or young person is excluded from humanitarian services.

Older people Older women and men are those aged over 60, according to the United Nations. However, cultural and social factors mean that this definition varies from one context to another. Older people make up a large proportion of the most vulnerable in disaster-affected populations, but they also have key contributions to make in survival and rehabilitation. Isolation is the most significant factor creating vulnerability for older people in disaster situations. Along with the disruption to livelihood strategies and family and community support structures, isolation exacerbates existing vulnerabilities derived from chronic health and mobility problems and potential mental deficiencies. However, experience shows that older people are more likely to be aid givers than receivers. If supported, they can play important roles as carers, resource managers and income generators, while using their knowledge and experience of community coping strategies to help preserve the community's cultural and social identities and encourage conflict resolution.

Disabled people In any disaster, disabled people – who can be defined as those who have physical, sensory or emotional impairments or learning difficulties that make it more difficult for them to use standard disaster support services – are particularly vulnerable. To survive a period of dislocation and displacement, they need standard facilities to be as accessible for their needs as possible. They also need an enabling social support network, which is usually provided by the family.

Gender The equal rights of women and men are explicit in the human

rights documents that form the basis of the Humanitarian Charter. Women and men, and girls and boys, have the same entitlement to humanitarian assistance; to respect for their human dignity; to acknowledgement of their equal human capacities, including the capacity to make choices; to the same opportunities to act on those choices; and to the same level of power to shape the outcome of their actions.

Humanitarian responses are more effective when they are based on an understanding of the different needs, vulnerabilities, interests, capacities and coping strategies of men and women and the differing impacts of disaster upon them. The understanding of these differences, as well as of inequalities in women's and men's roles and workloads, access to and control of resources, decision-making power and opportunities for skills development, is achieved through gender analysis. Gender cuts across all the other cross-cutting issues. Humanitarian aims of proportionality and impartiality mean that attention must be paid to achieving fairness between women and men and ensuring equality of outcome.

Protection Assistance and protection are the two indivisible pillars of humanitarian action. Humanitarian agencies are frequently faced with situations where human acts or obstruction threaten the fundamental well-being or security of whole communities or sections of a population, such as to constitute violations of the population's rights as recognised by international law. This may take the form of direct threats to people's well-being, or to their means of survival, or to their safety. In the context of armed conflict, the paramount humanitarian concern is to protect people against such threats.

The form of relief assistance and the way in which it is provided can have a significant impact (positive or negative) on the affected population's security. This handbook does not provide detailed descriptions of protection strategies or mechanisms, or of how agencies should implement their responsibility. However, where possible, it refers to protection aspects or rights issues – such as the prevention of sexual abuse and exploitation, or the need to ensure adequate registration of the population – as agencies must take these into account when they are involved in providing assistance.

HIV/AIDS The coping mechanisms and resilience of communities are reduced when there is a high prevalence of HIV/AIDS and consequently the threshold for external stressors to cause a disaster may be lowered, while the amount of time a community needs to recover may be prolonged. People living with HIV/AIDS (PLWH/A) often suffer from discrimination, and therefore confidentiality must be strictly adhered to and protection made available when needed. This debilitating disease not only affects individuals but also their families and communities, as young people in their most productive years, especially women, are disproportionately affected – physically, psychologically and financially. As the pandemic matures and more people die, the demographic characteristics of communities change to leave a disproportionate number of children, including orphans, and older people. These vulnerable groups require special attention and relief programmes may need to be modified accordingly.

Environment The environment is understood as the physical, chemical and biological surroundings in which disaster-affected and local communities live and develop their livelihoods. It provides the natural resources that sustain individuals, and determines the quality of the surroundings in which they live. It needs protection if these essential functions are to be maintained. The Minimum Standards address the need to prevent over-exploitation, pollution and degradation of environmental conditions. Their proposed minimal preventive actions aim to secure the life-supporting functions of the environment, and seek to introduce mechanisms that foster the adaptability of natural systems for self-recovery.

Scope and limitations of the Sphere handbook

Agencies' ability to achieve the Minimum Standards will depend on a range of factors, some of which are within their control while others, such as political and security factors, may lie outside their control. Of particular importance are the extent to which agencies have access to the affected population, whether they have the consent and cooperation of the authorities in charge, and whether they can operate in conditions of reasonable security. Equally critical is the availability of sufficient financial, human and material resources.

While the Humanitarian Charter is a general statement of humanitarian principles, this handbook alone cannot constitute a complete evaluation guide or set of criteria for humanitarian action. First, the Minimum Standards do not cover all the possible forms of appropriate humanitarian assistance. Second, there will inevitably be situations where it may be difficult, if not impossible, to meet all of the standards. There are many factors – including lack of access or insecurity, insufficient resources, the involvement of other actors and non-compliance with international law – that contribute to creating extremely difficult conditions in which to carry out humanitarian work.

For example, agencies may find that the resources at their disposal are insufficient to meet the needs of the affected population; prioritisation of needs and response and advocacy for the removal of the obstacles that hinder adequate assistance and protection may then be necessary. In situations where the vulnerability of local populations to disaster is high or where there is widespread poverty or prolonged conflict, it can be the case that the Minimum Standards exceed normal everyday living conditions. Since this can give rise to resentment, local conditions must be taken into account, and programmes should always be designed with equality of the affected and surrounding populations in mind.

It is recognised that in many cases not all of the indicators and standards will be met – however, users of this book should strive to meet them as well as they can. In the initial phase of a response, for example, providing basic facilities for all the affected population may be more important than reaching the Minimum Standards and indicators for only a proportion of the population. This handbook cannot cover every question or resolve every dilemma. What it can do is serve as a starting point, using standards and indicators based on consensus derived from years of experience and good practice; guidance notes designed to offer practical direction; and the Humanitarian Charter, which suggests a legal framework and a basis for advocacy.

The Humanitarian Charter and Minimum Standards will not solve all of the problems of humanitarian response, nor can they prevent all human suffering. What they offer is a tool for humanitarian agencies to enhance the effectiveness and quality of their assistance, and thus to make a significant difference to the lives of people affected by disaster.

The Humanitarian Charter

The Humanitarian Charter

Humanitarian agencies committed to this Charter and to the Minimum Standards will aim to achieve defined levels of service for people affected by calamity or armed conflict, and to promote the observance of fundamental humanitarian principles.

The Humanitarian Charter expresses agencies' commitment to these principles and to achieving the Minimum Standards. This commitment is based on agencies' appreciation of their own ethical obligations, and reflects the rights and duties enshrined in international law in respect of which states and other parties have established obligations.

The Charter is concerned with the most basic requirements for sustaining the lives and dignity of those affected by calamity or conflict. The Minimum Standards which follow aim to quantify these requirements with regard to people's need for water, sanitation, nutrition, food, shelter and health care. Taken together, the Humanitarian Charter and the Minimum Standards contribute to an operational framework for accountability in humanitarian assistance efforts.

1 Principles

We reaffirm our belief in the humanitarian imperative and its primacy. By this we mean the belief that all possible steps should be taken to prevent or alleviate human suffering arising out of conflict or calamity, and that civilians so affected have a right to protection and assistance.

It is on the basis of this belief, reflected in international humanitarian law and based on the principle of humanity, that we offer our services as humanitarian agencies. We will act in accordance with the principles of humanity and impartiality, and with the other principles set out in

the *Code of Conduct for the International Red Cross and Red Crescent Movement and Non-Governmental Organisations (NGOs) in Disaster Relief* (1994). **This Code of Conduct appears in full on page 315.**

The Humanitarian Charter affirms the fundamental importance of the following principles:

1.1 The right to life with dignity

This right is reflected in the legal measures concerning the right to life, to an adequate standard of living and to freedom from cruel, inhuman or degrading treatment or punishment. We understand an individual's right to life to entail the right to have steps taken to preserve life where it is threatened, and a corresponding duty on others to take such steps. Implicit in this is the duty not to withhold or frustrate the provision of life-saving assistance. In addition, international humanitarian law makes specific provision for assistance to civilian populations during conflict, obliging states and other parties to agree to the provision of humanitarian and impartial assistance when the civilian population lacks essential supplies.[1]

1.2 The distinction between combatants and non-combatants

This is the distinction which underpins the 1949 Geneva Conventions and their Additional Protocols of 1977. This fundamental principle has been increasingly eroded, as reflected in the enormously increased proportion of civilian casualties during the second half of the twentieth century. That internal conflict is often referred to as 'civil war' must not blind us to the need to distinguish between those actively engaged in hostilities, and civilians and others (including the sick, wounded and prisoners) who play no direct part. Non-combatants are protected under international humanitarian law and are entitled to immunity from attack.[2]

1.3 The principle of non-refoulement

This is the principle that no refugee shall be sent (back) to a country in which his or her life or freedom would be threatened on account of race, religion, nationality, membership of a particular social group or political opinion; or where there are substantial grounds for believing that s/he would be in danger of being subjected to torture.[3]

2 Roles and Responsibilities

2.1 We recognise that it is firstly through their own efforts that the basic needs of people affected by calamity or armed conflict are met, and we acknowledge the primary role and responsibility of the state to provide assistance when people's capacity to cope has been exceeded.

2.2 International law recognises that those affected are entitled to protection and assistance. It defines legal obligations on states or warring parties to provide such assistance or to allow it to be provided, as well as to prevent and refrain from behaviour that violates fundamental human rights. These rights and obligations are contained in the body of international human rights law, international humanitarian law and refugee law (see sources listed below).

2.3 As humanitarian agencies, we define our role in relation to these primary roles and responsibilities. Our role in providing humanitarian assistance reflects the reality that those with primary responsibility are not always able or willing to perform this role themselves. This is sometimes a matter of capacity. Sometimes it constitutes a wilful disregard of fundamental legal and ethical obligations, the result of which is much avoidable human suffering.

2.4 The frequent failure of warring parties to respect the humanitarian purpose of interventions has shown that the attempt to provide assistance in situations of conflict may potentially render civilians more vulnerable to attack, or may on occasion bring unintended advantage to one or more of the warring parties. We are committed to minimising any such adverse effects of our interventions in so far as this is consistent with the obligations outlined above. It is the obligation of warring parties to respect the humanitarian nature of such interventions.

2.5 In relation to the principles set out above and more generally, we recognise and support the protection and assistance mandates of the International Committee of the Red Cross and of the United Nations High Commissioner for Refugees under international law.

3 Minimum Standards

The Minimum Standards which follow are based on agencies' experience of providing humanitarian assistance. Though the achievement of the standards depends on a range of factors, many of which may be beyond our control, we commit ourselves to attempt consistently to achieve them and we expect to be held to account accordingly. We invite other humanitarian actors, including states themselves, to adopt these standards as accepted norms.

By adhering to the standards set out in chapters 1-5 we commit ourselves to make every effort to ensure that people affected by disasters have access to at least the minimum requirements (water, sanitation, food, nutrition, shelter and health care) to satisfy their basic right to life with dignity. To this end we will continue to advocate that governments and other parties meet their obligations under international human rights law, international humanitarian law and refugee law.

We expect to be held accountable to this commitment and undertake to develop systems for accountability within our respective agencies, consortia and federations. We acknowledge that our fundamental accountability must be to those we seek to assist.

Notes

1. Articles 3 and 5 of the *Universal Declaration of Human Rights* 1948; Articles 6 and 7 of the *International Covenant on Civil and Political Rights* 1966; common Article 3 of the four *Geneva Conventions* of 1949; Articles 23, 55 and 59 of the *Fourth Geneva Convention*; Articles 69 to 71 of *Additional Protocol I* of 1977; Article 18 of *Additional Protocol II* of 1977 as well as other relevant rules of international humanitarian law; *Convention against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment* 1984; Articles 10, 11 and 12 of the *International Covenant on Economic, Social, and Cultural Rights* 1966; Articles 6, 37 and 24 of the *Convention on the Rights of the Child* 1989; and elsewhere in international law.

2. The distinction between combatants and non-combatants is the basic principle underlying international humanitarian law. See in particular common Article 3 of the four *Geneva Conventions of 1949 and Article 48 of Additional Protocol I* of 1977. See also Article 38 of the *Convention on the Rights of the Child* 1989.

3. Article 33 of the *Convention on the Status of Refugees* 1951; Article 3 of the *Convention against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment* 1984; Article 22 of the *Convention on the Rights of the Child* 1989.

Sources

The following instruments inform this Charter:

Universal Declaration of Human Rights 1948.

International Covenant on Civil and Political Rights 1966.

International Covenant on Economic, Social and Cultural Rights 1966.

International Convention on the Elimination of All Forms of Racial Discrimination 1969.

The four Geneva Conventions of 1949 and their two Additional Protocols of 1977.

Convention relating to the Status of Refugees 1951 and the Protocol relating to the Status of Refugees 1967.

Convention against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment 1984.

Convention on the Prevention and Punishment of the Crime of Genocide 1948.

Convention on the Rights of the Child 1989.

Convention on the Elimination of All Forms of Discrimination Against Women 1979.

Convention relating to the Status of Stateless Persons 1960.

Guiding Principles on Internal Displacement 1998.

Chapter 1: Minimum Standards Common to All Sectors

How to use this chapter

This chapter details eight core 'process and people' standards that are relevant to each of the technical sectors. The standards are: 1) participation, 2) initial assessment, 3) response, 4) targeting, 5) monitoring, 6) evaluation, 7) aid worker competencies and responsibilities and 8) supervision, management and support of personnel. Each contains the following:

- *the minimum standards:* these are qualitative in nature and specify the minimum levels to be attained;
- *key indicators:* these are 'signals' that show whether the standard has been attained. They provide a way of measuring and communicating the impact, or result, of programmes as well as the process or methods used. The indicators may be qualitative or quantitative;
- *guidance notes:* these include specific points to consider when applying the standards and indicators in different situations, guidance on tackling practical difficulties, and advice on priority issues. They may also include critical issues relating to the standards or indicators, and describe dilemmas, controversies or gaps in current knowledge.

The chapter is followed by a select list of references, which point to sources of information on both general and specific technical issues relating to the standards.

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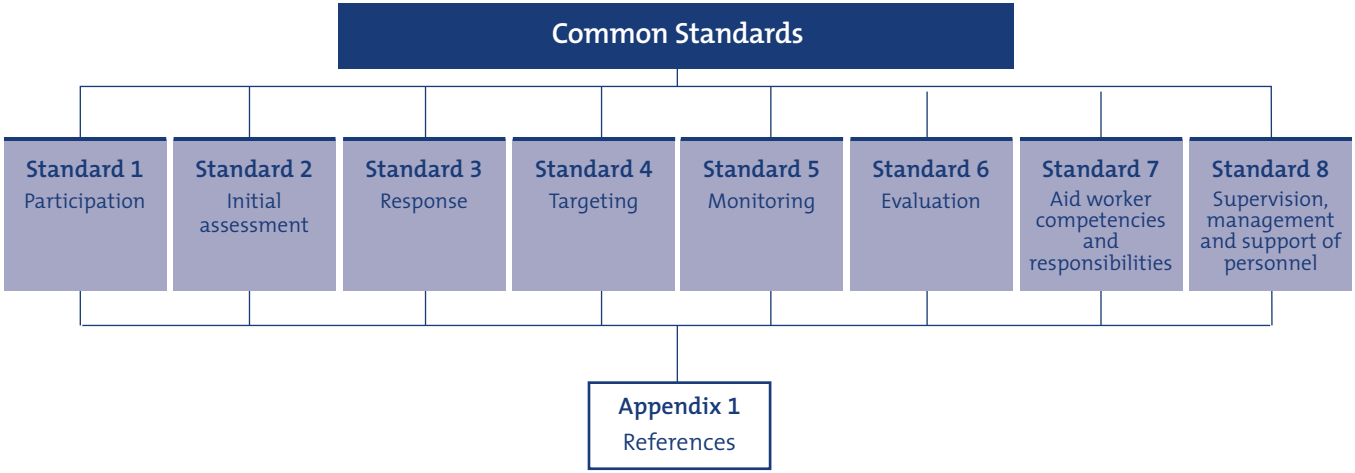
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Introduction

These common standards relate to each of the chapters in this handbook and are integral to all of them. By implementing the standards described here, agencies will support the realisation of the standards outlined in the technical chapters.

Links to international legal instruments

Everyone has the right to life with dignity and respect for their human rights. Humanitarian agencies have the responsibility to provide assistance in a manner that is consistent with human rights, including the right to participation, non-discrimination and information, as reflected in the body of international human rights, humanitarian and refugee law. In the Humanitarian Charter and the *Code of Conduct for the International Red Cross and Red Crescent Movement and Non-Governmental Organisations (NGOs) in Disaster Relief*, humanitarian agencies undertake to make themselves accountable to those they seek to assist. The common standards outline the responsibilities of organisations and individuals when providing protection and assistance.

The importance of the standards common to all sectors

Programmes that meet the needs of disaster-affected populations must be based on a clear understanding of the context. Initial assessments will analyse the nature of the disaster and its effect on a population. The affected people's capacities and available resources should be identified at the same time as assessing their needs and vulnerabilities and any gaps in essential services. No single sector can be considered in isolation from the others, or in isolation from economics, religious and traditional beliefs, social practices, political and security factors, coping mechanisms or anticipated future developments. Analysis of the causes and effects of the disaster is critical. If the problem is not correctly identified and understood then it will be difficult, if not impossible, to respond appropriately.

Response depends on a number of factors, including an organisation's capacity, area(s) of expertise, budget constraints, familiarity with the region or situation and security risks for staff. The response standards detailed here are designed to clarify 'who does what when'. Once an appropriate response has been determined, targeting mechanisms should be established that enable agencies to provide assistance impartially and without discrimination, according to need.

Monitoring systems should be established early in the process to continuously measure progress against objectives and to check on the continuing relevance of the programme within an evolving context. An evaluation, which may be carried out during or at the end of the response, determines the overall effectiveness of the programme and identifies lessons that may improve similar programmes in future.

The quality of humanitarian assistance will depend on the skills, abilities, knowledge and commitment of staff and volunteers working in difficult and sometimes insecure conditions. Sound management and supervision are key elements of an assistance programme and, along with capacity building, can help to ensure that minimum standards of humanitarian assistance are respected. Given the importance of gender and other cross-cutting issues, diversity in human resources should be taken into account when building a team.

The participation of disaster-affected people – including the vulnerable groups outlined below – in the assessment, development, implementation and monitoring of responses should be maximised to ensure the appropriateness and quality of any disaster response. Systematic sharing of knowledge and information among all those involved in the response is fundamental to achieving a common understanding of problems and effective coordination among agencies.

Links to other chapters

It is critical that this chapter be read first, before turning to the relevant technical sector.

Vulnerabilities and capacities of disaster-affected populations

The groups most frequently at risk in disasters are women, children, older people, disabled people and people living with HIV/AIDS (PLWH/A). In certain contexts, people may also become vulnerable by reason of ethnic origin, religious or political affiliation, or displacement. This is not an exhaustive list, but it includes those most frequently identified. Specific vulnerabilities influence people's ability to cope and survive in a disaster, and those most at risk should be identified in each context.

Throughout the handbook, the term 'vulnerable groups' refers to all these groups. When any one group is at risk, it is likely that others will also be threatened. Therefore, whenever vulnerable groups are mentioned, users are strongly urged to consider all those listed here. Special care must be taken to protect and provide for all affected groups in a non-discriminatory manner and according to their specific needs. However, it should also be remembered that disaster-affected populations possess, and acquire, skills and capacities of their own to cope, and that these should be recognised and supported.

The Minimum Standards

Common standard 1: participation

The disaster-affected population actively participates in the assessment, design, implementation, monitoring and evaluation of the assistance programme.

Key indicators (to be read in conjunction with the guidance notes)

- Women and men of all ages from the disaster-affected and wider local populations, including vulnerable groups, receive information about the assistance programme, and are given the opportunity to comment to the assistance agency during all stages of the project cycle (see guidance note 1).
- Written assistance programme objectives and plans should reflect the needs, concerns and values of disaster-affected people, particularly those belonging to vulnerable groups, and contribute to their protection (see guidance notes 1-2).
- Programming is designed to maximise the use of local skills and capacities (see guidance notes 3-4).

Guidance notes

1. ***Representation of all groups:*** the participation of disaster-affected people in decision-making throughout the project cycle (assessment, design, implementation, monitoring and evaluation) helps to ensure that programmes are equitable and effective. Special effort should be made to ensure the participation of a balanced representation of people within the assistance programme, including vulnerable and marginalised groups. Participation should ensure that programmes are based on the willing cooperation of disaster-affected people and that they respect local culture, where this does not undermine the rights of individuals. Assistance programmes should reflect the interdependency of individuals, households and communities and ensure that protection elements are not overlooked.

2. ***Communication and transparency:*** the sharing of information and knowledge among all those involved is fundamental to achieving a better understanding of the problem and to providing coordinated assistance. The results of assessments should be actively communicated to all concerned organisations and individuals. Mechanisms should be established to allow people to comment on the programme e.g. by means of public meetings or via community-based organisations. For individuals who are homebound or disabled, specific outreach programmes may be required.
3. ***Local capacity:*** participation in the programme should reinforce people's sense of dignity and hope in times of crisis, and people should be encouraged to participate in programmes in different ways. Programmes should be designed to build upon local capacity and to avoid undermining people's own coping strategies.
4. ***Long-term sustainability:*** long-term benefits are usually realised during the course of strengthening local capacities to deal with disasters. A disaster response programme should support and/or complement existing services and local institutions in terms of structure and design and be sustainable after the external assistance stops. Local and national governmental organisations have fundamental responsibilities for populations and must be consulted in the longer-term design of programmes when feasible.

Common standard 2: initial assessment

Assessments provide an understanding of the disaster situation and a clear analysis of threats to life, dignity, health and livelihoods to determine, in consultation with the relevant authorities, whether an external response is required and, if so, the nature of the response.

Key indicators (to be read in conjunction with the guidance notes)

- Information is gathered using standardised procedures and made available to allow for transparent decision-making (see guidance notes 1-6).

- The assessment considers all technical sectors (water and sanitation, nutrition, food, shelter, health), and the physical, social, economic, political and security environment (see guidance note 7).
- Through consultation, the assessment takes into account the responses of the local and national authorities and other actors and agencies (see guidance note 7).
- Local capacities and strategies to cope with the disaster, both those of the affected population and the surrounding population, are identified (see guidance note 8).
- Whenever feasible, data are disaggregated by sex and by age (see guidance note 9).
- The assessment is underpinned by the rights of those affected by disasters, as defined by international law.
- The assessment takes into account the responsibility of relevant authorities to protect and assist the population on the territory over which they have control, and also takes into account national law, standards and guidelines applicable where the affected population is found, as they conform with international law.
- The assessment includes an analysis of the operating environment, including factors affecting the personal safety and security of the affected population and of humanitarian staff (see guidance note 10).
- Estimates of population numbers are cross-checked and validated with as many sources as possible, and the basis for the estimate made known.
- Assessment findings are made available to other sectors, national and local authorities and representatives of the affected population. Recommendations are made on the need for external assistance, and on appropriate responses that should be linked with exit or transition strategies (see guidance note 11).

Assessment checklists for individual sectors can be found in the appendices at the end of each technical chapter.

Guidance notes

1. ***Initial assessments*** provide the basis for delivering any immediate assistance that may be needed and also identify the areas on which a more detailed assessment should focus. An initial assessment is not an end in itself, but should be seen as a first step in a continuous process of reviewing and updating as part of the monitoring process, particularly when the situation is evolving rapidly, or when there are critical developments such as large population movements or an outbreak of disease. Frequently it may not be possible to adequately address or consult all sectors or groups within the population. When this is the case, it should be clearly stated which groups have been omitted, and efforts should be made to return to them at the first opportunity.

2. ***Checklists:*** these are a useful way of ensuring that key areas have been examined, and examples of checklists are provided in appendices to each of the technical chapters of this handbook. Additional information can be found in Appendix 1: References on page 43.

3. ***Timeliness:*** an initial assessment should be carried out as soon as possible after the disaster occurs, while addressing any life-threatening or other critical needs. The report should normally be generated within days and its format and content should allow planners and analysts to easily identify priorities and provide sufficient information to rapidly design an appropriate programme. A more in-depth assessment will be needed later to identify gaps in assistance and to provide baseline information.

4. ***Assessment team:*** a gender-balanced team, composed of generalists and relevant technical specialists and with clear terms of reference, which seeks to actively involve the population in a culturally acceptable manner, will improve the quality of an assessment. Local knowledge and previous experience of disasters in the country or region are critical.

5. ***Collecting information:*** team members should be clear on the objectives and methodology of the assessment and on their own roles before field work begins, and a mix of quantitative and qualitative methods appropriate to the context should normally be used. Some individuals or groups may not be able to speak openly, and special arrangements may be considered to collect sensitive information. Information must be treated with the utmost

care and confidentiality must be ensured. Following the individual's consent, consideration may be given to passing on this information to appropriate actors or institutions. Staff operating in conflict situations need to be aware that information collected may be sensitive, could be misused and could compromise the agency's own ability to operate.

6. ***Sources of information:*** information for the assessment report can be compiled from primary sources, including direct observation and discussions with key individuals, such as agency staff, local authorities, community leaders (of both sexes), elders, children, health staff, teachers, traders and other relevant actors, and from secondary sources, such as existing literature and reports (both published and unpublished), relevant historical material and pre-emergency data. National or regional disaster-preparedness plans also provide an important source of information. Comparing secondary information with direct observation and judgement is crucial in order to minimise potential biases. The methods used for collecting information and the limitations of the resulting data must be clearly communicated to portray a realistic picture of the situation. The assessment report should clearly indicate specific concerns and recommendations expressed by all groups, notably those who are particularly vulnerable.

7. ***Sectoral assessments:*** a multi-sectoral assessment may not always be possible in the initial phase of a disaster and may delay action to meet critical needs in specific sectors. When individual sectoral assessments are carried out, extra attention should be paid to linkages with other sectors and to broader contextual and protection issues, in consultation with other actors and agencies.

8. ***Relationship with host population:*** the provision of facilities and support for displaced populations can cause resentment amongst the host community, especially where existing resources are limited and have to be shared with new arrivals. In order to minimise tensions, host populations should be consulted and, where appropriate, the development of infrastructure and services for displaced populations should lead also to a sustainable improvement in the livelihoods of the host population.

9. ***Disaggregation of data*** is important for various reasons. It enables users of an assessment to check the accuracy of results and allows comparison with earlier studies on the same area. In addition to age, gender, vulnerability, etc., it is useful to include average family size and number of households as

key disaggregated information, as this will help in planning a more appropriate response. In the early stages of a disaster, it may be difficult to disaggregate data by age and gender. However, mortality and morbidity for children under five years old should be documented from the outset, as this section of the population is usually at special risk. As time and conditions allow, more detailed disaggregation should be sought, to detect further differences according to age, sex and vulnerability.

10. ***Underlying context:*** the assessment and subsequent analysis should take account of underlying structural, political, security, economic, demographic and environmental issues. Likewise, any changes in living conditions and community structures of both host and displaced populations in relation to the pre-disaster phase should be considered.

11. ***Recovery:*** analysis and planning for the post-disaster recovery period should be part of the initial assessment, as external aid can slow recovery if not provided in a way that supports the local population's own survival mechanisms.

Common standard 3: response

A humanitarian response is required in situations where the relevant authorities are unable and/or unwilling to respond to the protection and assistance needs of the population on the territory over which they have control, and when assessment and analysis indicate that these needs are unmet.

Key indicators (to be read in conjunction with the guidance notes)

- Where people's lives are at risk as a result of disaster, programmes prioritise life-saving needs (see guidance note 1).
- Programmes and projects are designed to support and protect the affected population and to promote their livelihoods, so that they meet or exceed the Sphere Minimum Standards, as illustrated by the key indicators (see guidance note 2).
- There is effective coordination and exchange of information among those affected by or involved in the disaster response. Humanitarian

agencies undertake activities on the basis of need, where their expertise and capacity can have the greatest impact within the overall assistance programme (see guidance note 3).

- Organisations, programmes and projects that either cannot address identified needs or are unable to attain the Minimum Standards make any gaps known so that others may assist (see guidance notes 4-5).
- In conflict situations, the assistance programme takes into account the possible impact of the response on the dynamics of the situation (see guidance note 6).

Guidance notes

1. ***Responding to actual need:*** humanitarian response must be organised to meet assessed needs. Care should be taken that superfluous items that could interfere with the delivery of essential items are not included in the delivery channels.
2. ***Meeting the Minimum Standards:*** response programmes and projects should be designed to close the gap between existing living conditions and the Sphere Minimum Standards. It is nevertheless important to make a distinction between the emergency needs and the chronic needs of an affected population. In many cases, humanitarian needs and the resources that would be required to bring a community, area, region or even country up to the Minimum Standards are far greater than the resources available. An agency cannot expect to bring this about single-handedly and communities, their neighbours, host governments, donors and other local and international organisations all have an important role to play. Coordination among those responding to a disaster situation is essential to address critical gaps.
3. ***Capacity and expertise:*** in situations where an organisation is highly specialised, or mandated to respond to particular needs (or groups), it should aim to provide the greatest humanitarian impact possible using its own resources and skills base. Even within the specific limits of an agency's expertise or mandate, however, it is likely that the overall humanitarian need will outstrip its organisational resources. Where the agency finds itself with excess capacity, it should make that capacity known to the wider humanitarian response community and contribute when and where necessary.

4. ***Making gaps known:*** while humanitarian agencies prefer to demonstrate programme successes and positive evaluations of ongoing initiatives to help fund future programmes, they must nevertheless be prepared to promptly acknowledge gaps in their capacity to meet basic needs.

5. ***Sharing information:*** organisations identifying critical needs should make them known to the wider community as quickly as possible, to enable those agencies with the most appropriate resources and capacity to respond. Wherever possible, recognised terminology, standards and procedures should be used to help others mobilise their responses more quickly and more effectively. The use of standard survey formats and associated guidelines, agreed among the host government and agencies at country level, can help significantly in this regard.

6. ***Maximising positive impact and limiting harm:*** conflict and competition for scarce resources often lead to increased insecurity, misuse or misappropriation of aid, inequitable distribution or diversion of aid. Understanding the nature and source of conflict helps to ensure that aid is distributed in an impartial way and reduces or avoids negative impact. In conflict-affected settings, an analysis of the actors, mechanisms, issues and context of the conflict should be carried out prior to programme planning.

Common standard 4: targeting

Humanitarian assistance or services are provided equitably and impartially, based on the vulnerability and needs of individuals or groups affected by disaster.

Key indicators (to be read in conjunction with the guidance notes)

- Targeting criteria must be based on a thorough analysis of vulnerability (see guidance note 1).
- Targeting mechanisms are agreed among the affected population (including representatives of vulnerable groups) and other appropriate actors. Targeting criteria are clearly defined and widely disseminated (see guidance notes 2-3).

- Targeting mechanisms and criteria should not undermine the dignity and security of individuals, or increase their vulnerability to exploitation (see guidance notes 2-3).
- Distribution systems are monitored to ensure that targeting criteria are respected and that timely corrective action is taken when necessary (see guidance notes 4-5).

Guidance notes

1. ***The purpose of targeting*** is to meet the needs of the most vulnerable, while providing aid efficiently and in a way that minimises dependency.
2. ***Targeting mechanisms*** are the ways in which assistance is made available impartially and without discrimination, according to need. Options include community-based targeting, administrative targeting, self-targeting, and combinations of these methods. Agency workers should be aware that self-targeting can sometimes exclude certain vulnerable groups. To ensure that the disaster-affected population is consulted and is in agreement with the targeting decisions, a representative group of women and men, boys and girls and people from vulnerable groups should be included in the consultation process. In conflict situations, it is essential to understand the nature and source of the conflict and how this might influence administrative and community decisions about targeting assistance.
3. ***Targeting criteria*** are usually linked to the level or degree of vulnerability of a community, household or individual, which in turn are determined by the risks presented by the disaster and the coping capacity of the recipients. Individual dignity may be unintentionally undermined by improper targeting criteria and mechanisms and appropriate measures must be taken to avoid this. Some examples include:
   - administrative and community-based targeting mechanisms may ask for information about an individual's assets. Such questions may be perceived as intrusive and can potentially undermine social structures.
   - households with malnourished children are often targeted for selective food assistance. This may undermine people's dignity since it may encourage parents to keep their children thin so that they continue to receive selective rations. This can also apply when general rations are provided.

- where assistance is targeted through local clan systems, people who fall outside such systems (e.g. displaced individuals) are likely to be excluded.
- displaced women, girls and boys may be exposed to sexual coercion.
- people suffering from HIV/AIDS may be exposed to stigma. Confidentiality should be observed at all times.

4. ***Access to and use of facilities and services:*** people's use of facilities and goods provided are affected by many factors, such as access, security, convenience, quality and whether they are appropriate to needs and customs. Access may be particularly constrained in situations of armed conflict, and by factors such as corruption, intimidation and exploitation (including for sex). Wherever possible, factors that limit the use of facilities should be dealt with through community mobilisation or revisions to the programme. It is essential to ensure that consultation before and during programme implementation includes adequate discussion with women, children and other vulnerable groups, for whom the constraints on use are likely to be greatest.
5. ***Monitoring errors of exclusion and inclusion:*** when a targeting system fails to reach all of the vulnerable people in need following a disaster, individuals or groups can quickly develop critical needs. Provision should be made for updating and refining targeting and distribution systems to achieve more effective coverage.

Common standard 5: monitoring

The effectiveness of the programme in responding to problems is identified and changes in the broader context are continually monitored, with a view to improving the programme, or to phasing it out as required.

Key indicators (to be read in conjunction with the guidance notes)

- The information collected for monitoring is timely and useful, it is recorded and analysed in an accurate, logical, consistent, regular and transparent manner and it informs the ongoing programme (see guidance notes 1-2).

- Systems are in place to ensure regular collection of information in each of the technical sectors and to identify whether the indicators for each standard are being met.
- Women, men and children from all affected groups are regularly consulted and are involved in monitoring activities (see guidance note 3).
- Systems are in place that enable a flow of information between the programme, other sectors, the affected groups of the population, the relevant local authorities, donors and other actors as needed (see guidance note 4).

Guidance notes

1. ***Use of monitoring information:*** disaster situations are volatile and dynamic. Regularly updated information is therefore vital in ensuring that programmes remain relevant and effective. Regular monitoring allows managers to determine priorities, identify emerging problems, follow trends, determine the effect of their responses, and guide revisions to their programmes. Information derived from continual monitoring of programmes can be used for reviews, evaluations and other purposes. In some circumstances a shift in strategy may be required to respond to major changes in needs or in the context.
2. ***Using and disseminating information:*** information collected should be directly relevant to the programme – in other words, it should be useful and acted upon. It should also be documented and made available proactively as needed to other sectors and agencies, and to the affected population. The means of communication used (dissemination methods, language, etc.) must be appropriate and accessible for the intended audience.
3. ***People involved in monitoring:*** people who are able to collect information from all groups in the affected population in a culturally acceptable manner should be included, especially with regard to gender and language skills. Local cultural practices may require that women or minority groups be consulted separately by individuals who are culturally acceptable.

4. ***Information sharing:*** monitoring and evaluation activities require close consultation and cooperation across sectors. For example, during a cholera epidemic, information should be continually shared between water and sanitation agencies and health agencies. Coordination mechanisms such as regular meetings and the use of notice boards can facilitate this exchange of information.

Common standard 6: evaluation

There is a systematic and impartial examination of humanitarian action, intended to draw lessons to improve practice and policy and to enhance accountability.

Key indicators (to be read in conjunction with the guidance notes)

- The programme is evaluated with reference to stated objectives and agreed minimum standards to measure its overall appropriateness, efficiency, coverage, coherence and impact on the affected population (see guidance note 1).
- Evaluations take account of the views and opinions of the affected population, as well as the host community if different.
- The collection of information for evaluation purposes is independent and impartial.
- The results of each evaluation exercise are used to improve future practice (see guidance note 2).

Guidance notes

1. ***Establishing criteria:*** evaluating humanitarian assistance programmes is not an easy task since disasters are characterised by rapid changes and a high degree of uncertainty. While qualitative methods are more likely to capture the intricate nature of disaster responses, those evaluating such programmes should be prepared to use different methods and compare and weigh the results to arrive at valid conclusions.

2. ***Subsequent use of information:*** evaluations should result in written reports, which are shared to contribute to transparency and accountability, and which allow for lessons to be learned across programmes and agencies that lead to improvements in humanitarian policies and practices.

Common standard 7: aid worker competencies and responsibilities

Aid workers possess appropriate qualifications, attitudes and experience to plan and effectively implement appropriate programmes.

Key indicators (to be read in conjunction with the guidance notes)

- Aid workers have relevant technical qualifications and knowledge of local cultures and customs, and/or previous emergency experience. Workers are also familiar with human rights and humanitarian principles.
- Staff are knowledgeable about the potential tensions and sources of conflict within the disaster-affected population itself and with host communities. They are aware of the implications of delivering humanitarian assistance, and pay particular attention to vulnerable groups (see guidance note 1).
- Staff are able to recognise abusive, discriminatory or illegal activities, and refrain from such activities (see guidance note 2).

Guidance notes

1. ***Staff need to be aware*** of the extent to which crimes of violence, including rape and other forms of brutality against women, girls and boys, can increase during times of crisis. Fear of harassment and rape forces women into forming alliances with soldiers and other men in positions of authority or power. Young males are vulnerable to forced conscription into fighting forces. Staff and field partners should know how to refer women, men and children seeking redress for human rights violations, and be familiar with procedures for referring survivors of rape and sexual violence for counselling, medical or contraceptive care.

2. ***Staff must understand*** that responsibility for control over the management and allocation of the valuable resources involved in disaster response programmes puts them and others involved in their delivery in a position of relative power over other people. Staff must be alert to the danger that this power may be corruptly or abusively exercised. Staff should be aware that women and children are frequently coerced into humiliating, degrading or exploitative behaviour. Sexual activity cannot be required in exchange for humanitarian assistance nor should aid workers be party to any such forms of exchange. Activities such as forced labour and illicit drug use and trading are also prohibited.

Common standard 8: supervision, management and support of personnel

Aid workers receive supervision and support to ensure effective implementation of the humanitarian assistance programme.

Key indicators (to be read in conjunction with the guidance notes)

- Managers are accountable for their decisions and for ensuring adequate security and compliance with codes/rules of conduct as well as support for their staff (see guidance note 1).
- Technical and managerial staff are provided with the necessary training, resources and logistical support to fulfil their responsibilities (see guidance note 2).
- Staff working on programmes understand the purpose and method of the activities they are asked to carry out, and receive subsequent feedback on their performance.
- All staff have written job descriptions, with clear reporting lines, and undergo periodic written performance assessment.
- All staff are oriented regarding relevant health and safety issues for the region and environment in which they are to work (see guidance note 3).
- Staff receive appropriate security training.

- Capacity-building systems for staff are set up and these are subject to routine monitoring (see guidance notes 4-5).
- The capacity of national and local organisations is built up to promote long-term sustainability.

Guidance notes

1. ***Managers at all levels*** have particular responsibilities to establish and/or maintain systems that promote the implementation of programmes, of relevant policies, and to ensure compliance with rules/codes of conduct. Some humanitarian agencies already have codes or rules that relate to staff and institutional conduct with respect to issues such as child protection or sexual exploitation and abuse. As the importance of such rules is widely recognised, many humanitarian agencies are in the process of developing codes of conduct. Managerial accountability for ensuring compliance is a crucial aspect in the success of such codes.
2. ***Humanitarian agencies*** should ensure that their staff are qualified and competent, and properly trained and prepared, before assignment to an emergency situation. When deploying emergency teams, agencies should seek to ensure that there is a balance of women and men among staff and volunteers. Ongoing support and training may be necessary to ensure that staff can fulfil their responsibilities.
3. ***All staff*** should receive appropriate briefings on security and health issues, both prior to their deployment and when they arrive on-site. They should receive vaccinations and malaria prophylaxis medications (where needed) prior to deployment. Upon arrival, they should receive information aimed at minimising security risks, and should also be briefed on food and water safety, prevention of HIV/AIDS and other endemic infectious diseases, medical care availability, medical evacuation policies and procedures, and workers' compensation.
4. ***Special efforts*** should be made to promote diversity within the various levels of an organisation.
5. ***Capacity building*** is an explicit objective during the rehabilitation phase following a disaster. It should also be undertaken, to the extent possible, during the disaster/relief phase itself, especially when this is protracted.

Appendix 1

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Thanks to the Forced Migration Online programme of the Refugee Studies Centre at the University of Oxford, many of these documents have received copyright permission and are posted on a special Sphere link at: http://www.forcedmigration.org

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Notes

Notes

Notes

Chapter 2: Minimum Standards in Water Supply, Sanitation and Hygiene Promotion

How to use this chapter

This chapter is divided into six main sections: Hygiene Promotion, Water Supply, Excreta Disposal, Vector Control, Solid Waste Management and Drainage. Each contains the following:

- *the minimum standards:* these are qualitative in nature and specify the minimum levels to be attained in the provision of water and sanitation responses;
- *key indicators:* these are 'signals' that show whether the standard has been attained. They provide a way of measuring and communicating the impact, or result, of programmes as well as the process, or methods, used. The indicators may be qualitative or quantitative;
- *guidance notes:* these include specific points to consider when applying the standard and indicators in different situations, guidance on tackling practical difficulties, and advice on priority issues. They may also include critical issues relating to the standard or indicators, and describe dilemmas, controversies or gaps in current knowledge.

The appendices include a select list of references, which point to sources of information on both general issues and specific technical issues relating to this chapter.

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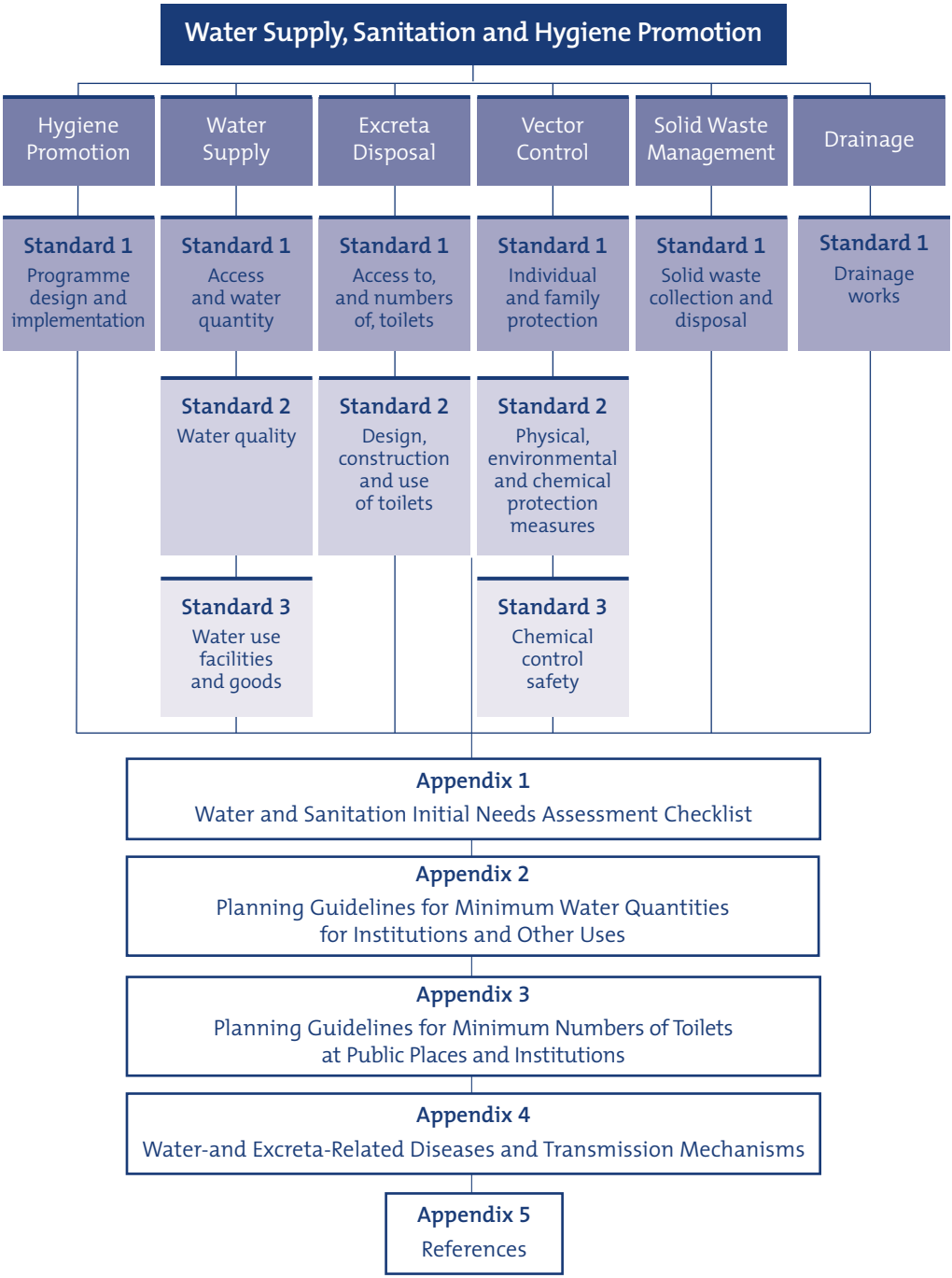
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Introduction

Links to international legal instruments

The Minimum Standards in Water, Sanitation and Hygiene Promotion are a practical expression of the principles and rights embodied in the Humanitarian Charter. The Humanitarian Charter is concerned with the most basic requirements for sustaining the lives and dignity of those affected by calamity or conflict, as reflected in the body of international human rights, humanitarian and refugee law.

Everyone has the right to water. This right is recognised in international legal instruments and provides for sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic uses. An adequate amount of safe water is necessary to prevent death from dehydration, to reduce the risk of water-related disease and to provide for consumption, cooking, and personal and domestic hygienic requirements.

The right to water is inextricably related to other human rights, including the right to health, the right to housing and the right to adequate food. As such, it is part of the guarantees essential for human survival. States and non-state actors have responsibilities in fulfilling the right to water. In times of armed conflict, for example, it is prohibited to attack, destroy, remove or render useless drinking water installations or irrigation works.

The Minimum Standards in this chapter are not a full expression of the Right to Water. However, the Sphere standards reflect the core content of the Right to Water and contribute to the progressive realisation of this right globally.

The importance of water supply, sanitation and hygiene promotion in emergencies

Water and sanitation are critical determinants for survival in the initial stages of a disaster. People affected by disasters are generally much more susceptible to illness and death from disease, which are related to a large extent to inadequate sanitation, inadequate water supplies and poor hygiene. The most significant of these diseases are diarrhoeal diseases and infectious diseases transmitted by the faeco-oral route (see Appendix 4). Other water- and sanitation-related diseases include those carried by vectors associated with solid waste and water.

The main objective of water supply and sanitation programmes in disasters is to reduce the transmission of faeco-oral diseases and exposure to disease-bearing vectors through the promotion of good hygiene practices, the provision of safe drinking water and the reduction of environmental health risks and by establishing the conditions that allow people to live with good health, dignity, comfort and security. The term 'sanitation', throughout Sphere, refers to excreta disposal, vector control, solid waste disposal and drainage.

Simply providing sufficient water and sanitation facilities will not, on its own, ensure their optimal use or impact on public health. In order to achieve the maximum benefit from a response, it is imperative to ensure that disaster-affected people have the necessary information, knowledge and understanding to prevent water- and sanitation-related disease, and to mobilise their involvement in the design and maintenance of those facilities.

In most disaster situations the responsibility for collecting water falls to women and children. When using communal water and sanitation facilities, for example in refugee or displaced situations, women and adolescent girls can be vulnerable to sexual violence or exploitation. In order to minimise these risks, and to ensure a better quality of response, it is important to encourage women's participation in water supply and sanitation programmes wherever possible. An equitable participation of women and men in planning, decision-making and local management will help to ensure that the entire affected population has safe and easy access to water supply and sanitation services, and that services are equitable and appropriate.

Links to other chapters

Many of the standards in the other sector chapters are relevant to this chapter. Progress in achieving standards in one area often influences and even determines progress in other areas. For a response to be effective, close coordination and collaboration are required with other sectors. Coordination with local authorities and other responding agencies is also necessary to ensure that needs are met, that efforts are not duplicated, and that the quality of water and sanitation responses is optimised.

For instance, where nutritional standards have not been met, the urgency to improve the standard of water and sanitation increases, as people's vulnerability to disease will have significantly increased. The same applies to populations where HIV/AIDS prevalence is high or where there is a large proportion of older or disabled people. Priorities should be decided on the basis of sound information shared between sectors as the situation evolves. Reference to specific standards or guidance notes in other technical chapters is made where relevant.

Links to the standards common to all sectors

The process by which an intervention is developed and implemented is critical to its effectiveness. This chapter should be utilised in conjunction with the standards common to all sectors, which cover participation, initial assessment, response, targeting, monitoring, evaluation, aid worker competencies and responsibilities, and the supervision, management and support of personnel (see chapter 1, page 21). In particular, in any response the participation of disaster-affected people – including the vulnerable groups outlined below – should be maximised to ensure its appropriateness and quality.

Vulnerabilities and capacities of disaster-affected populations

The groups most frequently at risk in emergencies are women, children, older people, disabled people and people living with HIV/AIDS (PLWH/A). In certain contexts, people may also become vulnerable by reason of ethnic origin, religious or political affiliation,

or displacement. This is not an exhaustive list, but it includes those most frequently identified. Specific vulnerabilities influence people's ability to cope and survive in a disaster, and those most at risk should be identified in each context.

Throughout the handbook, the term 'vulnerable groups' refers to all these groups. When any one group is at risk, it is likely that others will also be threatened. Therefore, whenever vulnerable groups are mentioned, users are strongly urged to consider all those listed here. Special care must be taken to protect and provide for all affected groups in a non-discriminatory manner and according to their specific needs. However, it should also be remembered that disaster-affected populations possess, and acquire, skills and capacities of their own to cope, and that these should be recognised and supported.

The Minimum Standards

1 Hygiene Promotion

The aim of any water and sanitation programme is to promote good personal and environmental hygiene in order to protect health. Hygiene promotion is defined here as the mix between the population's knowledge, practice and resources and agency knowledge and resources, which together enable risky hygiene behaviours to be avoided. The three key factors are 1) a mutual sharing of information and knowledge, 2) the mobilisation of communities and 3) the provision of essential materials and facilities. Effective hygiene promotion relies on an exchange of information between the agency and the affected community in order to identify key hygiene problems and to design, implement and monitor a programme to promote hygiene practices that will ensure the optimal use of facilities and the greatest impact on public health. Community mobilisation is especially pertinent during disasters as the emphasis must be on encouraging people to take action to protect their health and make good use of facilities and services provided, rather than on the dissemination of messages. It must be stressed that hygiene promotion should never be a substitute for good sanitation and water supplies, which are fundamental to good hygiene.

Hygiene promotion is integral to all the standards within this chapter. It is presented here as one overarching standard with related indicators. Further specific indicators are given within each standard for water supply, excreta disposal, vector control, solid waste management and drainage.

Hygiene promotion standard 1: programme design and implementation

All facilities and resources provided reflect the vulnerabilities, needs and preferences of the affected population. Users are involved in the management and maintenance of hygiene facilities where appropriate.

Key indicators (to be read in conjunction with the guidance notes)

- Key hygiene risks of public health importance are identified (see guidance note 1).
- Programmes include an effective mechanism for representative and participatory input from all users, including in the initial design of facilities (see guidance notes 2, 3 and 5).
- All groups within the population have equitable access to the resources or facilities needed to continue or achieve the hygiene practices that are promoted (see guidance note 3).
- Hygiene promotion messages and activities address key behaviours and misconceptions and are targeted for all user groups. Representatives from these groups participate in planning, training, implementation, monitoring and evaluation (see guidance notes 1, 3 and 4 and Participation standard on page 28).
- Users take responsibility for the management and maintenance of facilities as appropriate, and different groups contribute equitably (see guidance notes 5-6).

Guidance notes

1. ***Assessing needs:*** an assessment is needed to identify the key hygiene behaviours to be addressed and the likely success of promotional activity. The key risks are likely to centre on excreta disposal, the use and maintenance of toilets, the lack of hand washing with soap or an alternative, the unhygienic collection and storage of water, and unhygienic food storage and preparation. The assessment should look at resources available to the population as well as local behaviours, knowledge and

practices so that messages are relevant and practical. It should pay special attention to the needs of vulnerable groups. If consultation with any group is not possible, this should be clearly stated in the assessment report and addressed as quickly as possible (see Participation standard, page 28 and the assessment checklist in Appendix 1).

2. ***Sharing responsibility:*** the ultimate responsibility for hygiene practice lies with all members of the affected population. All actors responding to the disaster should work to enable hygienic practice by ensuring that both knowledge and facilities are accessible, and should be able to demonstrate that this has been achieved. As a part of this process, vulnerable groups from the affected population should participate in identifying risky practices and conditions and take responsibility to measurably reduce these risks. This can be achieved through promotional activities, training and facilitation of behavioural change, based on activities that are culturally acceptable and do not overburden the beneficiaries.

3. ***Reaching all sections of the population:*** hygiene promotion programmes need to be carried out with all groups of the population by facilitators who can access, and have the skills to work with, different groups (for example, in some cultures it is not acceptable for women to speak to unknown men). Materials should be designed so that messages reach members of the population who are illiterate. Participatory materials and methods that are culturally appropriate offer useful opportunities for groups to plan and monitor their own hygiene improvements. As a rough guide, in a camp scenario there should be two hygiene promoters/community mobilisers per 1,000 members of the target population. For information on hygiene items, see Non-food items standard 2 on page 232.

4. ***Targeting priority hygiene risks and behaviours:*** the objectives of hygiene promotion and communication strategies should be clearly defined and prioritised. The understanding gained through assessing hygiene risks, tasks and responsibilities of different groups should be used to plan and prioritise assistance, so that misconceptions (for example, how HIV/AIDS is transmitted) are addressed and information flow between humanitarian actors and the affected population is appropriate and targeted.

5. ***Managing facilities:*** where possible, it is good practice to form water and/or sanitation committees, made up of representatives from the various user groups and half of whose members are women. The functions of these committees are to manage the communal facilities such as water points, public toilets and washing areas, be involved in hygiene promotion activities and also act as a mechanism for ensuring representation and promoting sustainability.

6. ***Overburdening:*** it is important to ensure that no one group is overburdened with the responsibility for hygiene promotional activities or management of facilities and that each group has equitable influence and benefits (such as training). Not all groups, women or men have the same needs and interests and it should be recognised that the participation of women should not lead to men, or other groups within the population, not taking responsibility.

2 Water Supply

Water is essential for life, health and human dignity. In extreme situations, there may not be sufficient water available to meet basic needs, and in these cases supplying a survival level of safe drinking water is of critical importance. In most cases, the main health problems are caused by poor hygiene due to insufficient water and by the consumption of contaminated water.

Water supply standard 1: access and water quantity

All people have safe and equitable access to a sufficient quantity of water for drinking, cooking and personal and domestic hygiene. Public water points are sufficiently close to households to enable use of the minimum water requirement.

Key indicators (to be read in conjunction with the guidance notes)

- Average water use for drinking, cooking and personal hygiene in any household is at least 15 litres per person per day (see guidance notes 1-8).
- The maximum distance from any household to the nearest water point is 500 metres (see guidance notes 1, 2, 5 and 8).
- Queuing time at a water source is no more than 15 minutes (see guidance note 7).
- It takes no more than three minutes to fill a 20-litre container (see guidance notes 7-8).
- Water sources and systems are maintained such that appropriate quantities of water are available consistently or on a regular basis (see guidance notes 2 and 8).

Guidance notes

1. ***Needs:*** the quantities of water needed for domestic use may vary according to the climate, the sanitation facilities available, people's normal habits, their religious and cultural practices, the food they cook, the clothes they wear, and so on. Water consumption generally increases the nearer the water source is to the dwelling.

Simplified table of basic survival water needs		
Survival needs: water intake (drinking and food)	2.5-3 litres per day	Depends on: the climate and individual physiology
Basic hygiene practices	2-6 litres per day	Depends on: social and cultural norms
Basic cooking needs	3-6 litres per day	Depends on: food type, social as well as cultural norms
Total basic water needs	7.5-15 litres per day	

See Appendix 2 for guidance on minimum water quantities needed for institutions and other uses.

2. ***Water source selection:*** the factors that need to be taken into account are the availability and sustainability of a sufficient quantity of water; whether water treatment is required and, if so, the feasibility of this; the availability of the time, technology or funding required to develop a source; the proximity of the source to the affected population; and the existence of any social, political or legal factors concerning the source. Generally, groundwater sources are preferable as they require less treatment, especially gravity-flow supplies from springs, which require no pumping. Disasters often require a combination of approaches and sources in the initial phase. All sources need to be regularly monitored to avoid over-exploitation.

3. ***Measurement:*** measuring solely the volume of water pumped into the reticulation system or the time a handpump is in operation will not give an accurate indication of individual consumption. Household surveys,

observation and community discussion groups are a more effective method of collecting data on water use and consumption.

4. ***Quality and quantity:*** in many emergency situations, water-related disease transmission is due as much to insufficient water for personal and domestic hygiene as to contaminated water supplies. Until minimum standards for both quantity and quality are met, the priority should be to provide equitable access to an adequate quantity of water even if it is of intermediate quality, rather than to provide an inadequate quantity of water that meets the minimum quality standard. It should be taken into account that people living with HIV/AIDS need extra water for drinking and personal hygiene. Particular attention should be paid to ensuring that the water requirements of livestock and crops are met, especially in drought situations where lives and livelihoods are dependent on these (see Appendix 2).

5. ***Coverage:*** in the initial phase of a response the first priority is to meet the urgent survival needs of all the affected population. People affected by an emergency have a significantly increased vulnerability to disease and therefore the indicators should be reached even if they are higher than the norms of the affected or host population. In such situations it is recommended that agencies plan programmes to raise the levels of water and sanitation facilities of the host population also, to avoid provoking animosity.

6. ***Maximum numbers of people per water source:*** the number of people per source depends on the yield and availability of water at each source. For example, taps often function only at certain times of day and handpumps and wells may not give constant water if there is a low recharge rate. The rough guidelines (for when water is constantly available) are:

250 people per tap	based on a flow of 7.5 litres/minute
500 people per handpump	based on a flow of 16.6 l/m
400 people per single-user open well	based on a flow of 12.5 l/m.

These guidelines assume that the water point is accessible for approximately eight hours a day only; if access is greater than this, people can collect more than the 15 litres per day minimum requirement. These

targets must be used with caution, as reaching them does not necessarily guarantee a minimum quantity of water or equitable access.

7. ***Queuing time:*** excessive queuing times are indicators of insufficient water availability (either due to an inadequate number of water points or inadequate yields of water points). The potential negative results of excessive queuing times are: 1) reduced per capita water consumption; 2) increased consumption from unprotected surface sources; and 3) reduced time for water collectors to tend to other essential survival tasks.

8. ***Access and equity:*** even if a sufficient quantity of water is available to meet minimum needs, additional measures may be needed to ensure that access is equitable for all groups. Water points should be located in areas that are accessible to all regardless of e.g. sex or ethnicity. Some handpumps and water carrying containers may need to be designed or adapted for use by people living with HIV/AIDS, older and disabled people and children. In urban situations, it may be necessary to supply water into individual buildings to ensure that toilets continue to function. In situations where water is rationed or pumped at given times, this should be planned in consultation with the users. Times should be set which are convenient and safe for women and others who have responsibility for collecting water, and all users should be fully informed of when and where water is available.

Water supply standard 2: water quality

Water is palatable, and of sufficient quality to be drunk and used for personal and domestic hygiene without causing significant risk to health.

Key indicators (to be read in conjunction with the guidance notes)

- A sanitary survey indicates a low risk of faecal contamination (see guidance note 1).
- There are no faecal coliforms per 100ml at the point of delivery (see guidance note 2).
- People drink water from a protected or treated source in preference to other readily available water sources (see guidance note 3).

- Steps are taken to minimise post-delivery contamination (see guidance note 4).
- For piped water supplies, or for all water supplies at times of risk or presence of diarrhoea epidemic, water is treated with a disinfectant so that there is a free chlorine residual at the tap of 0.5mg per litre and turbidity is below 5 NTU (see guidance notes 5, 7 and 8).
- No negative health effect is detected due to short-term use of water contaminated by chemical (including carry-over of treatment chemicals) or radiological sources, and assessment shows no significant probability of such an effect (see guidance note 6).

Guidance notes

1. ***A sanitary survey*** is an assessment of conditions and practices that may constitute a public health risk. The assessment should cover possible sources of contamination to water at the source, in transport and in the home, as well as defecation practices, drainage and solid waste management. Community mapping is a particularly effective way of identifying where the public health risks are and thereby involving the community in finding ways to reduce these risks. Note that while animal excreta is not as harmful as human excreta, it can contain cryptosporidium, giardia, salmonella, campylobacter, caliciviruses and some other common causes of human diarrhoea and therefore does present a significant health risk.
2. ***Microbiological water quality:*** faecal coliform bacteria (>99% of which are *E. coli*) are an indicator of the level of human/animal waste contamination in water and the possibility of the presence of harmful pathogens. If any faecal coliforms are present the water should be treated. However, in the initial phase of a disaster, quantity is more important than quality (see Water supply standard 1, guidance note 4).
3. ***Promotion of protected sources:*** merely providing protected sources or treated water will have little impact unless people understand the health benefits of this water and therefore use it. People may prefer to use unprotected sources, e.g. rivers, lakes and unprotected wells, for reasons such as taste, proximity and social convenience. In such cases

technicians, hygiene promoters and community mobilisers need to understand the rationale for these preferences so that consideration of them can be included in promotional messages and discussions.

4. ***Post-delivery contamination:*** water that is safe at the point of delivery can nevertheless present a significant health risk due to re-contamination during collection, storage and drawing. Steps that can be taken to minimise such risk include improved collection and storage practices, distributions of clean and appropriate collection and storage containers (see Water supply standard 3), treatment with a residual disinfectant, or treatment at the point of use. Water should be routinely sampled at the point of use to monitor the extent of any post-delivery contamination.

5. ***Water disinfection:*** water should be treated with a residual disinfectant such as chlorine if there is a significant risk of water source or post-delivery contamination. This risk will be determined by conditions in the community, such as population density, excreta disposal arrangements, hygiene practices and the prevalence of diarrhoeal disease. The risk assessment should also include qualitative community data regarding factors such as community perceptions of taste and palatability (see guidance note 6). Piped water supply for any large or concentrated population should be treated with a residual disinfectant and, in the case of a threat or the existence of a diarrhoea epidemic, all drinking water supplies should be treated, either before distribution or in the home. In order for water to be disinfected properly, turbidity must be below 5 NTU.

6. ***Chemical and radiological contamination:*** where hydrogeological records or knowledge of industrial or military activity suggest that water supplies may carry chemical or radiological health risks, those risks should be assessed rapidly by carrying out chemical analysis. A decision that balances short-term public health risks and benefits should then be made. A decision about using possibly contaminated water for longer-term supplies should be made on the basis of a more thorough professional assessment and analysis of the health implications.

7. ***Palatability:*** although taste is not in itself a direct health problem (e.g. slightly saline water), if the safe water supply does not taste good, users may drink from unsafe sources and put their health at risk. This may also be a risk when chlorinated water is supplied, in which case promotional activities are needed to ensure that only safe supplies are used.

8. ***Water quality for health centres:*** all water for hospitals, health centres and feeding centres should be treated with chlorine or another residual disinfectant. In situations where water is likely to be rationed by an interruption of supply, sufficient water storage should be available at the centre to ensure an uninterrupted supply at normal levels of utilisation (see Appendix 2).

Water supply standard 3: water use facilities and goods

People have adequate facilities and supplies to collect, store and use sufficient quantities of water for drinking, cooking and personal hygiene, and to ensure that drinking water remains safe until it is consumed.

Key indicators (to be read in conjunction with the guidance notes)

- Each household has at least two clean water collecting containers of 10-20 litres, plus enough clean water storage containers to ensure there is always water in the household (see guidance note 1).
- Water collection and storage containers have narrow necks and/or covers, or other safe means of storage, drawing and handling, and are demonstrably used (see guidance note 1).
- There is at least 250g of soap available for personal hygiene per person per month.
- Where communal bathing facilities are necessary, there are sufficient bathing cubicles available, with separate cubicles for males and females, and they are used appropriately and equitably (see guidance note 2).
- Where communal laundry facilities are necessary, there is at least one washing basin per 100 people, and private laundering areas are available for women to wash and dry undergarments and sanitary cloths.
- The participation of all vulnerable groups is actively encouraged in the siting and construction of bathing facilities and/or the

production and distribution of soap, and/or the use and promotion of suitable alternatives (see guidance note 2).

Guidance notes

1. ***Water collection and storage:*** people need vessels to collect water, to store it and to use it for washing, cooking and bathing. These vessels should be clean, hygienic and easy to carry and be appropriate to local needs and habits, in terms of size, shape and design. Children, disabled people, older people and PLWH/A may need smaller or specially designed water carrying containers. The amount of storage capacity required depends on the size of the household and the consistency of water availability e.g. approximately 4 litres per person would be appropriate for situations where there is a constant daily supply. Promotion and monitoring of safe collection, storage and drawing provide an opportunity to discuss water contamination issues with vulnerable groups, especially women and children.

2. ***Communal washing and bathing facilities:*** people may need a space where they can bathe in privacy and dignity. If this is not possible at the household level, central facilities may be needed. Where soap is not available or commonly used, alternatives can be provided such as ash, clean sand, soda or various plants suitable for washing and/or scrubbing. Washing clothes is an essential hygiene activity, particularly for children, and cooking and eating utensils also need washing. The numbers, location, design, safety, appropriateness and convenience of facilities should be decided in consultation with the users, particularly women, adolescent girls and any disabled people. The location of facilities in central, accessible and well-lit areas can contribute to ensuring the safety of users.

3 Excreta Disposal

Safe disposal of human excreta creates the first barrier to excreta-related disease, helping to reduce transmission through direct and indirect routes. Safe excreta disposal is therefore a major priority, and in most disaster situations should be addressed with as much speed and effort as the provision of safe water supply. The provision of appropriate facilities for defecation is one of a number of emergency responses essential for people's dignity, safety, health and well-being.

Excreta disposal standard 1: access to, and numbers of, toilets

People have adequate numbers of toilets, sufficiently close to their dwellings, to allow them rapid, safe and acceptable access at all times of the day and night.

Key indicators (to be read in conjunction with the guidance notes)

- A maximum of 20 people use each toilet (see guidance notes 1-4).
- Use of toilets is arranged by household(s) and/or segregated by sex (see guidance notes 3-5).
- Separate toilets for women and men are available in public places (markets, distribution centres, health centres, etc.) (see guidance note 3).
- Shared or public toilets are cleaned and maintained in such a way that they are used by all intended users (see guidance notes 3-5).
- Toilets are no more than 50 metres from dwellings (see guidance note 5).
- Toilets are used in the most hygienic way and children's faeces are disposed of immediately and hygienically (see guidance note 6).

Guidance notes

1. ***Safe excreta disposal:*** the aim of a safe excreta disposal programme is to ensure that the environment is free from contamination by human faeces. The more all groups from the disaster-affected population are involved, the more likely the programme is to succeed. In situations where the population has not traditionally used toilets, it may be necessary to conduct a concerted education/promotion campaign to encourage their use and to create a demand for more toilets to be constructed. Disasters in urban areas where the sewerage system is damaged may require solutions such as isolating parts of the system that still work (and re-routing pipes), installing portable toilets and using septic tanks and containment tanks that can be regularly desludged.

2. ***Defecation areas:*** in the initial phase of a disaster, before any toilets can be constructed, it may be necessary to mark off an area to be used as a defecation field or for trench latrines. This will only work if the site is correctly managed and maintained.

3. ***Public toilets:*** in some initial disaster situations and in public places where it is necessary to construct toilets for general use, it is very important to establish systems for the proper regular cleaning and maintenance of these facilities. Disaggregated population data should be used to plan the ratio of women's cubicles to men's (of approximately 3:1). Where possible, urinals should be provided for men (see Appendix 3).

4. ***Communal toilets:*** for a displaced population where there are no existing toilets, it is not always possible to provide one toilet per 20 people immediately. In such cases, a figure of 50 people per toilet can be used, decreasing to 20 as soon as possible, and changing the sharing arrangements accordingly. Any communal toilet must have a system in place, developed with the community, to ensure that it is maintained and kept clean. In some circumstances, space limitations make it impossible to meet this figure. In this case, while advocating strongly for extra space to be made available, it should be remembered that the primary aim is to provide and maintain an environment free from human faeces.

5. ***Shared facilities:*** where one toilet is shared by four or five families it is generally better kept, cleaner and therefore regularly used when the families have been consulted about its siting and design and have the

responsibility and the means to clean and maintain it. It is important to organise access to shared facilities by working with the intended users to decide who will have access to the toilet and how it will be cleaned and maintained. Efforts should be made to provide people living with HIV/AIDS with easy access to a toilet as they frequently suffer from chronic diarrhoea and reduced mobility.

6. ***Children's faeces:*** particular attention should be given to the disposal of children's faeces, which are commonly more dangerous than those of adults, as the level of excreta-related infection among children is frequently higher and children lack antibodies. Parents or care givers need to be involved, and facilities should be designed with children in mind. It may be necessary to provide parents or care givers with information about safe disposal of infant faeces and nappy (diaper) laundering practices.

Excreta disposal standard 2: design, construction and use of toilets

Toilets are sited, designed, constructed and maintained in such a way as to be comfortable, hygienic and safe to use.

Key indicators (to be read in conjunction with the guidance notes)

- Users (especially women) have been consulted and approve of the siting and design of the toilet (see guidance notes 1-3).
- Toilets are designed, built and located to have the following features:

  – they are designed in such a way that they can be used by all sections of the population, including children, older people, pregnant women and physically and mentally disabled people (see guidance note 1);

  – they are sited in such a way as to minimise threats to users, especially women and girls, throughout the day and night (see guidance note 2);

– they are sufficiently easy to keep clean to invite use and do not present a health hazard;

– they provide a degree of privacy in line with the norms of the users;

– they allow for the disposal of women's sanitary protection, or provide women with the necessary privacy for washing and drying sanitary protection cloths (see guidance note 4);

– they minimise fly and mosquito breeding (see guidance note 7).

- All toilets constructed that use water for flushing and/or a hygienic seal have an adequate and regular supply of water (see guidance notes 1 and 3).
- Pit latrines and soakaways (for most soils) are at least 30 metres from any groundwater source and the bottom of any latrine is at least 1.5 metres above the water table. Drainage or spillage from defecation systems must not run towards any surface water source or shallow groundwater source (see guidance note 5).
- People wash their hands after defecation and before eating and food preparation (see guidance note 6).
- People are provided with tools and materials for constructing, maintaining and cleaning their own toilets if appropriate (see guidance note 7).

Guidance notes

1. ***Acceptable facilities:*** successful excreta disposal programmes are based on an understanding of people's varied needs as well as on the participation of the users. It may not be possible to make all toilets acceptable to all groups and special toilets may need to be constructed for children, older people and disabled people e.g. potties, or toilets with lower seats or hand rails. The type of toilet constructed should depend on the preferences and cultural habits of the intended users, the existing infrastructure, the ready availability of water (for flushing and water seals), ground conditions and the availability of construction materials.

2. ***Safe facilities:*** inappropriate siting of toilets may make women and girls more vulnerable to attack, especially during the night, and ways must be found to ensure that women feel, and are, safe using the toilets provided. Where possible, communal toilets should be provided with lighting or families provided with torches. The input of the community should be sought with regard to ways of enhancing the safety of users.

3. ***Anal cleansing:*** water should be provided for people who use it. For other people it may be necessary to provide toilet paper or other material for anal cleansing. Users should be consulted on the most culturally appropriate cleansing materials and on their safe disposal.

4. ***Menstruation:*** women and girls who menstruate should have access to suitable materials for the absorption and disposal of menstrual blood. Women should be consulted on what is culturally appropriate (see Non-food items standard 2 on page 232).

5. ***Distance of defecation systems from water sources:*** the distances given above may be increased for fissured rocks and limestone, or decreased for fine soils. In disasters, groundwater pollution may not be an immediate concern if the groundwater is not consumed. In flooded or high water table environments, it may be necessary to build elevated toilets or septic tanks to contain excreta and prevent it contaminating the environment.

6. ***Hand washing:*** the importance of hand washing after defecation and before eating and preparing food, to prevent the spread of disease, cannot be over-estimated. Users should have the means to wash their hands after defecation with soap or an alternative (such as ash), and should be encouraged to do so. There should be a constant source of water near the toilet for this purpose.

7. ***Hygienic toilets:*** if toilets are not kept clean they may become a focus for disease transmission and people will prefer not to use them. They are more likely to be kept clean if users have a sense of ownership. This is encouraged by promotional activities, having toilets close to where people sleep and involving users in decisions about their design and construction, rules on proper operation, maintenance, monitoring and use. Flies and mosquitoes are discouraged by keeping the toilet clean, having a water seal, Ventilated Improved Pit (VIP) latrine design or simply by the correct use of a lid on a squat hole.

4 Vector Control

A vector is a disease-carrying agent and vector-borne diseases are a major cause of sickness and death in many disaster situations. Mosquitoes are the vector responsible for malaria transmission, which is one of the leading causes of morbidity and mortality. Mosquitoes also transmit other diseases, such as yellow fever and dengue haemorrhagic fever. Non-biting or synanthropic flies, such as the house fly, the blow fly and the flesh fly, play an important role in the transmission of diarrhoeal disease. Biting flies, bed bugs and fleas are a painful nuisance and in some cases transmit significant diseases such as murine typhus and plague. Ticks transmit relapsing fever and human body lice transmit typhus and relapsing fever. Rats and mice can transmit diseases such as leptospirosis and salmonellosis and can be hosts for other vectors e.g. fleas, which may transmit Lassa fever, plague and other infections.

Vector-borne diseases can be controlled through a variety of initiatives, including appropriate site selection and shelter provision, appropriate water supply, excreta disposal, solid waste management and drainage, the provision of health services (including community mobilisation and health promotion), the use of chemical controls, family and individual protection and the effective protection of food stores. Although the nature of vector-borne disease is often complex and addressing vector-related problems may demand specialist attention, there is much that can be done to help prevent the spread of such diseases with simple and effective measures, once the disease, its vector and their interaction with the population have been identified.

Vector control standard 1: individual and family protection

All disaster-affected people have the knowledge and the means to protect themselves from disease and nuisance vectors that are likely to represent a significant risk to health or well-being.

Key indicators (to be read in conjunction with the guidance notes)

- All populations at risk from vector-borne disease understand the modes of transmission and possible methods of prevention (see guidance notes 1-5).
- All populations have access to shelters that do not harbour or encourage the growth of vector populations and are protected by appropriate vector control measures.
- People avoid exposure to mosquitoes during peak biting times by using all non-harmful means available to them. Special attention is paid to protection of high-risk groups such as pregnant and feeding mothers, babies, infants, older people and the sick (see guidance note 3).
- People with treated mosquito nets use them effectively (see guidance note 3).
- Control of human body lice is carried out where louse-borne typhus or relapsing fever is a threat (see guidance note 4).
- Bedding and clothing are aired and washed regularly (see guidance note 4).
- Food is protected at all times from contamination by vectors such as flies, insects and rodents.

Guidance notes

1. ***Defining vector-borne disease risk:*** decisions about vector control interventions should be based on an assessment of potential disease risk,

as well as on clinical evidence of a vector-borne disease problem. Factors influencing this risk include:

– immunity status of the population, including previous exposure, nutritional stress and other stresses. Movement of people (e.g. refugees, IDPs) from a non-endemic to an endemic area is a common cause of epidemics;

– pathogen type and prevalence, in both vectors and humans;

– vector species, behaviours and ecology;

– vector numbers (season, breeding sites, etc.);

– increased exposure to vectors: proximity, settlement pattern, shelter type, existing individual protection and avoidance measures.

2. ***Indicators for vector control programmes:*** commonly used indicators for measuring the impact of vector control activities are vector-borne disease incidence rates (from epidemiological data, community-based data and proxy indicators, depending on the response) and parasite counts (using rapid diagnostic kits or microscopy).

3. ***Individual malaria protection measures:*** if there is a significant risk of malaria, the systematic and timely provision of protection measures, such as insecticide-treated materials, i.e. tents, curtains and bednets, is recommended. Impregnated bednets have the added advantage of giving some protection against body and head lice, fleas, ticks, cockroaches and bedbugs. Long-sleeved clothing, household fumigants, coils, aerosol sprays and repellents are other protection methods that can be used against mosquitoes. It is vital to ensure that users understand the importance of protection and how to use the tools correctly so that the protection measures are effective. Where resources are scarce, they should be directed at individuals and groups most at risk, such as children under five years old, non-immunes and pregnant women.

4. ***Individual protection measures for other vectors:*** good personal hygiene and regular washing of clothes and bedding is the most effective protection against body lice. Infestations can be controlled by personal treatment (powdering), mass laundering or delousing campaigns and by treatment protocols as newly displaced people arrive in a settlement. A

clean household environment, together with good waste disposal and good food storage, will deter rats and other rodents from entering houses or shelters.

5. ***Water-borne diseases:*** people should be informed of health risks and should avoid entering water bodies where there is a known risk of contracting diseases such as schistosomiasis, Guinea worm or leptospirosis (transmitted by exposure to mammalian urine, especially that of rats: see Appendix 4). Agencies may need to work with the community to find alternative sources of water or ensure that water for all uses is appropriately treated.

Vector control standard 2: physical, environmental and chemical protection measures

The numbers of disease vectors that pose a risk to people's health and nuisance vectors that pose a risk to people's well-being are kept to an acceptable level.

Key indicators (to be read in conjunction with the guidance notes)

- Displaced populations are settled in locations that minimise their exposure to mosquitoes (see guidance note 1).
- Vector breeding and resting sites are modified where practicable (see guidance notes 2-4).
- Intensive fly control is carried out in high-density settlements when there is a risk or the presence of a diarrhoea epidemic.
- The population density of mosquitoes is kept low enough to avoid the risk of excessive transmission levels and infection (see guidance note 4).
- People infected with malaria are diagnosed early and receive treatment (see guidance note 5).

Guidance notes

1. ***Site selection*** is important in minimising the exposure of the population to the risk of vector-borne disease; this should be one of the key factors when considering possible sites. With regard to malaria control, for example, camps should be located 1-2km upwind from large breeding sites, such as swamps or lakes, whenever an additional clean water source can be provided (see Shelter and settlement standards 1-2 on pages 211-218).

2. ***Environmental and chemical vector control:*** there are a number of basic environmental engineering measures that can be taken to reduce the opportunities for vector breeding. These include the proper disposal of human and animal excreta (see Excreta Disposal section), proper disposal of refuse to control flies and rodents (see Solid Waste Management section), and drainage of standing water to control mosquitoes (see Drainage section). Such priority environmental health measures will have some impact on the population density of some vectors. It may not be possible to have sufficient impact on all the breeding, feeding and resting sites within a settlement or near it, even in the longer term, and localised chemical control measures or individual protection measures may be needed. For example, space spraying may reduce the numbers of adult flies and prevent a diarrhoea epidemic, or may help to minimise the disease burden if employed during an epidemic.

3. ***Designing a response:*** vector control programmes may have no impact on disease if they target the wrong vector, use ineffective methods, or target the right vector in the wrong place or at the wrong time. Control programmes should initially aim to address the following three objectives: 1) to reduce the vector population density; 2) to reduce the human-vector contact; and 3) to reduce the vector breeding sites. Poorly executed programmes can be counter-productive. Detailed study, and often expert advice, are needed and should be sought from national and international health organisations, while local advice should be sought on local disease patterns, breeding sites, seasonal variations in vector numbers and incidence of diseases, etc.

4. ***Environmental mosquito control:*** environmental control aims primarily at eliminating mosquito breeding sites. The three main species of mosquitoes responsible for transmitting disease are *Culex* (filariasis),

Anopheles (malaria and filariasis) and *Aedes* (yellow fever and dengue). *Culex* mosquitoes breed in stagnant water loaded with organic matter such as latrines, *Anopheles* in relatively unpolluted surface water such as puddles, slow-flowing streams and wells, and *Aedes* in water receptacles such as bottles, buckets, tyres, etc. Examples of environmental mosquito control include good drainage, properly functioning VIP latrines, keeping lids on the squatting hole of pit latrines and on water containers, and keeping wells covered and/or treating them with a larvicide (e.g. for areas where dengue fever is endemic).

5. ***Malaria treatment:*** malaria control strategies that aim to reduce the mosquito population density by eliminating breeding sites, reducing the mosquito daily survival rate and restricting the human biting habit should be carried out simultaneously with early diagnosis and treatment with effective anti-malarials. Campaigns to encourage early diagnosis and treatment should be initiated and sustained. In the context of an integrated approach, active case finding by trained outreach workers and treatment with effective anti-malarials is more likely to reduce the malaria burden than passive case finding through centralised health services (see Control of communicable diseases standard 5 on page 281).

Vector control standard 3: chemical control safety

Chemical vector control measures are carried out in a manner that ensures that staff, the people affected by the disaster and the local environment are adequately protected, and avoids creating resistance to the substances used.

Key indicators (to be read in conjunction with the guidance notes)

- Personnel are protected by the provision of training, protective clothing, use of bathing facilities, supervision and a restriction on the number of hours spent handling chemicals.
- The choice, quality, transport and storage of chemicals used for vector control, the application equipment and the disposal of the

substances follow international norms, and can be accounted for at all times (see guidance note 1).

- Communities are informed about the potential risks of the substances used in chemical vector control and about the schedule for application. They are protected during and after the application of poisons or pesticides, according to internationally agreed procedures (see guidance note 1).

Guidance note

1. ***National and international protocols:*** there are clear international protocols and norms, published by WHO, for both the choice and the application of chemicals in vector control, which should be adhered to at all times. Vector control measures should address two principal concerns: efficacy and safety. If national norms with regard to the choice of chemicals fall short of international standards, resulting in little or no impact or endangering health and safety, then the agency should consult and lobby the relevant national authority for permission to adhere to the international standards.

5 Solid Waste Management

If organic solid waste is not disposed of, major risks are incurred of fly and rat breeding (see Vector Control section) and surface water pollution. Uncollected and accumulating solid waste and the debris left after a natural disaster or conflict may also create a depressing and ugly environment, discouraging efforts to improve other aspects of environmental health. Solid waste often blocks drainage channels and leads to environmental health problems associated with stagnant and polluted surface water.

Solid waste management standard 1: collection and disposal

People have an environment that is acceptably uncontaminated by solid waste, including medical waste, and have the means to dispose of their domestic waste conveniently and effectively.

Key indicators (to be read in conjunction with the guidance notes)

- People from the affected population are involved in the design and implementation of the solid waste programme.
- Household waste is put in containers daily for regular collection, burnt or buried in a specified refuse pit.
- All households have access to a refuse container and/or are no more than 100 metres from a communal refuse pit.
- At least one 100-litre refuse container is available per 10 families, where domestic refuse is not buried on-site.

- Refuse is removed from the settlement before it becomes a nuisance or a health risk (see guidance notes 1, 2 and 6).
- Medical wastes are separated and disposed of separately and there is a correctly designed, constructed and operated pit, or incinerator with a deep ash pit, within the boundaries of each health facility (see guidance notes 3 and 6).
- There are no contaminated or dangerous medical wastes (needles, glass, dressings, drugs, etc.) at any time in living areas or public spaces (see guidance note 3).
- There are clearly marked and appropriately fenced refuse pits, bins or specified areas at public places, such as markets and slaughtering areas, with a regular collection system in place (see guidance note 4).
- Final disposal of solid waste is carried out in such a place and in such a way as to avoid creating health and environmental problems for the local and affected populations (see guidance notes 5-6).

Guidance notes

1. ***Burial of waste:*** if waste is to be buried on-site in either household or communal pits, it should be covered at least weekly with a thin layer of soil to prevent it attracting vectors such as flies and rodents and becoming their breeding ground. If children's faeces/nappies are being disposed of they should be covered with earth directly afterwards. Disposal sites should be fenced off to prevent accidents and access by children and animals; care should be taken to prevent any leachate contaminating the ground water.
2. ***Refuse type and quantity:*** refuse in settlements varies widely in composition and quantity, according to the amount and type of economic activity, the staple foods consumed and local practices of recycling and/or waste disposal. The extent to which solid waste has an impact on people's health should be assessed and appropriate action taken if necessary. Recycling of solid waste within the community should be encouraged, provided it presents no significant health risk. Distribution of commodities that produce a large amount of solid waste from packaging or processing on-site should be avoided.

3. ***Medical waste:*** poor management of health-care waste exposes the community, health-care workers and waste handlers to infections, toxic effects and injuries. In a disaster situation the most hazardous types of waste are likely to be infectious sharps and non-sharps (wound dressings, blood-stained cloth and organic matter such as placentas, etc.). The different types of waste should be separated at source. Non-infectious waste (paper, plastic wrappings, food waste, etc.) can be disposed of as solid waste. Contaminated sharps, especially used needles and syringes, should be placed in a safety box directly after use. Safety boxes and other infectious waste can be disposed of on-site by burial, incineration or other safe methods.

4. ***Market waste:*** most market waste can be treated in the same way as domestic refuse. Slaughterhouse waste may need special treatment and special facilities to deal with the liquid wastes produced, and to ensure that slaughtering is carried out in hygienic conditions and in compliance with local laws. Slaughter waste can often be disposed of in a large pit with a hole cover next to the abattoir. Blood, etc. can be run from the abattoir into the pit through a slab-covered channel (reducing fly access to the pit). Water should be made available for cleaning purposes.

5. ***Controlled tipping/sanitary landfill:*** large-scale disposal of waste should be carried out off-site through either controlled tipping or sanitary landfill. This method is dependent upon sufficient space and access to mechanical equipment. Ideally waste that is tipped should be covered with soil at the end of each day to prevent scavenging and vector breeding.

6. ***Staff welfare:*** all solid waste management staff who collect, transport or dispose of waste should be provided with protective clothing, at minimum gloves and ideally overalls, boots and protective masks. Water and soap should be available for hand and face washing. Staff who come into contact with medical waste should be informed of the correct methods of storage, transport and disposal and the risks associated with improper management of the waste.

6 Drainage

Surface water in or near emergency settlements may come from household and water point wastewater, leaking toilets and sewers, rainwater or rising floodwater. The main health risks associated with surface water are contamination of water supplies and the living environment, damage to toilets and dwellings, vector breeding and drowning. Rainwater and rising floodwaters can worsen the drainage situation in a settlement and further increase the risk of contamination. A proper drainage plan, addressing stormwater drainage through site planning and wastewater disposal using small-scale, on-site drainage, should be implemented to reduce potential health risks to the population. This section addresses small-scale drainage problems and activities. Large-scale drainage is generally determined by site selection and development (see Shelter, Settlement and Non-Food Items, chapter 4 on page 203).

Drainage standard 1: drainage works

People have an environment in which the health and other risks posed by water erosion and standing water, including stormwater, floodwater, domestic wastewater and wastewater from medical facilities, are minimised.

Key indicators (to be read in conjunction with the guidance notes)

- Areas around dwellings and water points are kept free of standing wastewater, and stormwater drains are kept clear (see guidance notes 1, 2, 4 and 5).
- Shelters, paths and water and sanitation facilities are not flooded or eroded by water (see guidance notes 2-4).

- Water point drainage is well planned, built and maintained. This includes drainage from washing and bathing areas as well as water collection points (see guidance notes 2 and 4).
- Drainage waters do not pollute existing surface or groundwater sources or cause erosion (see guidance note 5).
- Sufficient numbers of appropriate tools are provided for small drainage works and maintenance where necessary (see guidance note 4).

Guidance notes

1. ***Site selection and planning:*** the most effective way to control drainage problems is in the choice of site and the layout of the settlement (see Shelter and settlement standards 1-4 on pages 211-224).
2. ***Wastewater:*** sullage or domestic wastewater is classified as sewage when mixed with human excreta. Unless the settlement is sited where there is an existing sewerage system, domestic wastewater should not be allowed to mix with human waste. Sewage is difficult and more expensive to treat than domestic wastewater. At water points and washing and bathing areas, the creation of small gardens to utilise wastewater should be encouraged. Special attention needs to be paid to prevent wastewater from washing and bathing areas contaminating water sources.
3. ***Drainage and excreta disposal:*** special care is needed to protect toilets and sewers from flooding in order to avoid structural damage and leakage.
4. ***Promotion:*** it is essential to involve the affected population in providing small-scale drainage works as they often have good knowledge of the natural flow of drainage water and of where channels should be. Also, if they understand the health and physical risks involved and have assisted in the construction of the drainage system, they are more likely to maintain it (see Vector Control section). Technical support and tools may then be needed.
5. ***On-site disposal:*** where possible, and if favourable soil conditions exist, drainage from water points and washing areas should be on-site rather than via open channels, which are difficult to maintain and often clog. Simple and cheap techniques such as soak pits can be used for on-site

disposal of wastewater. Where off-site disposal is the only possibility, channels are preferable to pipes. Channels should be designed both to provide flow velocity for dry-weather sullage and to carry stormwater. Where the slope is more than 5%, engineering techniques must be applied to prevent excessive erosion. Drainage of residuals from any water treatment processes should be carefully controlled so that people cannot use such water and it does not contaminate surface or groundwater sources.

Appendix 1

Water and Sanitation Initial Needs Assessment Checklist

This list of questions is primarily for use to assess needs, identify indigenous resources and describe local conditions. It does not include questions to determine external resources needed in addition to those immediately and locally available.

1 General

- How many people are affected and where are they? Disaggregate the data as far as possible by sex, age, disability etc.
- What are people's likely movements? What are the security factors for the people affected and for potential relief responses?
- What are the current or threatened water- and sanitation-related diseases? What are the extent and expected evolution of problems?
- Who are the key people to consult or contact?
- Who are the vulnerable people in the population and why?
- Is there equal access for all to existing facilities?
- What special security risks exist for women and girls?
- What water and sanitation practices were the population accustomed to before the emergency?

2 Water supply

- What is the current water source and who are the present users?
- How much water is available per person per day?
- What is the daily/weekly frequency of the water supply?
- Is the water available at the source sufficient for short-term and longer-term needs for all groups in the population?

- Are water collection points close enough to where people live? Are they safe?
- Is the current water supply reliable? How long will it last?
- Do people have enough water containers of the appropriate size and type?
- Is the water source contaminated or at risk of contamination (microbiological or chemical/radiological)?
- Is treatment necessary? Is treatment possible? What treatment is necessary?
- Is disinfection necessary, even if the supply is not contaminated?
- Are there alternative sources nearby?
- What traditional beliefs and practices relate to the collection, storage and use of water?
- Are there any obstacles to using available supplies?
- Is it possible to move the population if water sources are inadequate?
- Is it possible to tanker water if water sources are inadequate?
- What are the key hygiene issues related to water supply?
- Do people have the means to use water hygienically?

3 Excreta disposal

- What is the current defecation practice? If it is open defecation, is there a designated area? Is the area secure?
- What are current beliefs and practices, including gender-specific practices, concerning excreta disposal?
- Are there any existing facilities? If so, are they used, are they sufficient and are they operating successfully? Can they be extended or adapted?
- Is the current defecation practice a threat to water supplies (surface or ground water) or living areas?

- Do people wash their hands after defecation and before food preparation and eating? Are soap or other cleansing materials available?
- Are people familiar with the construction and use of toilets?
- What local materials are available for constructing toilets?
- Are people prepared to use pit latrines, defecation fields, trenches, etc.?
- Is there sufficient space for defecation fields, pit latrines, toilets, etc.?
- What is the slope of the terrain?
- What is the level of the groundwater table?
- Are soil conditions suitable for on-site excreta disposal?
- Do current excreta disposal arrangements encourage vectors?
- Are there materials or water available for anal cleansing? How do people normally dispose of these materials?
- How do women manage issues related to menstruation? Are there appropriate materials or facilities available for this?

4 Vector-borne disease

- What are the vector-borne disease risks and how serious are these risks?
- What traditional beliefs and practices relate to vectors and vector-borne disease? Are any of these either useful or harmful?
- If vector-borne disease risks are high, do people at risk have access to individual protection?
- Is it possible to make changes to the local environment (by drainage, scrub clearance, excreta disposal, refuse disposal, etc.) to discourage vector breeding?
- Is it necessary to control vectors by chemical means? What programmes, regulations and resources exist for vector control and the use of chemicals?

- What information and safety precautions need to be provided to households?

5 Solid waste disposal

- Is solid waste a problem?
- How do people dispose of their waste? What type and quantity of solid waste is produced?
- Can solid waste be disposed of on-site, or does it need to be collected and disposed of off-site?
- What is the normal practice of solid waste disposal for the affected population? (compost/refuse pits? collection system? bins?)
- Are there medical facilities and activities producing waste? How is this being disposed of? Who is responsible?

6 Drainage

- Is there a drainage problem (e.g. flooding of dwellings or toilets, vector breeding sites, polluted water contaminating living areas or water supplies)?
- Is the soil prone to waterlogging?
- Do people have the means to protect their dwellings and toilets from local flooding?

Appendix 2

Planning Guidelines for Minimum Water Quantities for Institutions and Other Uses

Health centres and hospitals	5 litres/out-patient 40-60 litres/in-patient/day Additional quantities may be needed for laundry equipment, flushing toilets, etc.
Cholera centres	60 litres/patient/day 15 litres/carer/day
Therapeutic feeding centres	30 litres/in-patient/day 15 litres/carer/day
Schools	3 litres/pupil/day for drinking and hand washing (use for toilets not included: see below)
Mosques	2-5 litres/person/day for washing and drinking
Public toilets	1-2 litres/user/day for hand washing 2-8 litres/cubicle/day for toilet cleaning
All flushing toilets	20-40 litres/user/day for conventional flushing toilets connected to a sewer 3-5 litres/user/day for pour-flush toilets
Anal washing	1-2 litres/person/day
Livestock	20-30 litres/large or medium animal/day 5 litres/small animal/day
Small-scale irrigation	3-6mm/m^2/day, but can vary considerably

Appendix 3

Planning Guidelines for Minimum Numbers of Toilets at Public Places and Institutions in Disaster Situations

Institution	Short term	Long term
Market areas	1 toilet to 50 stalls	1 toilet to 20 stalls
Hospitals/medical centres	1 toilet to 20 beds or 50 out-patients	1 toilet to 10 beds or 20 out-patients
Feeding centres	1 toilet to 50 adults 1 toilet to 20 children	1 toilet to 20 adults 1 toilet to 10 children
Reception/transit centres	1 toilet per 50 people 3:1 female to male	
Schools	1 toilet to 30 girls 1 toilet to 60 boys	1 toilet to 30 girls 1 toilet to 60 boys
Offices		1 toilet to 20 staff

Source: *adapted from Harvey, Baghri and Reed (2002)*

Appendix 4

Water- and Excreta-Related Diseases and Transmission Mechanisms

Water-borne or water-washed	Cholera, shigellosis, diarrhoea, salmonellosis, etc. Typhoid, paratyphoid, etc. Amoebic dysentery, giardiasis Hepatitis A, poliomyelitis, rotavirus diarrhoea	**Faecal-oral bacterial** **Faecal-oral non-bacterial**	Water contamination Poor sanitation Poor personal hygiene Crop contamination
Water-washed or water-scarce	Skin and eye infections Louse-borne typhus and louse-borne relapsing fever		Inadequate water Poor personal hygiene
Excreta-related helminths	Roundworm, hookworm, whipworm, etc.	**Soil-transmitted helminths**	Open defecation Ground contamination
Beef and pork tape worms	Taeniasis	**Man-animal**	Half-cooked meat Ground contamination
Water-based	Schistosomiasis, Guinea worm, clonorchiasis, etc.	**Long stay in infected water**	Water contamination
Water-related insect vectors **Excreta-related insect vectors**	Malaria, dengue, sleeping sickness, filariasis, etc. Diarrhoea and dysentery	**Biting by mosquitoes, flies** **Transmitted by flies and cockroaches**	Bite near water Breed in water Dirty environment

Appendix 5

References

Thanks to the Forced Migration Online programme of the Refugee Studies Centre at the University of Oxford, many of these documents have received copyright permission and are posted on a special Sphere link at: http://www.forcedmigration.org

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Notes

Notes

Notes

Chapter 3: Minimum Standards in Food Security, Nutrition and Food Aid

How to use this chapter

This chapter is divided into four sections: 1) Food Security and Nutrition Assessment and Analysis standards, 2) Food Security standards, 3) Nutrition standards and 4) Food Aid standards. While the Food Security and Nutrition standards are a practical expression of the right to food, the Food Aid standards are more operationally focused. The Food Aid standards can contribute towards the achievement of both the Food Security and Nutrition standards.

Each of the sections contains the following:

- *the minimum standards:* these are qualitative in nature and specify the minimum levels to be attained in the provision of food security, nutrition and food aid responses;
- *key indicators:* these are 'signals' that show whether the standard has been attained. They provide a way of measuring and communicating the impact, or result, of programmes as well as the process, or methods, used. The indicators may be qualitative or quantitative;
- *guidance notes:* these include specific points to consider when applying the standards and indicators in different situations, guidance on tackling practical difficulties, and advice on priority issues. They may also include critical issues relating to the standards or indicators, and describe dilemmas, controversies or gaps in current knowledge.

Appendices at the end of the chapter include checklists for assessments, examples of food security responses, guidance on measuring acute malnutrition and determining the public health significance of micronutrient deficiency, nutritional requirements and a select list of references, which point to sources of information on both general issues and specific technical issues relating to this chapter.

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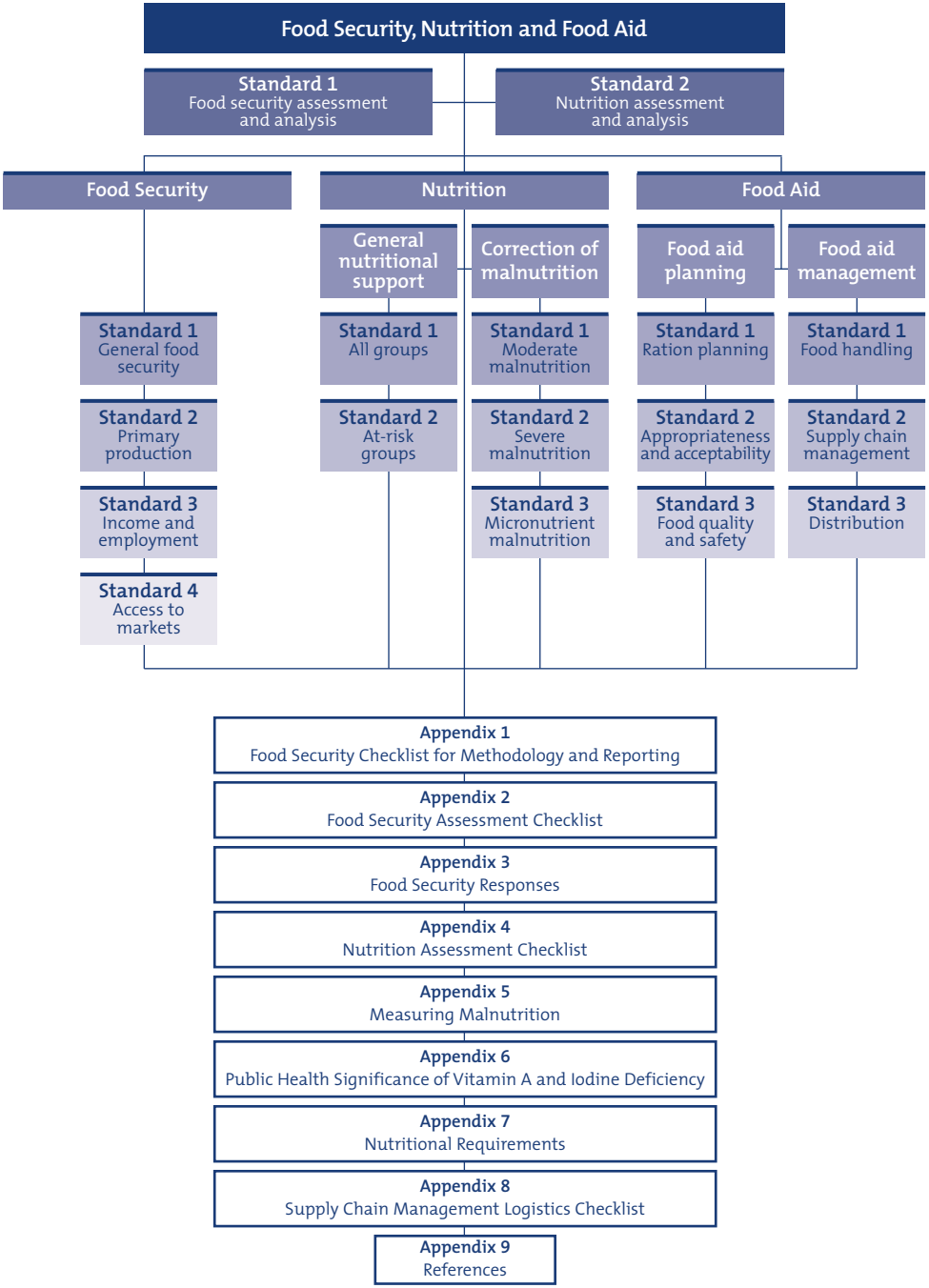
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Introduction

Links to international legal instruments

The Minimum Standards in Food Security, Nutrition and Food Aid are a practical expression of the principles and rights embodied in the Humanitarian Charter. The Humanitarian Charter is concerned with the most basic requirements for sustaining the lives and dignity of those affected by calamity or conflict, as reflected in the body of international human rights, humanitarian and refugee law.

Everyone has the right to adequate food. This right is recognised in international legal instruments and includes the right to be free from hunger. Key aspects of the right to adequate food include:

- the availability of food in a quantity and of a quality sufficient to satisfy the dietary needs of individuals, free from adverse substances and acceptable within a given culture;
- the accessibility of such food in ways that are sustainable and do not interfere with the enjoyment of other human rights.

States and non-state actors have responsibilities in fulfilling the right to food. There are many situations in which the non-fulfilment of these obligations and violations of international law – including, for example, the deliberate starvation of populations or destruction of their livelihoods as a war strategy – have devastating effects on food security and nutrition. In times of armed conflict, it is prohibited for combatants to attack or destroy foodstuffs, agricultural areas for the production of foodstuffs, crops or livestock. In these situations, humanitarian actors can help to realise the rights of affected populations: for example, by providing food assistance in ways that respect national law and international human rights obligations.

The Minimum Standards in this chapter are not a full expression of the Right to Adequate Food. However, the Sphere standards reflect the core content of the Right to Food and contribute to the progressive realisation of this right globally.

The importance of food security, nutrition and food aid in disasters

Access to food and the maintenance of adequate nutritional status are critical determinants of people's survival in a disaster. Malnutrition can be the most serious public health problem and may be a leading cause of death, whether directly or indirectly. The resilience of livelihoods and people's subsequent food security determine their health and nutrition in the short term and their future survival and well-being. Food aid can be important in protecting and providing for food security and nutrition, as part of a combination of measures.

The food security standards are less detailed than the nutrition or the food aid standards, largely because food security is a diverse field with a limited body of best practice in disaster situations.

For this chapter the following definitions are used:

- **food security** exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food for a healthy and active life (World Food Summit Plan of Action, paragraph 1, 1996);
- **livelihoods** comprise the capabilities, assets (including both material and social resources) and activities required for a means of living linked to survival and future well-being. *Livelihood strategies* are the practical means or activities through which people access food or income to buy food, while *coping strategies* are temporary responses to food insecurity.
- **malnutrition** encompasses a range of conditions, including acute malnutrition, chronic malnutrition and micronutrient deficiencies. Acute malnutrition refers to wasting (thinness) and/or nutritional oedema, while chronic malnutrition refers to stunting (shortness). Stunting and wasting are two forms of growth failure. In this chapter we refer only to acute malnutrition and micronutrient deficiency.

As women usually assume overall responsibility for food in the household and because they are the major recipients of food aid, it is

important to encourage their participation in the design and implementation of programmes wherever possible.

Links to other chapters

Many of the standards in the other sector chapters are relevant to this chapter. Progress in achieving standards in one area often influences and even determines progress in other areas. For an intervention to be effective, close coordination and collaboration are required with other sectors. Coordination with local authorities and other responding agencies is also necessary to ensure that needs are met, that efforts are not duplicated, and that the quality of food security, nutrition and food aid responses is optimised.

For example, requirements for cooking utensils, fuel and water for food consumption, and for the maintenance of public health, are addressed in the standards for Water, Sanitation and Hygiene Promotion, Health Services and Shelter, Settlement and Non-Food Items. These requirements have a direct impact on the ability of households to access food and the maintenance of adequate nutritional status. Reference to specific standards or guidance notes in other technical chapters is made where relevant.

Links to the standards common to all sectors

The process by which a response is developed and implemented is critical to its effectiveness. This chapter should be utilised in conjunction with the standards common to all sectors, which cover participation, initial assessment, response, targeting, monitoring, evaluation, aid worker competencies and responsibilities, and the supervision, management and support of personnel (see chapter 1, page 21). In particular, in any response the participation of disaster-affected people – including the vulnerable groups outlined below – should be maximised to ensure its appropriateness and quality.

Vulnerabilities and capacities of disaster-affected populations

The groups most frequently at risk in emergencies are women, children, older people, disabled people and people living with HIV/AIDS (PLWH/A). In certain contexts, people may also become vulnerable by reason of ethnic origin, religious or political affiliation, or displacement. This is not an exhaustive list, but it includes those most frequently identified. Specific vulnerabilities influence people's ability to cope and survive in a disaster, and those most at risk should be identified in each context.

Throughout the handbook, the term 'vulnerable groups' refers to all these groups. When any one group is at risk, it is likely that others will also be threatened. Therefore, whenever vulnerable groups are mentioned, users are strongly urged to consider all those listed here. Special care must be taken to protect and provide for all affected groups in a non-discriminatory manner and according to their specific needs. However, it should also be remembered that disaster-affected populations possess, and acquire, skills and capacities of their own to cope, and that these should be recognised and supported.

The Minimum Standards

1 Food Security and Nutrition Assessment and Analysis

These two standards follow on from the common Initial assessment (see page 29) and Participation (see page 28) standards, and both apply wherever nutrition and food security interventions are planned or are advocated. These assessments are in-depth and require considerable time and resources to undertake properly. In an acute crisis and for immediate response, a rapid assessment may be sufficient to decide whether or not immediate assistance is required, and if so what provisions should be made. Assessment checklists are provided in Appendices 1-3, pages 172-179.

Assessment and analysis standard 1: food security

Where people are at risk of food insecurity, programme decisions are based on a demonstrated understanding of how they normally access food, the impact of the disaster on current and future food security, and hence the most appropriate response.

Key indicators (to be read in conjunction with the guidance notes)

- Assessments and analyses examine food security in relevant geographic locations and livelihood groupings, distinguishing between seasons, and over time, to identify and prioritise needs (see guidance note 1).

- The assessment demonstrates understanding of the broader social, economic and political policies, institutions and processes that affect food security (see guidance note 2).
- The assessment includes an investigation and analysis of coping strategies (see guidance note 3).
- Where possible, the assessment builds upon local capacities, including both formal and informal institutions (see guidance note 4).
- The methodology used is comprehensively described in the assessment report and is seen to adhere to widely accepted principles (see guidance note 5).
- Use is made of existing secondary data, and the collection of new primary data in the field is focused on additional information essential for decision-making (see guidance note 6).
- Recommended food security responses are designed to support, protect and promote livelihood strategies, while also meeting immediate needs (see guidance note 7).
- The impact of food insecurity on the population's nutritional status is considered (see guidance note 8).

Guidance notes

1. ***Scope of analysis:*** food security varies according to people's livelihoods, their location, their social status, the time of year and the nature of the disaster and associated responses. The focus of the assessment will reflect how the affected population acquired food and income before the disaster, and how the disaster has affected this. For example, in urban and peri-urban areas, the focus may be on reviewing the market supply of food, while in rural areas it will usually be on food production. Where people have been displaced, the food security of the host population must also be taken into account. Food security assessments may be undertaken when planning to phase out a programme as well as prior to starting one. In either case, they should be coordinated among all concerned parties to minimise duplication of effort. Assessments gathering new information should complement secondary data from existing information sources.

2. ***Context:*** food insecurity may be the result of wider macro-economic and structural socio-political factors e.g. national and international policies, processes or institutions that affect people's access to nutritionally adequate food. This is usually defined as chronic food insecurity, in that it is a long-term condition resulting from structural vulnerabilities, but it may be aggravated by the impact of a disaster.

3. ***Coping strategies:*** assessment and analysis should consider the different types of coping strategy, who is applying them and how well they work. While strategies vary, there are nonetheless distinct stages of coping. Early coping strategies are not necessarily abnormal, are reversible and cause no lasting damage e.g. collection of wild foods, selling non-essential assets or sending a family member to work elsewhere. Later strategies, sometimes called crisis strategies, may permanently undermine future food security e.g. sale of land, distress migration of whole families or deforestation. Some coping strategies employed by women and girls tend to expose them to higher risk of HIV infection e.g. prostitution and illicit relationships, or sexual violence as they travel to unsafe areas. Increased migration generally may increase risk of HIV transmission. Coping strategies may also affect the environment e.g. over-exploitation of commonly owned natural resources. It is important that food security is protected and supported before all non-damaging options are exhausted.

4. ***Local capacities:*** participation of the community and appropriate local institutions at all stages of assessment and planning is vital. Programmes should be based on need and tailored to the particular local context. In areas subject to recurrent natural disasters or long-running conflicts there may be local early warning and emergency response systems or networks. Communities which have previously experienced drought or floods may have their own contingency plans. It is important that such local capacities are supported.

5. ***Methodology:*** it is important to consider carefully the coverage of assessments and sampling procedures, even if informal. The process documented in the report should be both logical and transparent, and should reflect recognised procedures for food security assessment. Methodological approaches need to be coordinated among agencies and with the government to ensure that information and analyses are complementary and

consistent, so that information can be compared over time. Multi-agency assessments are usually preferable. The triangulation of different sources and types of food security information is vital in order to arrive at a consistent conclusion across different sources e.g. crop assessments, satellite images, household assessments etc. A checklist of the main areas to be considered in an assessment is given in Appendix 1. A checklist for reviewing methodology is provided in Appendix 2.

6. ***Sources of information:*** in many situations a wealth of secondary information exists about the situation pre-disaster, including the normal availability of food, the access that different groups normally have to food, the groups that are most food-insecure, and the effects of previous crises on food availability and the access of different groups. Effective use of secondary information enables the gathering of primary data during the assessment to be focused on what is essential in the new situation.

7. ***Long-term planning:*** while meeting immediate needs and preserving productive assets will always be the priority during the initial stages of a crisis, responses must always be planned with the longer term in mind. This requires technical expertise in a range of sectors, as well as abilities to work closely with members of the community, including representatives from all groups. Participation of community members at all stages of assessment and programme planning is vital, not least for their perspectives of long-term possibilities and risks. Recommendations must be based on a sound and demonstrated understanding by appropriately qualified and experienced personnel. The assessment team should include relevant sectoral experts, including e.g. agriculturalists, agro-economists, veterinarians, social scientists, and water and sanitation or other appropriate experts (see Participation standard on page 28).

8. ***Food insecurity and nutritional status:*** food insecurity is one of three underlying causes of malnutrition, and therefore wherever there is food insecurity there is risk of malnutrition, including micronutrient deficiencies. Consideration of the impact of food insecurity on the nutrition situation is an essential part of food security assessment. However, it should not be assumed that food insecurity is the sole cause of malnutrition, without considering possible health and care causal factors.

Assessment and analysis standard 2: nutrition

Where people are at risk of malnutrition, programme decisions are based on a demonstrated understanding of the causes, type, degree and extent of malnutrition, and the most appropriate response.

Key indicators (to be read in conjunction with the guidance notes)

- Before conducting an anthropometric survey, information on the underlying causes of malnutrition (food, health and care) is analysed and reported, highlighting the nature and severity of the problem(s) and those groups with the greatest nutritional and support needs (see guidance note 1 and General nutrition support standard 2 on page 140).
- The opinions of the community and other local stakeholders on the causes of malnutrition are considered (see guidance note 1).
- Anthropometric surveys are conducted only where information and analysis is needed to inform programme decision-making (see guidance note 2).
- International anthropometric survey guidelines, and national guidelines consistent with these, are adhered to for determining the type, degree and extent of malnutrition (see guidance note 3).
- Where anthropometric surveys are conducted among children under five years, international weight-for-height reference values are used for reporting malnutrition in Z scores and percentage of the median for planning purposes (see guidance note 3).
- Micronutrient deficiencies to which the population is at risk are determined (see guidance note 4).
- Responses recommended after nutrition assessment build upon and complement local capacities in a coordinated manner.

Guidance notes

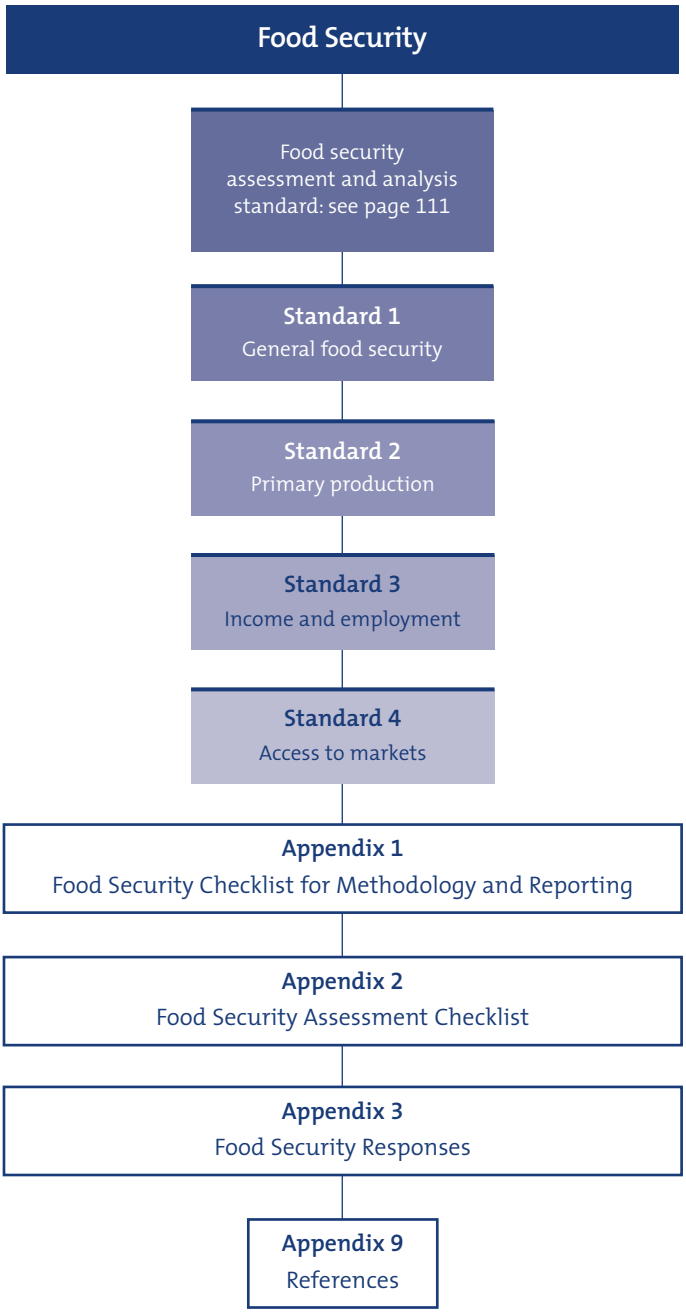
1. ***Underlying causes:*** the immediate causes of malnutrition are disease and/or inadequate food intake (which in turn result from food insecurity), a poor public health or social and care environment, or inadequate access to health services at household and community levels. These underlying causes are influenced by other basic causes including human, structural, natural and economic resources, the political, cultural and security context, the formal and informal infrastructure, and population movements (forced or unforced) and constraints on movement. An understanding of the causes of malnutrition in each specific context is an essential prerequisite for any nutrition programme. Information on the causes of malnutrition can be gathered from primary or secondary sources, including existing health and nutrition profiles, research reports, early warning information, health centre records, food security reports and community welfare groups, and can comprise both quantitative and qualitative information. A nutrition assessment checklist can be found in Appendix 4.

2. ***Decision-making*** should rely on an understanding of all three possible underlying causes of malnutrition as well as results from anthropometric surveys. In an acute crisis, however, decisions to implement general food distribution need not await the results of anthropometric surveys, as these can take up to three weeks. It should, however, be possible to use anthropometric survey findings to inform decisions on responses aimed at correcting malnutrition.

3. ***Anthropometric surveys*** provide an estimate of the prevalence of malnutrition. The most widely accepted practice is to assess malnutrition levels in children aged 6-59 months as a proxy for the population as a whole. However, other groups may be affected to a greater extent or face greater nutritional risk. When this is the case, the situation of these groups should be assessed, although measurement can be problematic (see Appendix 5). International guidelines stipulate that a representative sample is used for surveys; adherence to national guidelines can promote coordination and comparability of reporting. Where representative data are available on trends in nutritional status, these are preferable to a single prevalence figure. Immunisation coverage rates can also usefully be

gathered during an anthropometric survey, as can retrospective mortality data, using a different sampling frame. Reports should always describe the probable causes of malnutrition, and nutritional oedema should be reported separately.

4. ***Micronutrient deficiencies:*** if the population is known to have been vitamin A-, iodine- or iron-deficient prior to the disaster, it can be assumed that this will remain a problem during the disaster. When analysis of the health and food security situations suggests a risk of micronutrient deficiency, steps to improve the quantification of specific deficiencies should be taken (see also General nutrition support standard 1 on page 137 and Correction of malnutrition standard 3 on page 152).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2 Minimum Standards in Food Security

Food security includes access to food (including affordability), adequacy of food supply or availability, and the stability of supply and access over time. It also covers the quality, variety and safety of food, and the consumption and biological utilisation of food.

The resilience of people's livelihoods, and their vulnerability to food insecurity, is largely determined by the resources available to them, and how these have been affected by disaster. These resources include economic and financial property (such as cash, credit, savings and investments) and also include physical, natural, human and social capital. For people affected by disaster, the preservation, recovery and development of the resources necessary for their food security and future livelihoods is usually a priority.

In conflict situations, insecurity and the threat of conflict may seriously restrict livelihood activities and access to markets. Households may suffer direct loss of assets, either abandoned as a result of flight or destroyed or commandeered by warring parties.

The first food security standard, following on from the food security assessment and analysis standard on page 111, is a general standard that applies to all aspects of food security programming in disasters, including issues relating to survival and preservation of assets. The remaining three standards relate to primary production, income generation and employment, and access to markets, including goods and services. Appendix 3 describes a range of food security responses.

There is some obvious overlap between the food security standards, as food security responses usually have multiple objectives, relating to different aspects of food security and hence are covered by more than one standard (including also standards in the water, health and shelter sectors). In addition, a balance of programmes is required to

achieve all standards in food security. Disaster response should support and/or complement existing government services in terms of structure, design and long-term sustainability.

Food security standard 1: general food security

People have access to adequate and appropriate food and non-food items in a manner that ensures their survival, prevents erosion of assets and upholds their dignity.

Key indicators (to be read in conjunction with the guidance notes)

- Where people's lives are at risk through lack of food, responses prioritise meeting their immediate food needs (see guidance note 1).
- In all disaster contexts, measures are taken to support, protect and promote food security. This includes preserving productive assets or recovering those lost as the result of disaster (see guidance note 2).
- Responses that protect and support food security are based on sound analysis, in consultation with the disaster-affected community.
- Responses take account of people's coping strategies, their benefits and any associated risks and costs (see guidance note 3).
- Transition and exit strategies are developed for all food security responses to disaster, and are publicised and applied as appropriate (see guidance note 4).
- When a response supports the development of new or alternative livelihood strategies, all groups have access to appropriate support, including necessary knowledge, skills and services (see guidance note 5).
- Food security responses have the least possible degradative effect on the environment (see guidance note 6).

- Numbers of beneficiaries are monitored to determine the level of acceptance and access by different groups in the population and to ensure overall coverage of the affected population without discrimination (see guidance note 7).
- The effects of responses on the local economy, social networks, livelihoods and the environment are monitored, in addition to ongoing monitoring linked to programme objectives (see guidance note 8).

Guidance notes

1. ***Prioritising life-saving responses:*** although food distribution is the most common response to acute food insecurity in disasters, other types of response may also help people meet their immediate food needs. Examples include sales of subsidised food (when people have some purchasing power but supplies are lacking); improving purchasing power through employment programmes (including food-for-work); and destocking initiatives or cash distributions. Especially in urban areas, the priority may be to re-establish normal market arrangements and revitalise economic activities that provide employment. Such strategies may be more appropriate than food distribution because they uphold dignity, support livelihoods and thereby reduce future vulnerability. Agencies have a responsibility to take into account what others are doing to ensure that the combined response provides complementary inputs and services. General food distributions should be introduced only when absolutely necessary and should be discontinued as soon as possible. General free food distribution may not be appropriate when:
   - adequate supplies of food are available in the area (and the need is to address obstacles to access);
   - a localised lack of food availability can be addressed by support of market systems;
   - local attitudes or policies are against free food handouts.
2. ***Support, protection and promotion of food security:*** appropriate measures to support food security can include a wide range of responses

and advocacy (see Appendix 3). Although in the short term it may not be feasible to achieve food security based entirely on people's own livelihood strategies, existing strategies that contribute to household food security and preserve dignity should be protected and supported wherever possible. Food security responses do not necessarily seek a complete recovery of assets lost as a result of disaster, but seek to prevent further erosion and to promote a process of recovery.

3. ***Risks associated with coping strategies:*** many coping strategies carry costs or incur risks that may increase vulnerability. For example:

   – cutbacks in amounts of food eaten or in the quality of diets lead to declining health and nutritional status;

   – cutbacks in expenditure on school fees and health care undermine human capital;

   – prostitution and external relationships to secure food undermine dignity, and risk social exclusion and HIV infection or other sexually transmitted diseases;

   – sale of household assets may reduce the future productive capacity of the household;

   – failure to repay loans risks losing future access to credit;

   – over-use of natural resources reduces the availability of natural capital (e.g. excessive fishing, collection of firewood etc);

   – travel to insecure areas to work or to gather food or fuel exposes people (especially women and children) to attack;

   – producing or trading illicit goods risks arrest and imprisonment;

   – separation of families and mothers from children risks poor standards of child care and malnutrition.

   These progressive and debilitating effects must be recognised and early interventions undertaken to discourage such strategies and prevent asset loss. Certain coping strategies may also undermine dignity, where people are forced to engage in socially demeaning or unacceptable activities. However, in many societies certain strategies (such as sending a family member to work elsewhere during hard times) are a well-established tradition.

4. ***Exit and transition strategies:*** such strategies must be considered from the outset of a programme, particularly where the response may have long-term implications e.g. the provision of free services which would normally be paid for, such as access to credit or veterinary services. Before closing the programme or transiting to a new phase, there should be evidence that the situation has improved.

5. ***Access to knowledge, skills and services:*** structures that provide relevant services should be designed and planned together with the users, so that they are appropriate and adequately maintained, where possible beyond the life of the project. Some groups have very specific needs e.g. children orphaned as a result of AIDS may miss out on the information and skills transfer that takes place within families.

6. ***Environmental impact:*** as far as possible, the natural resource base for production and livelihoods of the affected population – and of host populations – should be preserved. Impact on the surrounding environment should be considered during assessment and the planning of any response. For example, people living in camps require cooking fuel, which may lead rapidly to local deforestation. The distribution of foodstuffs which have long cooking times, such as certain beans, will require more cooking fuel, thus also potentially affecting the environment (see Food aid planning standard 2 on page 158). Where possible, responses should aim to preserve the environment from further degradation. For example, destocking programmes reduce the pressure of animal grazing on pasture during a drought, making more feed available for surviving livestock.

7. ***Coverage, access and acceptability:*** beneficiaries and their characteristics should be described and their numbers estimated before determining the level of participation of different groups (paying particular attention to vulnerable groups). Participation is partly determined by ease of access and the acceptability of activities to participants. Even though some food security responses are targeted at the economically active, they should nevertheless be non-discriminatory and seek to provide access for vulnerable groups, as well as protecting dependents, including children. Various constraints, including capacity to work, workload at home, responsibilities for caring for children, the chronically ill or disabled, and restricted physical access, may limit the participation of women, people with disabilities and older people. Overcoming these constraints

involves identifying activities that are within the capacity of these groups or setting up appropriate support structures. Targeting mechanisms based on self-selection should normally be established with full consultation with all groups in the community (see Targeting standard on page 35).

8. ***Monitoring:*** as well as routine monitoring (see Monitoring and Evaluation standards on pages 37-40), it is also necessary to monitor the wider food security situation in order to assess the continued relevance of the programme, determine when to phase out specific activities or to introduce modifications or new projects as needed, and to identify any need for advocacy. Local and regional food security information systems, including famine early warning systems, are important sources of information.

Food security standard 2: primary production

Primary production mechanisms are protected and supported.

Key indicators (to be read in conjunction with the guidance notes)

- Interventions to support primary production are based on a demonstrated understanding of the viability of production systems, including access to and availability of necessary inputs and services (see guidance note 1).
- New technologies are introduced only where their implications for local production systems, cultural practices and environment are understood and accepted by food producers (see guidance note 2).
- Where possible, a range of inputs is provided in order to give producers more flexibility in managing production, processing and distribution and in reducing risks (see guidance note 3).
- Productive plant, animal or fisheries inputs are delivered in time, are locally acceptable and conform to appropriate quality norms (see guidance notes 4-5).
- The introduction of inputs and services does not exacerbate vulnerability or increase risk, e.g. by increasing competition for scarce natural resources or by damaging existing social networks (see guidance note 6).

- Inputs and services are purchased locally whenever possible, unless this would adversely affect local producers, markets or consumers (see guidance note 7).
- Food producers, processors and distributors receiving project inputs make appropriate use of them (see guidance notes 8-9).
- Responses understand the need for complementary inputs and services and provide these where appropriate.

Guidance notes

1. ***Viability of primary production:*** to be viable, food production strategies must have a reasonable chance of developing adequately and succeeding. This may be influenced by a wide range of factors including:
   - access to sufficient natural resources (farmland, pasture, water, rivers, lakes, coastal waters, etc.). The ecological balance should not be endangered, e.g. by over-exploitation of marginal lands, over-fishing, or pollution of water, especially in peri-urban areas;
   - levels of skills and capacities, which may be limited where communities are seriously affected by disease, or where education and training may be barred to some groups;
   - labour availability in relation to existing patterns of production and the timing of key agricultural activities;
   - availability of inputs and the nature and coverage of related services (financial, veterinary, agricultural extension), which may be provided by government institutions and/or other bodies;
   - the legality of specific activities or the affected groups' right to work e.g. controls on the collection of firewood or restrictions on rights of refugees to undertake paid work;
   - security because of armed conflict, destruction of transport infrastructure, landmines, threat of attack or banditry.

   Production should not adversely affect the access of other groups to life-sustaining natural resources such as water.

2. ***Technological development:*** 'new' technologies may include improved crop varieties or livestock species, new tools or fertilisers. As far as possible, food production activities should follow existing patterns and/or be linked with national development plans. New technologies should only be introduced during a disaster if they have previously been tested in the local area and are known to be appropriate. When introduced, new technologies should be accompanied by appropriate community consultations, provision of information, training and other relevant support. The capacity of extension services within local government departments, NGOs and others to facilitate this should be assessed and if necessary reinforced.

3. ***Improving choice:*** examples of interventions that offer producers greater choice include cash inputs or credit in lieu of, or to complement, productive inputs, and seed fairs that provide farmers with the opportunity to select seed of their choice. Production should not have negative nutritional implications, such as the replacement of food crops by cash crops. The provision of animal fodder during drought can provide a more direct human nutrition benefit to pastoralists than the provision of food assistance.

4. ***Timeliness and acceptability:*** examples of productive inputs include seeds, tools, fertiliser, livestock, fishing equipment, hunting implements, loans and credit facilities, market information, transport facilities, etc. The provision of agricultural inputs and veterinary services must be timed to coincide with the relevant agricultural and animal husbandry seasons; e.g. the provision of seeds and tools must precede the planting season. Emergency destocking of livestock during a drought should take place before excess livestock mortality occurs, while restocking should start when recovery is well assured, e.g. following the next rains.

5. ***Seeds:*** priority should be given to local seed, so that farmers can use their own criteria to establish quality. Local varieties should be approved by farmers and local agricultural staff. Seeds should be adaptable to local conditions and be resistant to disease. Seeds originating from outside the region need to be adequately certified and checked for appropriateness to local conditions. Hybrid seeds may be appropriate where farmers are familiar with them and have experience growing them. This can only be determined through consultation with the community. When seeds are provided free of charge, farmers may prefer hybrid seeds to local varieties

because these are otherwise costly to purchase. Government policies regarding hybrid seeds should also be complied with before distribution. Genetically modified (GMO) seeds should not be distributed unless they have been approved by the national or other ruling authorities.

6. ***Impact on rural livelihoods:*** primary food production may not be viable if there is a shortage of vital natural resources. Promoting production that requires increased or changed access to locally available natural resources may heighten tensions within the local population, as well as further restricting access to water and other essential needs. Care should be taken with the provision of financial resources, in the form of either grants or loans, since these may also increase the risk of local insecurity (see Food security standard 3, guidance note 5 on page 130). In addition, the free provision of inputs may disturb traditional mechanisms for social support and redistribution.

7. ***Local purchase of inputs:*** inputs and services for food production, such as livestock health services, seed, etc., should be obtained through existing in-country supply systems where possible. However, before embarking on local purchases the risk should be considered of project purchases distorting the market e.g. raising prices of scarce items.

8. ***Monitoring usage:*** indicators of the process and the outputs from food production, processing and distribution may be estimated e.g. area planted, quantity of seed planted per hectare, yield, number of offspring, etc. It is important to determine how producers use the project inputs i.e. verifying that seeds are indeed planted, and that tools, fertilisers, nets and fishing gear are used as intended. The quality of the inputs should also be reviewed in terms of their acceptability and producer preferences. Important for evaluation is consideration of how the project has affected food available to the household e.g. household food stocks, the quantity and quality of food consumed, or the amount of food traded or given away. Where the project aims to increase production of a specific food type, such as animal or fish products or protein-rich legumes, the households' use of these products should be investigated. The results of this type of analysis may be cross-validated with nutritional surveys (provided health and care determinants of nutritional status are also considered).

9. ***Unforeseen or negative effects of inputs:*** for example, the effect of changes in labour patterns in subsequent agricultural seasons, the effect of responses on alternative and existing coping strategies (e.g. diversion of labour), labour patterns of women and effect on child care, school attendance and effect on education, risks taken in order to access land and other essential resources.

Food security standard 3: income and employment

Where income generation and employment are feasible livelihood strategies, people have access to appropriate income-earning opportunities, which generate fair remuneration and contribute towards food security without jeopardising the resources on which livelihoods are based.

Key indicators (to be read in conjunction with the guidance notes)

- Project decisions about timing, work activities, type of remuneration and the technical feasibility of implementation are based on a demonstrated understanding of local human resource capacities, a market and economic analysis, and an analysis of demand and supply for relevant skills and training needs (see guidance notes 1-2).
- Responses providing job or income opportunities are technically feasible and all necessary inputs are available on time. Where possible, responses contribute to the food security of others and preserve or restore the environment.
- The level of remuneration is appropriate, and payments for waged labour are prompt, regular and timely. In situations of acute food insecurity, payments may be made in advance (see guidance note 3).
- Procedures are in place to provide a safe, secure working environment (see guidance note 4).
- Projects involving large sums of cash include measures to avoid diversion and/or insecurity (see guidance note 5).

- Responses providing labour opportunities protect and support household caring responsibilities, and do not negatively affect the local environment or interfere with regular livelihood activities (see guidance note 6).
- The household management and use of remuneration (cash or food), grants or loans are understood and seen to be contributing towards the food security of all household members (see guidance note 7).

Guidance notes

1. ***Appropriateness of initiatives:*** project activities should make maximum use of local human resources in project design and the identification of appropriate activities. As far as possible, food-for-work (FFW) and cash-for-work (CFW) activities should be selected by, and planned with, the participating groups themselves. Where there are large numbers of displaced people (refugees or IDPs), employment opportunities should not be at the expense of the local host population. In some circumstances, employment opportunities should be made available to both groups. Understanding household management and use of cash is important in deciding whether and in what form microfinance services could support food security (see also Food security standard 2).
2. ***Type of remuneration:*** remuneration may be in cash or in food, or a combination of both, and should enable food-insecure households to meet their needs. Rather than payment, remuneration may often take the form of an incentive provided to help people to undertake tasks that are of direct benefit to themselves. FFW may be preferred to CFW where markets are weak or unregulated, or where little food is available. FFW may also be appropriate where women are more likely to control the use of food than of cash. CFW is preferred where trade and markets can assure the local availability of food, and secure systems for dispersal of cash are available. People's purchasing needs, and the impact of giving either cash or food on other basic needs (school attendance, access to health services, social obligations) should be considered. The type and level of remuneration should be decided on a case-by-case basis, taking account of the above and the availability of cash and food resources.

3. ***Payments:*** levels of remuneration should take account of the needs of the food-insecure households and of local labour rates. There are no universally accepted guidelines for setting levels of remuneration, but where remuneration is in kind and provided as an income transfer, the resale value of the food on local markets must be considered. The net gain to individuals in income through participation in the programme activities should be greater than if they had spent their time on other activities. This applies to FFW, CFW and also credit, business start-ups, etc. Income-earning opportunities should enhance the range of income sources, and not take the place of existing sources. Remuneration should not have a negative impact on local labour markets e.g. by causing wage rate inflation, diverting labour from other activities or undermining essential public services.

4. ***Risk in the work environment:*** a high-risk working environment should be avoided, by introducing practical procedures for minimising risk or treating injuries e.g. briefings, first aid kits, protective clothing where necessary. This should include risk of HIV exposure, and measures should be taken to minimise this.

5. ***Risk of insecurity and diversion:*** handing out cash, e.g. in the distribution of loans or payment of remuneration for work done, introduces security concerns for both programme staff and the recipients. A balance has to be achieved between security risks to both groups, and a range of options should be reviewed. For ease of access and safety of recipients, the point of distribution should be as close as possible to their homes, i.e. decentralised, though this may jeopardise the safety of programme staff. If a high level of corruption or diversion of funds is suspected, FFW may be preferable to CFW.

6. ***Caring responsibilities and livelihoods:*** participation in income-earning opportunities should not undermine child care or other caring responsibilities as this could increase the risk of malnutrition. Programmes may need to consider employing care providers or providing care facilities (see General nutrition support standard 2 on page 140). Responses should not adversely affect access to other opportunities, such as other employment or education, or divert household resources from productive activities already in place.

7. ***Use of remuneration:*** fair remuneration means that the income generated contributes a significant proportion of the resources necessary for food security. The household management of cash or food inputs (including intra-household distribution and end uses) must be understood, as the way cash is given may either defuse or exacerbate existing tensions, and thereby affect food security and the nutrition of household members. Responses that generate income and employment often have multiple food security objectives, including community-level resources that affect food security. For example, repairing roads may improve access to markets and access to health care, while repairing or constructing water-harvesting and irrigation systems may improve productivity.

Food security standard 4: access to markets

People's safe access to market goods and services as producers, consumers and traders is protected and promoted.

Key indicators (to be read in conjunction with the guidance notes)

- Food security responses are based on a demonstrated understanding of local markets and economic systems, which informs their design and, where necessary, leads to advocacy for system improvement and policy change (see guidance notes 1-2).
- Producers and consumers have economic and physical access to operating markets, which have a regular supply of basic items, including food at affordable prices (see guidance note 3).
- Adverse effects of food security responses, including food purchases and distribution, on local markets and market suppliers are minimised where possible (see guidance note 4).
- There is increased information and local awareness of market prices and availability, of how markets function and the policies that govern this (see guidance note 5).
- Basic food items and other essential commodities are available (see guidance note 6).

- The negative consequences of extreme seasonal or other abnormal price fluctuations are minimised (see guidance note 7).

Guidance notes

1. ***Market analysis:*** the types of market – local, regional, national – and how they are linked to each other should be reviewed. Consideration should be given to access to functioning markets for all affected groups, including vulnerable groups. Responses that remunerate in food, or provide inputs, such as seeds, agricultural tools, shelter materials, etc., should be preceded by a market analysis in relation to the commodity supplied. Local purchase of any surpluses will support local producers. Imports are likely to reduce local prices. Where inputs such as seeds may not be available on the open market, despite still being accessible to farmers through their own seed supply networks and systems, consideration should be given to the effect of external inputs on such systems.

2. ***Advocacy:*** markets operate in the wider national and global economies, which influence local market conditions. For example, governmental policies, including pricing and trade policies, influence access and availability. Although actions at this level are beyond the scope of disaster response, analysis of these factors is necessary as there may be opportunities for a joint agency approach, or advocacy to government and other bodies to improve the situation.

3. ***Market demand and supply:*** economic access to markets is influenced by purchasing power, market prices and availability. Affordability depends on the terms of trade between basic needs (including food, essential agricultural inputs such as seeds, tools, health care, etc.) and income sources (cash crops, livestock, wages, etc). Erosion of assets occurs when deterioration in terms of trade forces people to sell assets (often at low prices) in order to buy basic needs (at inflated prices). Access to markets may also be influenced by the political and security environment, and by cultural or religious considerations, which restrict access by certain groups (such as minorities).

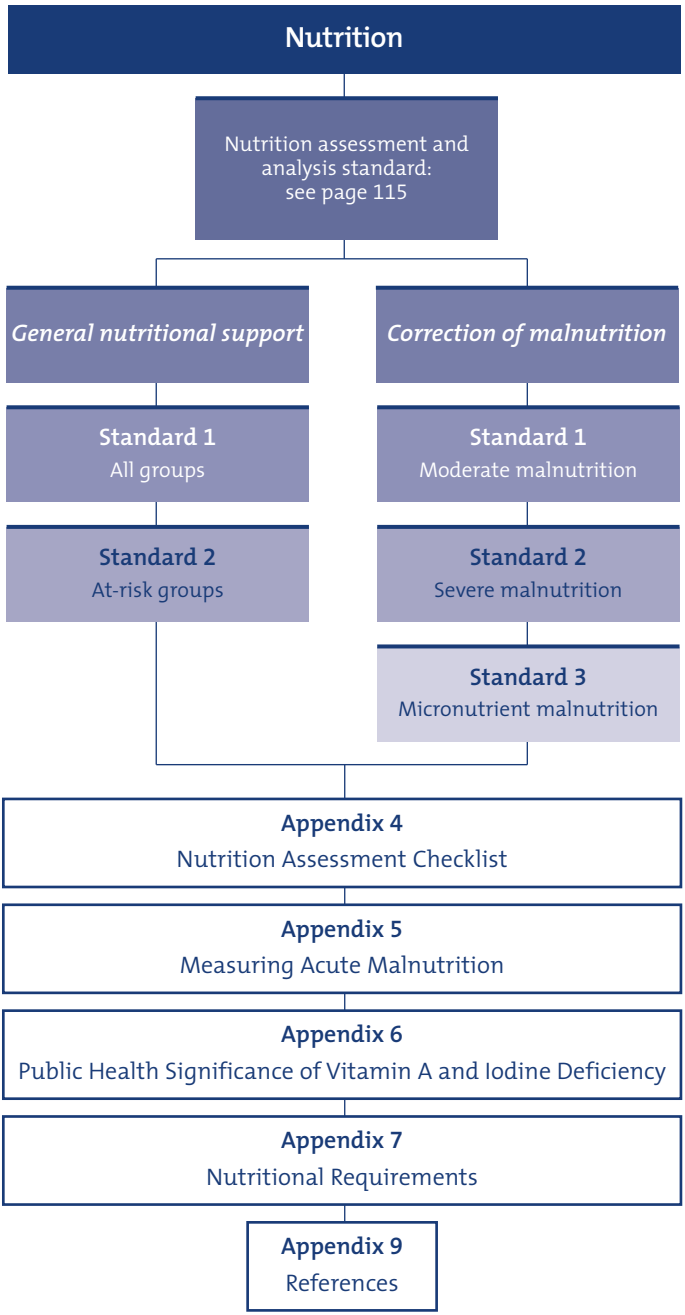
4. ***Impact of interventions:*** local procurement of food, seeds or other commodities may cause local inflation to the disadvantage of consumers but to the benefit of local producers. Conversely, imported food aid may drive prices down and act as a disincentive to local food production,

increasing the numbers who are food-insecure. Those responsible for procurement should monitor and take account of these effects. Food distribution also affects the purchasing power of beneficiaries, as it is a form of income transfer. Some commodities are easier to sell for a good price than others, e.g. oil versus blended food. The 'purchasing power' associated with a given food or food basket will influence whether it is eaten or sold by the beneficiary household. An understanding of household sales and purchases is important in determining the wider impact of food distribution programmes (see also Food aid management standard 3).

5. ***Transparent market policies:*** local producers and consumers need to be aware of market pricing controls and other policies that influence supply and demand. These may include state pricing and taxation policies, policies influencing movement of commodities across regional boundaries, or local schemes to facilitate trade with neighbouring areas (although in many conflict situations clear policies on these issues may not necessarily exist).

6. ***Essential food items:*** selection of food items for market monitoring depends on local food habits and therefore must be locally determined. The principles of planning nutritionally adequate rations should be applied to deciding what food items are essential in a particular context (see General nutrition support standard 1 on page 137 and Food aid planning standard 1 on page 157).

7. ***Abnormally extreme seasonal price fluctuations*** may adversely affect poor agricultural producers, who have to sell their produce when prices are at their lowest (i.e. after harvest). Conversely, consumers who have little disposable income cannot afford to invest in food stocks, depending instead on small but frequent purchases. They are therefore forced to buy even when prices are high (e.g. during drought). Examples of interventions which can minimise these effects include improved transport systems, diversified food production and cash or food transfers at critical times.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3 Minimum Standards in Nutrition

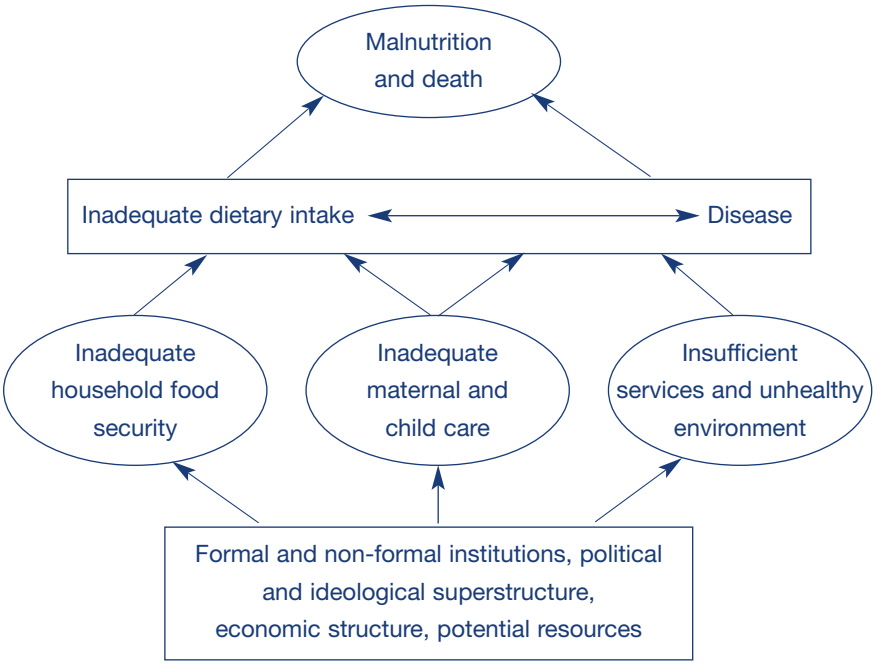
The immediate causes of malnutrition are disease and/or inadequate food intake, which in turn result from inadequate food, health or care at household or community levels.

The aim of preventive programmes is to ensure that the causes of malnutrition identified in the assessment are addressed. This includes ensuring that people have safe access to food of adequate quality and quantity, and have the means to prepare and consume it safely; ensuring that people's living environment, their access to, and the quality of health services (both preventive and curative) minimise their risk of disease; and ensuring that an environment exists in which care can be provided to nutritionally vulnerable members of the population. Care includes the provision within households and the community of time, attention and support to meet the physical, mental and social needs of household members. The protection of the social and care environment is addressed through the Food Aid and Food Security standards, while nutritional care and support for groups of the population that may be at increased risk are addressed in the Nutrition standards.

Programmes aiming to correct malnutrition may include special feeding programmes, medical treatment and/or supportive care for malnourished individuals. Feeding programmes should only be implemented when anthropometric surveys have been conducted or are planned. They should always be complemented by preventive measures.

The first two standards in this section deal with the nutritional issues relating to programmes that prevent malnutrition and should be used alongside the Food Aid and Food Security standards. The last three standards concern programmes that correct malnutrition.

Responses to prevent and correct malnutrition require the achievement of minimum standards both in this chapter and those in other chapters: health services, water supply and sanitation, and shelter. They also require the common standards detailed in chapter 1 to be achieved (see page 21). In other words, in order for the nutrition of all groups to be protected and supported, in a manner that ensures their survival and upholds their dignity, it is not sufficient to achieve only the standards in this section of the handbook.



Conceptual framework showing the causes of malnutrition

i) General Nutrition Support

This section considers the nutritional resources and services required to meet the needs of both the general population and specific groups that may be at increased nutritional risk. Until these needs are met, any response aimed at the correction of malnutrition is likely to have a limited impact, since those who recover will return to a context of inadequate nutritional support and are therefore likely to deteriorate again.

Where populations require food aid to meet some or all of their nutritional needs, General nutrition support standard 1 should be used alongside Food aid planning standards 1-2 on pages 157-160 and Non-food items standards 3-4 on pages 233-236. General nutrition support standard 2 focuses on at-risk groups. However, those who are vulnerable to a disaster vary according to the context and so the specific groups at risk should be identified in each situation.

General nutrition support standard 1: all groups

The nutritional needs of the population are met.

Key indicators (to be read in conjunction with the guidance notes)

- There is access to a range of foods – staple (cereal or tuber), pulses (or animal products) and fat sources – that meet nutritional requirements (see guidance note 1).
- There is access to vitamin A-, C- and iron-rich or fortified foods or appropriate supplements (see guidance notes 2, 3, 5 and 6).
- There is access to iodised salt for the majority (>90%) of households (see guidance notes 2, 3 and 6).
- There is access to additional sources of niacin (e.g. pulses, nuts, dried fish) if the staple is maize or sorghum (see guidance notes 2-3).
- There is access to additional sources of thiamine (e.g. pulses, nuts, eggs) if the staple is polished rice (see guidance notes 2-3).

- There is access to adequate sources of riboflavin where people are dependent on a very limited diet (see guidance notes 2-3).
- Levels of moderate and severe malnutrition are stable at, or declining to, acceptable levels (see guidance note 4).
- There are no cases of scurvy, pellagra, beri-beri or riboflavin deficiency (see guidance note 5).
- Rates of xerophthalmia and iodine deficiency disorders are not of public health significance (see guidance note 6).

Guidance notes

1. ***Nutritional requirements:*** the following estimates for average population requirements should be used, with the figures adjusted for each population as described in Appendix 7.

   – 2,100 kcals per person per day

   – 10-12% of total energy provided by protein

   – 17% of total energy provided by fat

   – adequate micronutrient intake through fresh or fortified foods.

   It should be noted that these are the requirements for food aid provision only if the population is entirely dependent on food aid to meet its nutritional requirements. In situations where people can meet some of their nutritional needs themselves, food aid provision should be adjusted accordingly, based on the assessment. For planning food rations, see Food aid planning standard 1 on page 157.

2. ***Preventing micronutrient diseases:*** if these indicators are met, then deterioration of the micronutrient status of the population should be prevented, provided adequate public health measures are in place to prevent diseases such as measles, malaria and parasitic infection (see Control of communicable diseases standards on page 273). Possible options for the prevention of micronutrient deficiencies include food security measures to promote access to nutritious foods (see Food security standards 2-3 on pages 124-131); improving the nutritional quality of the ration through fortification or inclusion of blended foods or locally purchased commodities to provide nutrients otherwise missing;

and/or medicinal supplementation. Micronutrient losses which can occur during transport, storage, processing and cooking should be taken into account. Exceptionally, where nutrient-rich foods are available locally, increasing the quantity of food in any general ration to allow more food exchanges may be considered, but cost-effectiveness and impact on markets must be taken into account.

3. ***Monitoring access to micronutrients:*** the indicators measure the quality of the diet but do not quantify nutrient availability. Measuring the quantity of nutrient intake would impose unrealistic requirements for information collection. Indicators can be measured using information from various sources gathered by different techniques. These might include monitoring food availability and use at the household level; assessing food prices and food availability on the markets; assessing the nutrient content of any distributed food; examining food aid distribution plans and records; assessing any contribution of wild foods; and conducting food security assessments. Household-level analysis will not determine individual access to food. Intra-household food allocation may not always be equitable and vulnerable groups may be particularly affected, but this is not practical to measure. Distribution mechanisms (see Food aid management standard 3 on page 168), the choice of food aid commodities and discussion with the affected population could contribute to improved intra-household allocation.

4. ***Interpreting levels of malnutrition:*** trends in malnutrition might be indicated by health centre records, repeat anthropometric surveys, nutritional surveillance, screening or reports from the community. It may be expensive to set up systems to monitor malnutrition rates over large areas or long periods of time, and technical expertise is required. The relative cost of such a system should be judged against the scale of resourcing. A combination of complementary information systems, e.g. both surveillance and intermittent surveys, may be the most effective use of resources. Wherever possible, local institutions and communities should participate in monitoring activities, interpretation of findings and the planning of any response. Determining whether levels of malnutrition are acceptable requires analysis of the situation in the light of the reference population, morbidity and mortality rates (see Health systems and infrastructure standard 1, guidance note 3 on page 260), seasonal fluctuations, pre-emergency levels of malnutrition and the underlying causes of malnutrition.

5. ***Epidemic micronutrient deficiencies:*** four micronutrient deficiencies – scurvy (vitamin C), pellagra (niacin), beri-beri (thiamine) and riboflavin – have been highlighted, as these are the most commonly observed deficiencies to result from inadequate access to micronutrients in food aid-dependent populations and are usually avoidable in a disaster situation. If individuals with any of these deficiencies present at health centres, for example, it is likely to be as a result of restricted access to certain types of food and probably indicative of a population-wide problem. As such, deficiencies should be tackled by population-wide interventions as well as individual treatment (see Correction of malnutrition standard 3 on page 152). In any context where there is clear evidence that these micronutrient deficiencies are an endemic problem, their levels should be reduced at least to pre-disaster levels.
6. ***Endemic micronutrient deficiencies:*** tackling micronutrient deficiencies within the initial phase of a disaster is complicated by difficulties in identifying them. The exceptions are xerophthalmia (vitamin A) and goitre (iodine) for which clear 'field-friendly' identification criteria are available. These deficiencies can also be tackled by population-level interventions, e.g. high-dose vitamin A supplementation for children and post-partum women, salt iodisation and public awareness campaigns. See Appendix 6 for definitions of their public health significance.

General nutrition support standard 2: at-risk groups

The nutritional and support needs of identified at-risk groups are met.

Key indicators (to be read in conjunction with the guidance notes)

- Infants under six months are exclusively breastfed or, in exceptional cases, have access to an adequate amount of an appropriate breast milk substitute (see guidance notes 1-2).
- Children aged 6-24 months have access to nutritious, energy-dense complementary foods (see guidance note 3).
- Pregnant and breastfeeding women have access to additional nutrients and support (see guidance note 4).

- Specific attention is paid to the protection, promotion and support of the care and nutrition of adolescent girls (see guidance note 4).
- Appropriate nutritional information, education and training is given to relevant professionals, care givers and organisations on infant and child feeding practices (see guidance notes 1-4 and 8).
- Older people's access to appropriate nutritious foods and nutritional support is protected, promoted and supported (see guidance note 5).
- Families with chronically ill members, including people living with HIV/AIDS, and members with specific disabilities have access to appropriate nutritious food and adequate nutritional support (see guidance notes 6-8).
- Community-based systems are in place to ensure appropriate care of vulnerable individuals (see guidance note 8).

Guidance notes

1. ***Infant feeding:*** exclusive breastfeeding is the healthiest way to feed a baby under six months. Babies who are exclusively breastfed receive no prelactates, water, teas or complementary foods. Rates of exclusive breastfeeding are typically low and so it is important to promote and support breastfeeding, especially when hygiene and care practices have broken down and the risk of infection is high. There are exceptional cases where a baby cannot be exclusively breastfed (such as where the mother has died or the baby is already fully artificially fed). In these cases adequate amounts of an appropriate breast milk substitute should be used, judged according to the Codex Alimentarius standards, and relactation encouraged where possible. Breast milk substitutes can be dangerous because of the difficulties involved in safe preparation. Feeding bottles should never be used, as they are unhygienic. Professionals should be trained in providing adequate protection, promotion and support for breastfeeding, including relactation. If infant formula is distributed, care givers will need advice and support on its safe use. Procurement and distribution must adhere to the International Code of Marketing of Breastmilk Substitutes and relevant World Health Assembly resolutions.

2. ***HIV and infant feeding:*** if voluntary and confidential testing for HIV/AIDS is not possible, all mothers should be supported to breastfeed. Alternatives to breast milk are too risky to offer if a woman does not know her status. If a woman has been tested and knows she is HIV-positive, replacement feeding is recommended if it can be done in a way that is acceptable, feasible, affordable, sustainable and safe. HIV-positive mothers who choose not to breastfeed should be provided with specific guidance and support for at least the first two years of the child's life to ensure adequate feeding.

3. ***Young child feeding:*** breastfeeding should continue for at least the first two years of life. At the age of six months, young children require energy-dense foods in addition to breast milk; it is recommended that 30% of the energy content of their diet comes from fat sources. Where children aged 6-24 months do not have access to breast milk, foods must be sufficient to meet all their nutritional requirements. Efforts should be made to provide households with the means and skills to prepare appropriate complementary foods for children under 24 months. This may be through the provision of specific food commodities or of utensils, fuel and water. When measles or other immunisation is carried out, it is usual practice to provide a vitamin A supplement to all children aged 6-59 months. Low birth-weight infants and young children can also benefit from iron supplementation, though compliance with daily protocols is very difficult to maintain.

4. ***Pregnant and breastfeeding women:*** the risks associated with inadequate nutrient intakes for pregnant and breastfeeding women include pregnancy complications, maternal mortality, low birth weight and impaired breastfeeding performance. The average planning figures for general rations take into account the additional needs of pregnant and breastfeeding women. When the general ration is inadequate, supplementary feeding to prevent nutritional deterioration may be necessary. Low body weight at conception is strongly associated with low birth weight which means that, where they exist, mechanisms for providing nutritional support to adolescent girls should be used. Pregnant and breastfeeding women should receive daily supplements of iron and folic acid but as with children, compliance can be problematic. It is therefore important to ensure that steps are taken to reduce the prevalence of iron deficiency through a diversified diet (see General

nutrition support standard 1). Post-partum women should also receive vitamin A within six weeks of delivery.

5. ***Older people*** can be particularly affected by disasters. Nutritional risk factors which reduce access to food and can increase nutrient requirements include disease and disability, psychosocial stress, cold and poverty. These factors can be exacerbated when normal support networks, either formal or informal, are disrupted. While the average planning figures for general rations take into account the nutritional requirements of older people, special attention should be paid to their nutritional and care needs. Specifically:

   – older people should be able to easily access food sources (including relief food);

   – foods should be easy to prepare and consume;

   – foods should meet the additional protein and micronutrient requirements of older people.

   Older people are often important care givers to other household members and may need specific support in fulfilling this function.

6. ***People living with HIV/AIDS (PLWH/A)*** may face greater risk of malnutrition, because of a number of factors. These include reduced food intake due to appetite loss or difficulties in eating; poor absorption of nutrients due to diarrhoea; parasites or damage to intestinal cells; changes in metabolism; and chronic infections and illness. There is evidence to show that the energy requirements of PLWH/A increase according to the stage of the infection. Micronutrients are particularly important in preserving immune function and promoting survival. PLWH/A need to ensure that they keep as well nourished and healthy as possible to delay the onset of AIDS. Milling and fortification of food aid or provision of fortified, blended foods are possible strategies for improving their access to an adequate diet and in some situations it may be appropriate to increase the overall size of any food ration (see Targeting standard on page 35).

7. ***Disabled people*** may face a range of nutritional risks which can be further exacerbated by the environment in which they are living. Nutritional risks include difficulties in chewing and swallowing, leading to reduced food intake and choking; inappropriate position/posture when feeding;

reduced mobility affecting food access and access to sunlight (affecting vitamin D status); discrimination affecting food access; and constipation, particularly affecting individuals with cerebral palsy. Disabled individuals may be at particular risk of being separated from immediate family members (and usual care givers) in a disaster. Efforts should be made to determine and reduce these risks by ensuring physical access to food (including relief food), developing mechanisms for feeding support (e.g. provision of spoons and straws, developing systems for home visiting or outreach) and access to energy-dense foods.

8. ***Community-based care:*** care givers and those they are caring for may have specific nutritional needs: e.g. they may have less time to access food because they are ill/caring for the ill; they may have a greater need to maintain hygienic practices which may be compromised; they may have fewer assets to exchange for food due to the costs of treatment or funerals; and they may face social stigma and reduced access to community support mechanisms. The availability of care givers may have changed as a consequence of the disaster e.g. due to family break-up or death, children and older people can become the main care givers. It is important that care givers be supported and not undermined in the care of vulnerable groups; this includes feeding, hygiene, health and psychosocial support and protection. Existing social networks can be used to provide training to selected community members to take on responsibilities in these areas.

ii) Correction of Malnutrition

Malnutrition, including micronutrient deficiency, is associated with increased risk of morbidity and mortality for affected individuals. Therefore, when rates of malnutrition are high, it is necessary to ensure access to services which correct as well as prevent malnutrition. The impact of these services will be considerably reduced if appropriate general support for the population is not in place – for example, if there is a failure in the general food pipeline, or acute food insecurity, or if supplementary feeding without general support is being done for security reasons. In these instances, advocacy for general nutritional support should be a key element of the programme (see Response standard on page 33).

There are many ways to address moderate malnutrition, for example through the improvement of the general food ration, improving food security, improving access to health care and to sanitation and potable water. In disasters, targeted supplementary feeding is often the primary strategy for correction of moderate malnutrition and prevention of severe malnutrition (standard 1). In some instances, rates of malnutrition may be so high that it may be inefficient to target the moderately malnourished and all individuals meeting certain at-risk criteria (e.g. those aged 6-59 months) may be eligible. This is known as blanket supplementary feeding.

Severe malnutrition is corrected through therapeutic care which can be delivered through a variety of approaches, including 24-hour in-patient care, day care and home-based care (standard 2). The provision of in-patient care relies on other standards being achieved, such as the provision of functioning water and sanitation facilities (see Water, Sanitation and Hygiene Promotion, page 51). The correction of micronutrient deficiencies (standard 3) relies on the achievement of standards in health systems and infrastructure and control of communicable diseases (see Health Services, page 249).

Correction of malnutrition standard 1: moderate malnutrition

Moderate malnutrition is addressed.

Key indicators (to be read in conjunction with the guidance notes)

- From the outset, clearly defined and agreed objectives and criteria for set-up and closure of the programme are established (see guidance note 1).
- Coverage is >50% in rural areas, >70% in urban areas and >90% in a camp situation (see guidance note 2).
- More than 90% of the target population is within <1 day's return walk (including time for treatment) of the distribution centre for dry

ration supplementary feeding programmes and no more than 1 hour's walk for on-site supplementary feeding programmes (see guidance note 2).

- The proportion of exits from targeted supplementary feeding programmes who have died is <3%, recovered is >75% and defaulted is <15% (see guidance note 3).
- Admission of individuals is based on assessment against internationally accepted anthropometric criteria (see guidance note 4 and Appendix 5).
- Targeted supplementary feeding programmes are linked to any existing health structure and protocols are followed to identify health problems and refer accordingly (see guidance note 5).
- Supplementary feeding is based on the distribution of dry take-home rations unless there is a clear rationale for on-site feeding (see guidance note 6).
- Monitoring systems are in place (see guidance note 7).

Guidance notes

1. ***Design of targeted supplementary feeding:*** programme design must be based on an understanding of the complexity and dynamics of the nutrition situation. Targeted supplementary feeding programmes should only be implemented when anthropometric surveys have been conducted or are planned and if the underlying causes of moderate malnutrition are being addressed simultaneously. Targeted supplementary feeding programmes may be implemented in the short term, before General nutrition support standard 1 is met. The purpose of the programme should be clearly communicated and discussed with the target population (see Participation standard on page 28).
2. ***Coverage*** is calculated in relation to the target population, defined at the start of the programme, and can be estimated as part of an anthropometric survey. It can be affected by the acceptability of the programme, location of distribution points, security for staff and those requiring treatment, waiting times, service quality and the extent of home visiting. Distribution centres

should be close to the targeted population, to reduce the risks and costs associated with travelling long distances with young children and the risk of people being displaced to them. Affected communities should be involved in deciding where to locate distribution centres. The final decision should be based on wide consultation and on non-discrimination.

3. ***Exit indicators:*** exits from a feeding programme are those individuals no longer registered. The total of exited individuals is made up of those who have defaulted, recovered (including those who are referred) and died.

   Proportion of exits defaulted =
   number of defaulters in the programme x 100%
   number of exits

   Proportion of exits died =
   number of deaths in the programme x 100%
   number of exits

   Proportion of exits recovered =
   number of individuals successfully discharged in the programme x 100%
   number of exits.

4. ***Admission criteria:*** individuals other than those who meet anthropometric criteria defining malnutrition may also benefit from supplementary feeding e.g. people living with HIV/AIDS or TB or those who have a disability. Monitoring systems will need to be adjusted if these individuals are included. In situations where emergency feeding programmes are overwhelmed with the numbers of individuals eligible for treatment, this may not be the best way to address the needs of these individuals, who will also remain at risk beyond the duration of the disaster. It may be better to identify alternative mechanisms for providing longer-term nutritional support e.g. through community home-based support or TB treatment centres.

5. ***Health inputs:*** targeted supplementary feeding programmes should include appropriate medical protocols such as the provision of anti-helminths, vitamin A supplementation and immunisations, but delivery of these services should take into account the capacity of existing health services. In areas where there is a high prevalence of particular diseases (e.g. HIV/AIDS), the quality and quantity of the supplementary food should be given special consideration.

6. ***On-site feeding:*** dry take-home rations, distributed on a weekly or bi-weekly basis, are preferred to on-site feeding but their size should take into account household sharing. On-site feeding may be considered only where security is a concern. Where fuel, water or cooking utensils are in short supply, such as in populations which are displaced or on the move, distributions of ready-to-eat foods may be considered in the short term, provided they do not disrupt traditional feeding patterns. For take-home feeding, clear information should be given on how to prepare supplementary food in a hygienic manner, how and when it should be consumed and the importance of continued breastfeeding for children under 24 months of age (see Food aid management standard 3 on page 168).

7. ***Monitoring systems:*** systems should monitor community participation, acceptability of the programme (a good measure of this is the rate of defaulting), rates of readmission, the quantity and quality of food being provided, programme coverage, admission and discharge rates and external factors such as morbidity patterns, levels of malnutrition in the population, level of food insecurity in households and in the community, and the capacity of existing systems for service delivery. Individual causes of readmission, defaulting and failure to recover should be investigated on an ongoing basis.

Correction of malnutrition standard 2: severe malnutrition

Severe malnutrition is addressed.

Key indicators (to be read in conjunction with the guidance notes)

- From the outset, clearly defined and agreed criteria for set-up and closure of the programme are established (see guidance note 1).
- Coverage is >50% in rural areas, >70% in urban areas and >90% in camp situations (see guidance note 2).
- The proportion of exits from therapeutic care who have died is <10%, recovered is >75% and defaulted is <15% (see guidance notes 3-5).

- Discharge criteria include non-anthropometric indices such as good appetite and the absence of diarrhoea, fever, parasitic infestation and other untreated illness (see guidance note 4).
- Mean weight gain is >8g per kg per person per day (see guidance note 6).
- Nutritional and medical care is provided according to internationally recognised therapeutic care protocols (see guidance note 7).
- As much attention is attached to breastfeeding and psychosocial support, hygiene and community outreach as to clinical care (see guidance note 8).
- There should be a minimum of one feeding assistant for 10 in-patients.
- Constraints to caring for malnourished individuals and affected family members should be identified and addressed (see guidance note 9).

Guidance notes

1. ***Starting therapeutic care:*** factors which should be taken into account in the opening of centres for the treatment of severe malnutrition are the numbers and geographical spread of affected individuals; the security situation; recommended criteria for setting up and for closing centres; and the capacity of existing health structures. Therapeutic feeding programmes should not undermine the capacity of health systems, nor allow governments to abdicate their responsibilities for providing services. Wherever possible, programmes should aim to build on and strengthen existing capacity to treat severe malnutrition. The purpose of the programme should be clearly communicated and discussed with the target population (see Participation standard on page 28). A therapeutic care programme should only be started if there is a plan in place for remaining patients, at the end of the programme, to complete their treatment.
2. ***Coverage*** is calculated according to the target population and can be estimated as part of an anthropometric survey. It can be affected by the acceptability of the programme, location of treatment centres, security for staff and those requiring treatment, waiting times and service quality.

3. ***Exit indicators:*** the time needed to achieve the exit indicators for a therapeutic feeding programme is 1-2 months. Exits from a feeding programme are those no longer registered. The population of exited individuals is made up those who have defaulted, recovered (including those who are referred) and died (see previous standard, guidance note 3 for how to calculate exit indicators). Mortality rates should be interpreted in the light of coverage rates and the severity of malnutrition treated. The extent to which mortality rates are affected in situations where a high proportion of admissions are HIV-positive is unknown; for this reason, the figures have not been adjusted for these situations.

4. ***Recovery rates:*** a discharged individual must be free from medical complications and have achieved and maintained sufficient weight gain (e.g. for two consecutive weighings). Established protocols suggest discharge criteria which should be adhered to, in order to avoid the risks associated with premature exit from the programme. Protocols also define limits for the mean length of stay for patients in therapeutic feeding, aimed at avoiding prolonged recovery periods (e.g. typical lengths of stay may be 30-40 days). HIV/AIDS and TB may result in some malnourished individuals failing to recover. Options for longer-term treatment or care should be considered in conjunction with health services and other social and community support (see Control of communicable disease standards 3 and 6, pages 277 and 283). Causes of readmission, defaulting and failure to respond should be investigated and documented on an ongoing basis. Individuals should be followed up wherever possible after discharge and referred for supplementary feeding where possible.

5. ***Default rates*** can be high when the programme is not accessible to the population. Accessibility may be affected by the distance of the treatment point from the community, an ongoing armed conflict, a lack of security, the level of support offered to the care giver of the individual treated, the number of care givers who are left at home to look after other dependants (this may be very few in situations of high HIV/AIDS prevalence), and the quality of the care provided. A defaulter from a therapeutic feeding programme is an individual who has not attended for a defined period of time (e.g. for more than 48 hours for in-patients).

6. ***Weight gain:*** similar rates of weight gain can be achieved in both adults and children when they are given similar diets. Average rates of weight gain, however, may mask situations where individual patients are not

improving and are not being discharged. Lower rates may be more acceptable in out-patient programmes because the risks and demands on the community, e.g. in terms of time, can be much lower. Mean weight gain is calculated as follows: (weight on exit (g) minus weight on admission (g))/(weight on admission (kg)) x duration of treatment (days).

7. ***Protocols:*** internationally accepted protocols, including definitions of failure to respond, are found in the references in Appendix 9. In order to implement treatment protocols, clinical staff require special training (see Health systems and infrastructure standards, page 258). Individuals admitted for therapeutic care who are tested or suspected to be HIV-positive should have equal access to care if they meet the criteria for admission. This is also applicable to TB cases. PLWH/A who do not meet admission criteria often require nutritional support, but this is not best offered in the context of treatment for severe malnutrition in disasters. These individuals and their families should be supported through a range of services including community home-based care, TB treatment centres and prevention programmes aimed at mother-to child-transmission.

8. ***Breastfeeding and psychosocial support:*** breastfeeding mothers require special attention to support lactation and optimal infant and young child feeding. A breastfeeding corner may be set up for this purpose. Emotional and physical stimulation through play is important for severely malnourished children during the rehabilitation period. Care givers of severely malnourished children often require social and psychosocial support to bring their children for treatment. This may be achieved through outreach and mobilisation programmes (see General nutrition support standard 2).

9. ***Carers:*** all carers of severely malnourished individuals should be enabled to feed and care for them during treatment through the provision of advice, demonstrations and health and nutrition information. Programme staff should be aware that discussions with care givers may expose individual human rights violations (e.g. deliberate starvation of populations by warring parties) and they should be trained in procedures for dealing with such situations.

Correction of malnutrition standard 3: micronutrient malnutrition

Micronutrient deficiencies are addressed.

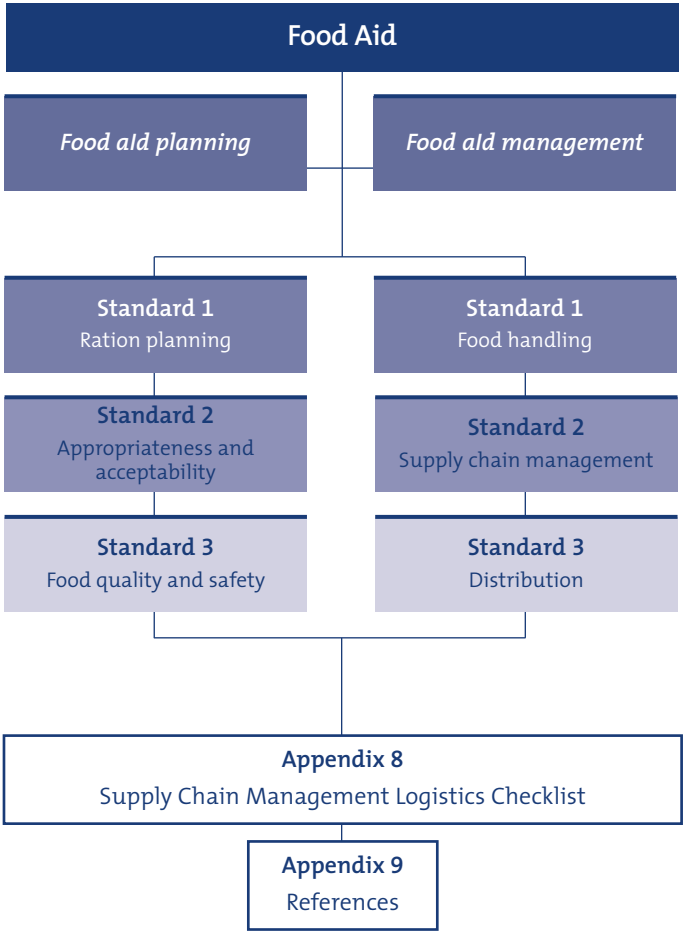
Key indicators (to be read in conjunction with the guidance notes)

- All clinical cases of deficiency diseases are treated according to WHO micronutrient supplementation protocols (see guidance note 1).
- Procedures are established to respond efficiently to micronutrient deficiencies to which the population may be at risk (see guidance note 2).
- Health staff are trained in how to identify and treat micronutrient deficiencies to which the population is most at risk (see guidance note 2).

Guidance notes

1. ***Diagnosis and treatment:*** diagnosis of some micronutrient deficiencies is possible through simple clinical examination. Indicators of these deficiencies can then be incorporated into health or nutritional surveillance systems, although careful training of staff is required to ensure that assessment is accurate. Other micronutrient deficiencies cannot be identified without biochemical examination. In such instances, case definition is problematic and in emergencies can often only be determined through the response to supplementation by individuals who present themselves to health staff. Treatment of micronutrient deficiencies or those at risk of deficiency due to disease should take place in the health system and within feeding programmes.
2. ***Preparedness:*** strategies for the prevention of micronutrient deficiencies are given in General nutrition support standard 1. Prevention can also be achieved through the reduction of the incidence of diseases such as acute respiratory infection, measles, parasitic infection, malaria and diarrhoea that deplete micronutrient stores (see Control of communicable diseases

standards on page 273). Treatment of deficiencies will involve active case finding and the development of case definitions and protocols for treatment.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4 Minimum Standards in Food Aid

If a community's normal means of accessing food is compromised by disaster (for example, through loss of crops due to natural disaster, deliberate starvation by a party to an armed conflict, commandeering of food by soldiers, or forced or non-forced displacement), a food aid response may be required to sustain life, protect or restore people's self-reliance, and reduce the need for them to adopt potentially damaging coping strategies.

Whenever analysis determines that food aid is an appropriate response, this should be undertaken in a manner that meets short-term needs but also, as far as possible, contributes to restoring long-term food security. The following should be taken into account.

- General (free) distributions are introduced only when absolutely necessary, targeted to those who need the food most, and discontinued as soon as possible.
- Dry rations for home preparation are provided wherever possible. Mass feeding (the provision of cooked food that is eaten on the spot) is organised only for an initial short period following a major sudden disaster or population movement when people do not have the means to cook for themselves, or in a situation of insecurity when the distribution of dry rations could put recipients at risk.
- Food assistance to refugees and IDPs is based on assessment of their situation and needs, not on their status as refugees or IDPs.
- Food commodities are imported only when there is an in-country deficit or no practical possibility of moving available surpluses into the disaster-affected area.

- Where there is a risk of food aid being commandeered or used by combatants in an armed conflict, measures are put in place to avoid it fuelling the conflict.

Arrangements for food aid distribution must be particularly robust and accountable in view of the high value and high volume involved in most disaster relief programmes. Delivery and distribution systems should be monitored at all stages, including at the community level. Programme evaluation should be carried out regularly, and findings disseminated to and discussed with all stakeholders, including the affected population.

The six Food Aid standards are divided into two sub-categories. Food Aid Planning covers ration planning, appropriateness and acceptability of food, and food quality and safety. Food Aid Management deals with food handling, supply chain management and distribution. Appendix 8 at the end of the chapter provides a logistics checklist for supply chain management purposes.

i) Food Aid Planning

Initial assessment and analysis of an emergency situation should identify people's own food and income sources, as well as any threats to those sources. It should determine whether food aid is required and, if so, the type and quantity needed to ensure that people are able to maintain an adequate nutritional status. When it is determined that free distribution of food is necessary, an appropriate general ration must be established to enable households to meet their nutritional needs, taking account of the food they are able to provide for themselves without adopting damaging coping strategies (see Food security analysis standard 1, guidance note 3 on page 113 and Food security standard 1, guidance note 3 on page 122).

When it is determined that a supplementary feeding programme (SFP) is needed, an appropriate supplementary ration must be established. In such cases, the SFP ration is in addition to any general ration to which individuals are entitled (see Correction of malnutrition standard 1, guidance note 1 on page 147).

In all cases, the commodities provided must be carefully chosen, in consultation with the affected population. They must be of good quality, safe to consume, and appropriate and acceptable to recipients.

Food aid planning standard 1: ration planning

Rations for general food distributions are designed to bridge the gap between the affected population's requirements and their own food resources.

Key indicators (to be read in conjunction with the guidance notes)

- Rations for general distribution are designed on the basis of the standard initial planning requirements for energy, protein, fat and micronutrients, adjusted as necessary to the local situation (see guidance note 1; see also General nutrition support standards on pages 137-144 and Appendix 7).
- The ration distributed reduces or eliminates the need for disaster-affected people to adopt damaging coping strategies.
- When relevant, the economic transfer value of the ration is calculated and is appropriate to the local situation (see guidance note 2).

Guidance notes

1. ***Nutritional requirements:*** where people are displaced and have no access to any food at all, the distributed ration should meet their total nutritional requirement. However, most disaster-affected populations are able to obtain some food by their own means. Rations should then be planned to make up the difference between the nutritional requirement and what people can provide for themselves. Thus, if the standard requirement is 2,100 kcals/person/day and the assessment determines that people within the target population can, on average, acquire 500 kcals/person/day from their own efforts or resources, the ration should be designed to provide 2,100 – 500 = 1,600 kcals/person/day. Similar calculations should be made for fat and protein. Agreed estimates must

be established for the average quantities of food to which people have access (see Food security assessment standard on page 111).

2. ***Economic context:*** where little or no other food is available and people can be expected to consume all (or almost all) of any food distributed, the ration should be designed strictly on the basis of nutritional criteria, taking into account issues of acceptability and cost-effectiveness. Where other foods are available and beneficiaries may be expected to trade some of their ration to obtain them, the ration's transfer value becomes relevant. The transfer value is the local market value of the ration i.e. what it would cost to buy the same quantities of the same items on the local market.

Food aid planning standard 2: appropriateness and acceptability

The food items provided are appropriate and acceptable to recipients and can be used efficiently at the household level.

Key indicators (to be read in conjunction with the guidance notes)

- People are consulted during assessment or programme design on the acceptability, familiarity and appropriateness of food items, and results are factored into programme decisions on the choice of commodities (see guidance note 1).
- When an unfamiliar food is distributed, instructions on its preparation in a locally palatable manner, with minimum nutrient loss, are provided to women and other people who prepare food, preferably in the local language (see guidance note 1).
- People's ability to access cooking fuel and water, and the duration of cooking times and requirements for soaking, are considered when selecting commodities for distribution (see guidance note 2).
- When a whole grain cereal is distributed, recipients either have the means to mill or process it in a traditional home-based manner or have access to adequate milling/processing facilities reasonably close to their dwellings (see guidance note 3).

- People have access to culturally important items, including condiments (see guidance note 4).
- There is no distribution of free or subsidised milk powder or of liquid milk as a single commodity (see guidance note 5).

Guidance notes

1. ***Familiarity and acceptability:*** while nutritional value is the primary consideration when choosing commodities for a food basket, the foods distributed should be familiar to the recipients and consistent with their religious and cultural traditions, including any food taboos for pregnant or breastfeeding women. In assessment reports and requests to donors, the reasons for the choice of particular commodities or the exclusion of others should be explained. When there are acute survival needs and there is no access to cooking facilities, ready-to-eat foods must be provided. In these circumstances there may sometimes be no practical alternative to providing unfamiliar items. Only in such instances should special 'emergency rations' be considered.
2. ***Fuel requirements:*** when assessing food requirements, a fuel assessment should also be undertaken to ensure that recipients are able to cook food sufficiently to avoid adverse effects to their health, and without degradation of the environment through excessive collection of fuel wood. When necessary, appropriate fuel should be provided or a wood harvesting programme established that is supervised for the safety of women and children, who are the main gatherers of firewood. In general, items should be provided that do not require long cooking times or the use of large quantities of water. The provision of milled grain or of grain mills will reduce cooking times and the amount of fuel required.
3. ***Grain processing:*** milling is a particular concern for maize, as milled whole maize has a shelf life of only 6-8 weeks. Milling should therefore take place shortly before consumption. Where household-level grinding is part of the recipients' tradition, whole grain can be distributed. Whole grain has the advantage of a longer shelf life and may have a higher economic value for recipients. Alternatively, facilities for low-extraction commercial milling can be provided: this removes the germ, oil and enzymes, which cause rancidity. This greatly increases the shelf life of the grain, although at the

same time it reduces its protein content. National laws relating to the import and distribution of whole grain should be complied with.

4. ***Culturally important items:*** the assessment should 1) identify culturally important condiments and other food items that are an essential part of daily food habits; and 2) determine the access people have to these items. The food basket should be designed accordingly, especially where people will be dependent on distributed rations for an extended period.

5. ***Milk:*** powdered milk, or liquid milk distributed as a single commodity (this includes milk intended for mixing with tea), should not be included in a general food distribution or a take-home supplementary feeding programme, as its indiscriminate use may give rise to serious health hazards. This is especially relevant in the case of young children, for whom the risks of inappropriate dilution and germ contamination are very high (see General nutrition support standard 2 on page 140).

Food aid planning standard 3: food quality and safety

Food distributed is of appropriate quality and is fit for human consumption.

Key indicators (to be read in conjunction with the guidance notes)

- Food commodities conform to national (recipient country) and other internationally accepted standards (see guidance notes 1-2).
- All imported packaged food has a minimum six-month shelf life on arrival in the country and is distributed before the expiry date or well within the 'best before' period (see guidance note 1).
- There are no verifiable complaints about the quality of food distributed (see guidance note 3).
- Food packaging is sturdy, convenient for handling, storage and distribution, and is not a hazard for the environment (see guidance note 4).

- Food packages are labelled in an appropriate language with, for packaged foods, the date of production, the 'best before' date and details of the nutrient content.
- Storage conditions are adequate and appropriate, stores are properly managed and routine checks on food quality are carried out in all locations (see guidance note 5).

Guidance notes

1. ***Food quality:*** foods must conform to the food standards of the recipient government and/or the Codex Alimentarius standards with regard to quality, packaging, labelling, shelf life, etc. Samples should be systematically checked at the point of delivery by the supplier to ensure their quality is appropriate. Whenever possible, commodities purchased (either locally or imported), should be accompanied by phytosanitary certificates or other inspection certificates that confirm their fitness for human consumption. Random sample testing should be carried out on in-country stocks to ensure their continued fitness for consumption. When large quantities are involved or there are doubts and could be disputes about quality, independent quality surveyors should inspect the consignment. Information on the age and quality of particular food consignments may be obtained from supplier certificates, quality control inspection reports, package labels, warehouse reports, etc.
2. ***Genetically modified foods:*** national regulations concerning the receipt and use of genetically modified foods must be understood and respected. External food aid should take such regulations into account when any food aid programme is being planned.
3. ***Complaints:*** recipients' complaints about food quality should be followed up promptly and handled in a transparent and fair manner.
4. ***Packaging:*** if possible, packaging should allow direct distribution of goods, without the need for repacking.
5. ***Storage areas*** should be dry and hygienic, adequately protected from climatic conditions and uncontaminated by chemical or other residues. They should also be secured, as far as possible, against pests such as insects and rodents. See also Food aid management standard 2 on page 165.

ii) Food Aid Management

The goal of food aid management is to deliver food to those people who need it most. Generally speaking, this involves delivering the right goods, to the right location, in the right condition, at the right time and for the right price, with minimal handling loss.

The weight and volume of food aid required to sustain a large population severely affected by disaster may amount to thousands of tonnes. The physical movement of food commodities to points of distribution may involve an extensive network of purchasers, forwarding agents, transporters and receivers, and multiple handling and transfers from one mode of transport to another. These networks, or supply chains, are put together using a series of contracts and agreements, which define roles and responsibilities, and establish liabilities and rights to compensation, among the contracting parties. All of this requires proper and transparent procedures that contribute towards establishing accountability.

Setting up and managing the supply chain entails cooperation among donors, the recipient government, humanitarian actors, local authorities, various service providers and local community organisations engaged in the food aid programme. Each party will have specific roles and responsibilities as a link, or series of links, in the supply chain. As a chain is only as strong as its weakest link, all parties involved in food aid logistics share responsibility for maintaining the flow of sufficient commodities to meet distribution targets and schedules.

Equity in the distribution process is of primary importance and the involvement of people from the disaster-affected population in decision-making and implementation is essential. People should be informed about the quantity and type of food rations to be distributed, and they should feel assured that the distribution process is fair and that they receive what has been promised. Any differences between rations provided to different groups must be explained and understood.

Food aid management standard 1: food handling

Food is stored, prepared and consumed in a safe and appropriate manner at both household and community levels.

Key indicators (to be read in conjunction with the guidance notes)

- There are no adverse health effects resulting from inappropriate food handling or preparation at any distribution site (see guidance note 1).
- Recipients of food aid are informed about and understand the importance of food hygiene (see guidance note 1).
- There are no complaints concerning difficulties in storing, preparing, cooking or consuming the food distributed (see guidance note 2).
- Every household has access to appropriate cooking utensils, fuel and hygiene materials (see guidance notes 3-4).
- Individuals who cannot prepare food or cannot feed themselves have access to a carer who prepares appropriate food in a timely manner and administers feeding where necessary (see guidance notes 4-5).
- Where food is distributed in cooked form, staff have received training in safe storage, handling of commodities and the preparation of food and understand the potential health hazards caused by improper practices.

Guidance notes

1. ***Food hygiene:*** changed circumstances may disrupt people's normal hygiene practices. It may therefore be necessary to promote food hygiene and actively support measures compatible with local conditions and disease patterns e.g. stressing the importance of washing hands before handling food, avoiding contamination of water, taking pest control

measures, etc. People should be informed about how to store food safely at the household level, and care givers should be provided with information on the optimal use of household resources for child feeding and safe methods for food preparation (see Hygiene promotion standard on page 59).

2. ***Sources of information*** may include programme monitoring systems, focus group discussions with recipients and rapid household surveys.

3. ***Household items and fuel:*** each household should have access to at least one cooking pot, water storage containers with a capacity of 40 litres, 250g of soap per person per month, and adequate fuel for food preparation. If access to cooking fuel is limited, foods requiring a short cooking time should be distributed. If this is not possible, then external sources of fuel supply should be established to bridge the gap (see Water supply standard 3 on page 69 and Non-food items standards 2-4 on pages 232-236).

4. ***Access to grinding mills*** and other processing facilities, and access to clean water, are very important in that they enable people to prepare food in the best form of their choice and also save time for other productive activities. Care givers spending excessive amounts of time waiting for these services could otherwise be preparing food, feeding children or engaging in other tasks that have a positive effect on nutritional outcomes and/or long-term self-reliance. Household-level food processing (including grinding) can reduce the time (as well as the quantities of water and fuel) required for cooking.

5. ***Special needs:*** although not an exhaustive list, those who require assistance with feeding usually include young children, older people, disabled people and people living with HIV/AIDS. See General nutrition support standard 2 on page 140.

Food aid management standard 2: supply chain management

Food aid resources (commodities and support funds) are well managed, using transparent and responsive systems.

Key indicators (to be read in conjunction with the guidance notes)

- Food aid resources reach the intended beneficiaries.
- An assessment is made of local supply chain management (SCM) capabilities and logistics infrastructure and a co-ordinated, efficient SCM system is established, using local capacity where this is feasible (see guidance notes 1-2).
- The assessment considers the availability of locally sourced food commodities (see guidance note 3).
- The award of contracts for SCM services is transparent, fair and open (see guidance note 4).
- Staff at all levels of the SCM system are adequately trained and observe procedures relating to food quality and safety (see guidance note 5).
- Appropriate inventory accounting, reporting and financial systems are in place to ensure accountability at all levels of the SCM system (see guidance notes 6-7).
- Care is taken to minimise losses, including through theft, and all losses are accounted for (see guidance notes 8-10).
- The food pipeline is monitored and maintained in such a way that any interruption to distribution is avoided (see guidance note 11).
- Information on the performance of the supply chain is provided to all stakeholders on a regular basis (see guidance note 12).

Guidance notes

1. ***Supply chain management (SCM)*** is an integrated approach to food aid logistics. Starting with the choice of commodity, it includes sourcing,

procurement, quality assurance, packaging, shipping, transportation, warehousing, inventory management, insurance, etc. The chain involves many different players, and it is important that their activities are coordinated. Appropriate management and monitoring practices should be adopted to ensure that all commodities are safeguarded until distribution to recipient households.

2. ***Using local services:*** an assessment should be made of the availability and reliability of local capability before sourcing from outside the area. Reputable local or regional transporters and freight forwarders can be contracted to provide logistics services. Such organisations have valuable knowledge of local regulations, procedures and facilities, and can help to ensure compliance with the laws of the host country as well as expediting delivery operations.

3. ***Local sourcing vs. importation:*** the local availability of food commodities, and the implications for local production and market systems of food being either sourced locally or imported, should be assessed (see Food security assessment and analysis standard on page 111; Food security standard 2 on page 124; and Food security standard 4 on page 131). Where a number of different organisations are involved in supplying food, local sourcing including purchases of commodities should be co-ordinated as far as possible. Other in-country sources of food commodities may include loans or reallocations from existing food aid programmes or national grain reserves, and loans from, or swaps with, commercial suppliers.

4. ***Impartiality:*** fair and transparent contracting procedures are essential in order to avoid any suspicion of favouritism or corruption. Food aid packaging should not carry any messages that are politically or religiously motivated or divisive in nature.

5. ***Skills and training:*** experienced SCM practitioners and food aid managers should be mobilised to set up the SCM system and train staff. Particular types of relevant expertise include contracts management, transportation and warehouse management, inventory management, pipeline analysis and information management, shipment tracking, import management, etc. When training is carried out, it should include the staff of partner organisations.

6. ***Reporting:*** most food aid donors have specific reporting requirements; supply chain managers should be aware of these requirements and establish systems that meet them as well as day-to-day management needs. This includes reporting promptly any delays or deviations in the supply chain. Pipeline information and other SCM reports should be shared in a transparent manner.

7. ***Documentation:*** a sufficient stock of documentation and forms (waybills, stock ledgers, reporting forms, etc.) should be available at all locations where food aid is received, stored, and/or dispatched in order to maintain a documented audit trail of transactions.

8. ***Warehousing:*** dedicated (food-only) warehouses are preferable to shared facilities. When selecting a warehouse, it should be established that no hazardous goods have previously been stored there and there is no danger of contamination. Other factors to consider include security, capacity, ease of access, solidity (of roof, walls, doors and floor) and absence of any threat of flooding.

9. ***Disposal of commodities unfit for human consumption:*** damaged commodities should be inspected by qualified inspectors, such as medical doctors, public health laboratories etc., to certify them as fit or unfit for human consumption. Methods of disposal of unfit commodities may include sale for animal feed, burial or incineration. In the case of disposal for animal feed, certification must be obtained to certify the commodity's fitness for this purpose. In all cases it must be ensured that unfit commodities do not re-enter the human or animal food supply chain and that their disposal does not cause harm to the environment or contaminate water sources in the vicinity.

10. ***Threats to the supply chain:*** in a situation of armed conflict, there is a danger of food aid being looted or requisitioned by warring parties, and the security of transport routes and warehouses should be taken into consideration. In all disaster situations, there is the potential for loss through theft at all levels of the supply chain, and control systems must be established and supervised at all storage, hand-over and distribution points to minimise this risk. Internal control systems should ensure division of duties/responsibilities to reduce the risk of collusion. Stocks should be regularly checked to detect any diversion of food. If diversion is detected,

measures should be taken not only to ensure the integrity of the supply chain, but also to analyse and address the broader political and security implications (e.g. the possibility of diverted stocks fuelling an armed conflict).

11. ***Pipeline analysis:*** regular pipeline analysis should be carried out and relevant information on stock levels, expected arrivals, distributions, etc. shared among all those involved in the supply chain. The regular tracking and forecasting of stock levels along the supply chain should highlight anticipated shortfalls or problems in time for solutions to be found.

12. ***Providing information:*** the use of local media or traditional methods of news dissemination should be considered as a way of keeping people informed about food supplies and operations. This reinforces transparency. Women's groups may be enlisted to help provide information about food aid programmes to the community.

Food aid management standard 3: distribution

The method of food distribution is responsive, transparent, equitable and appropriate to local conditions.

Key indicators (to be read in conjunction with the guidance notes)

- Recipients of food aid are identified and targeted on the basis of need, by means of an assessment carried out through consultation with stakeholders, including community groups (see guidance notes 1-2).
- Efficient and equitable distribution methods are designed in consultation with local groups and partner organisations, and involve the various recipient groups (see guidance notes 1-3).
- The point of distribution is as close as possible to recipients' homes to ensure easy access and safety (see guidance notes 4-5).
- Recipients are informed well in advance of the quality and quantity of the food ration and the distribution plan (see guidance notes 6-7).
- The performance and effectiveness of the food aid programme are properly monitored and evaluated (see guidance note 8).

Guidance notes

1. ***Targeting:*** food aid should be targeted to meet the needs of the most vulnerable in the community, without discrimination on the basis of gender, disability, religious or ethnic background, etc. The selection of distribution agents should be based on their impartiality, capacity and accountability. Distribution agents may include local elders, locally elected relief committees, local institutions, local NGOs, or government or international NGOs (see Participation and Initial assessment standards on pages 28-33 and Targeting standard on page 35).

2. ***Registration:*** formal registration of households receiving food aid should be carried out as soon as is feasible, and updated as necessary. Lists developed by local authorities and community-generated family lists may be useful, and the involvement of women from the affected population in this process is to be encouraged. Women should have the right to be registered in their own names if they wish. Care should be taken to ensure that female or adolescent-headed households and other vulnerable individuals are not omitted from distribution lists. If registration is not possible in the initial stages of the emergency, it should be completed as soon as the situation has stabilised. This is especially important when food aid may be required for lengthy periods.

3. ***Distribution methods:*** most distribution methods evolve over time. In the initial stages, general distributions based on family lists or population estimates provided by local communities may be the only feasible method. Any system should be monitored closely to ensure that food is reaching the intended recipients, and that the system is fair and equitable. Particular emphasis should be given to the accessibility of the programme to vulnerable groups. However, attempts to target vulnerable groups should not add to any stigma already experienced by these groups. This may be a particular issue in populations with large number of people living with HIV/AIDS (see Participation, Targeting, Monitoring and Evaluation standards in chapter 1).

4. ***Distribution points*** should be established where they are safe and most convenient for the recipients, not merely on the basis of logistic convenience for the distributing agency. The frequency of distribution and the number of distribution points should take into account the time spent by recipients

travelling to/from centres, and the practicalities and cost of transporting commodities. Recipients should not be made to walk long distances to collect rations, and distributions should be scheduled at convenient times to minimise disruption to everyday activities. Waiting areas and potable water should be provided at distribution points (see Correction of malnutrition standards 1-2 on pages 145-152).

5. ***Minimising security risks:*** food is a valuable commodity and its distribution can create security risks, including both the risk of diversion and the potential for violence. When food is in short supply, tensions can run high when deliveries are made. Women, children, elderly people and people with disabilities may be unable to obtain their entitlement, or may have it taken from them by force. The risks must be assessed in advance and steps taken to minimise them. These should include adequate supervision of distributions and guarding of distribution points, including the involvement of local police where appropriate. Measures to prevent, monitor and respond to gender-based violence or sexual exploitation associated with food distribution may also be necessary.

6. ***Dissemination of information:*** recipients should be informed about

   – the quantity and type of ration to be distributed and the reasons for any differences from established norms;

   – the distribution plan (day, time, location, frequency) and deviation, if any, due to outside circumstances;

   – the nutritional quality of the food and, if needed, special attention required to protect its nutritional value; and

   – the requirements for the safe handling and use of the food commodities.

7. ***Changes to the programme:*** changes in the food basket or ration levels caused by insufficient availability of food must be discussed with the recipients, through distribution committees or community leaders, and a course of action should be jointly developed. The distribution committee should inform the population of changes and the reasons behind them, how long changes will continue and when the distribution of normal rations will be resumed. It is essential to communicate clearly what people should receive. For example, ration quantities should be displayed

prominently at distribution sites, written in the local language and/or drawn pictorially, so that people are aware of their entitlements.

8. ***Monitoring and evaluation*** of food aid distribution should be carried out at all levels of the supply chain. At distribution points, random weighing should be carried out of rations collected by households to measure the accuracy and equity of distribution management, and exit interviews should be conducted. At community level, random visits to households receiving food aid can help to ascertain the acceptability and usefulness of the ration, and also to identify people who meet the selection criteria but who are not receiving food aid. Such visits can also ascertain if extra food is being received and where it is coming from (e.g. as a result of commandeering, recruitment or exploitation, sexual or otherwise). The wider effects on the food distribution system should also be considered. These may include implications for the agricultural cycle, agricultural activities, market conditions and availability of agricultural inputs.

Appendix 1

Food Security Checklist for Methodology and Reporting

Food security assessments should:

1. include a clear description of the methodology
   - – overall design and objectives
   - – background and number of assessors (whether they are working individually or in pairs)
   - – selection of key informants (are they representative of all groups?)
   - – composition of focus or other discussion groups
   - – criteria for selecting informants
   - – timeframe of the assessment
   - – framework for analysis and methodological tools, including PRA tools and techniques;
2. be based on a qualitative approach, including review of secondary sources of quantitative information;
3. use terms correctly e.g. purposive sampling, key informant, focus group, terms for specific techniques;
4. involve local institutions as partners in the assessment process, unless inappropriate e.g. in some conflict situations;
5. employ an appropriate range of PRA tools and techniques (which are applied in sequence to analyse and triangulate findings);
6. involve a representative range of affected population groups or livelihood groupings;
7. describe the limitations or practical constraints of the assessment;
8. describe the coverage of the assessment, including its geographic spread, the range of livelihood groups included and other relevant stratification of the population (e.g. gender, ethnicity, tribal group, etc.);

9. include interviews with representatives of relevant government ministries and public services, traditional leaders, representatives of key civil society organisations (religious groups, local NGOs, advocacy or pressure groups, farmers' or pastoralists' associations, women's groups) and representatives of each of the livelihood groups under consideration.

The assessment report findings should cover:

1. the recent history of food security and relevant policies prior to the current situation;
2. a description of the different livelihood groups and their food security situation prior to the disaster;
3. food security pre-disaster for different livelihood groups;
4. the impact of the disaster on the food system and food security for different livelihood groups;
5. identification of particularly vulnerable livelihood groups or those vulnerable to food insecurity in the present situation;
6. suggested interventions, including means of implementation, advocacy and any additional assessments required;
7. the precise nature, purpose and duration of any food aid response, if a response is considered appropriate. Food aid responses should be justified on the basis of the above data and analysis.

Appendix 2

Food Security Assessment Checklist

Food security assessments often broadly categorise the affected population into livelihood groupings, according to their sources of, and strategies for obtaining, income or food. This may also include a breakdown of the population according to wealth groups or strata. It is important to compare the prevailing situation with the history of food security pre-disaster. So-called 'average years' may be considered as a baseline. The specific roles and vulnerabilities of women and men, and the implications for household food security should be considered. Consideration of intra-household food security differences may also be important.

This checklist covers the broad areas that are usually considered in a food security assessment. Additional information must also be collected on the wider context of the disaster (e.g. its political context, population numbers and movements, etc.) and possibly in relation to other relevant sectors (nutrition, health, water and shelter). The checklist must be adapted to suit the local context and the objectives of the assessment. More detailed checklists are available in, for example, the Field Operations Guide of USAID (1998).

Food security of livelihood groups

1. Are there groups in the community who share the same livelihood strategies? How can these be categorised according to their main sources of food or income?

Food security pre-disaster (baseline)

2. How did the different livelihood groups acquire food or income before the disaster? For an average year in the recent past, what were their sources of food and income?
3. How did these different sources of food and income vary between seasons in a normal year? (Constructing a seasonal calendar may be useful.)

4. Looking back over the past 5 or 10 years, how has food security varied from year to year? (Constructing a timeline or history of good and bad years may be useful.)
5. What kind of assets, savings or other reserves are owned by the different livelihood groups (e.g. food stocks, cash savings, livestock holdings, investments, credit, unclaimed debt, etc.)?
6. Over a period of a week or a month, what do household expenditures include, and what proportion is spent on each item?
7. Who is responsible for management of cash in the household, and on what is cash spent?
8. How accessible is the nearest market for obtaining basic goods? (Consider distance, security, ease of mobility, availability of market information, etc.)
9. What is the availability and price of essential goods, including food?
10. Prior to the disaster, what were the average terms of trade between essential sources of income and food, e.g. wages to food, livestock to food, etc.?

Food security during disaster

11. How has the disaster affected the different sources of food and income for each of the livelihood groups identified?
12. How has it affected the usual seasonal patterns of food security for the different groups?
13. How has it affected access to markets, market availability and prices of essential goods?
14. For different livelihood groups, what are the different coping strategies and what proportion of people are engaged in them?
15. How has this changed as compared with the pre-disaster situation?
16. Which group or population is most affected?
17. What are the short- and medium-term effects of coping strategies on people's financial and other assets?

18. For all livelihood groups, and all vulnerable groups, what are the effects of coping strategies on their health, general well-being and dignity? Are there risks associated with coping strategies?

Appendix 3

Food Security Responses

The range of interventions possible to support, protect and promote food security in emergencies is wide. The list below is not exhaustive. Each intervention must be designed to suit the local context and strategy for supporting food security, and therefore is unique in its objectives and design. It is important to consider a range of responses and programming options based on analysis and consideration of expressed needs. 'Off-the-shelf' interventions that do not take account of local priorities rarely work. The responses are categorised into three groups, which relate to the Food Security standards 2-4:

- primary production
- income and employment
- access to market goods and services.

General food distribution provides free food assistance directly to households and thus is of great importance in ensuring food security in the short term.

Primary production

- ***Distribution of seeds, tools and fertiliser:*** provided to encourage agricultural production, as starter packs to returnees, or to diversify crops. Often combined with agricultural extension services and possibly technical training.
- ***Seed vouchers and fairs:*** based on the provision of seed vouchers to potential buyers. Organising a seed fair to bring together potential sellers stimulates local seed procurement systems while allowing buyers access to a wide range of seeds.
- ***Local agricultural extension services***
- ***Training and education in relevant skills***

- ***Livestock interventions:*** can include animal health measures; emergency destocking; restocking of livestock; distribution of livestock fodder and nutritional supplementation; livestock refuges; and provision of alternative water sources.
- ***Distribution of fish nets and gear, or hunting implements***
- ***Promotion of food processing***

Income and employment

- ***Cash-for-work (CFW)*** provides food-insecure households with opportunities for paid work.
- ***Food-for-work (FFW)*** provides food-insecure households with opportunities for paid work that at the same time produce outputs of benefit to themselves and the community.
- ***Food-for-recovery (FFR):*** a less structured form of food-for-work. Activities can contribute to initial recovery and should not require outside technical supervision.
- ***Income generating schemes*** allow people to diversify their sources of income in small-scale, self-employment business schemes. These include support of people in the management, supervision and implementation of their businesses.

Access to market goods and services

- ***Market and infrastructure support:*** includes transportation to allow producers to take advantage of distant markets.
- ***Destocking:*** provides herders with a good price for their livestock in times of drought, when there is pressure on water supplies and grazing and market prices of livestock are falling.
- ***Fair price shops:*** sale of basic items at controlled or subsidised prices, or in exchange for vouchers or goods in kind.
- ***Food or cash vouchers:*** for exchange in shops for food and other goods.

- ***Support and technical assistance to government services:*** including agricultural extension services and veterinary services.
- ***Microfinance projects:*** including e.g. the provision of credit and methods for saving assets, which may involve grants, loans, cattle banks, cooperative savings accounts, etc.

See also the Food Security references in Appendix 9.

Appendix 4

Nutrition Assessment Checklist

Below are sample questions for assessments examining the underlying causes of malnutrition, the level of nutritional risk and possibilities for response. The questions are based on the conceptual framework of the causes of malnutrition (see page 136). The information is likely to be available from a variety of sources and gathering it will require a variety of assessment tools, including key informant interviews, observation and review of secondary data (see also Initial assessment and Participation standards on pages 28-33).

1. What information on the **nutritional situation** exists?
   a) Have any nutrition surveys been conducted?
   b) Are there any data from mother and child health clinics?
   c) Are there any data from existing supplementary or therapeutic feeding centres?
   d) What information exists on the nutritional situation of the affected population prior to the current crisis (even if people are no longer in the same place)?

2. What is the **risk of malnutrition related to poor public health?**
   a) Are there any reports of disease outbreaks which may affect nutritional status, such as measles or acute diarrhoeal disease? Is there a risk that these outbreaks will occur? (See Control of communicable diseases standards on page 273.)
   b) What is the estimated measles vaccination coverage of the affected population? (See Control of communicable diseases standard 2 on page 275.)
   c) Is Vitamin A routinely given in measles vaccination? What is the estimated Vitamin A supplement coverage?

d) Has anyone estimated mortality rates (either crude or under five)? What are they and what method has been used? (see Health systems and infrastructure standard 1 on page 259).

e) Is there, or will there be, a significant decline in ambient temperature likely to affect the prevalence of acute respiratory infection or the energy requirements of the affected population?

f) Is there a high prevalence of HIV/AIDS, and are people already vulnerable to malnutrition due to poverty or ill health?

g) Have people been in water or wet clothes for long periods of time?

3. What is the **risk of malnutrition related to inadequate care?**

a) Is there a change in work patterns (e.g. due to migration, displacement or armed conflict) which means that roles and responsibilities in the household have changed?

b) Is there a change in the normal composition of households? Are there large numbers of separated children?

c) Has the normal care environment been disrupted (e.g. through displacement), affecting access to secondary carers, access to foods for children, access to water, etc?

d) What are the normal infant feeding practices? Are mothers bottle feeding their babies or using manufactured complementary foods? If so, is there an infrastructure that can support safe bottle feeding?

e) Is there evidence of donations of baby foods and milks, bottles and teats or requests for donations?

f) In pastoral communities, have the herds been away from young children for long? Has access to milk changed from normal?

g) Has HIV/AIDS affected caring practices at household level?

4. What is the **risk of malnutrition related to reduced food access?** See Appendix 2 for food security assessment checklist.

5. What formal and informal **local structures** are currently in place through which potential interventions could be channelled?
   a) What is the capacity of the Ministry of Health, religious organisations, HIV/AIDS community support groups, infant feeding support groups, or NGOs with a long- or short-term presence in the area?
   b) What is available in the food pipeline?
   c) Is the population likely to move (for pasture/assistance/work) in the near future?
6. What **nutrition intervention or community-based support was already in place** before the current disaster, organised by local communities, individuals, NGOs, government organisations, UN agencies, religious organisations, etc.? What are the nutrition policies (past, ongoing and lapsed), the planned long-term nutrition responses, and programmes that are being implemented or planned in response to the current situation?

Appendix 5

Measuring Acute Malnutrition

Children under five years

The table below shows the commonly used indicators of different grades of malnutrition among children aged 6-59 months. Weight for height (WFH) indicators should be taken from the NCHS/CDC reference data. The WFH Z score is the preferred indicator for reporting anthropometric survey results and WFH percentage of the median is preferred to determine eligibility for treatment. Mid Upper Arm Circumference (MUAC) should not be used alone in anthropometric surveys, but it is one of the best predictors of mortality, partly because it is biased towards younger children. It is, therefore, often used as part of a two-stage screening for admission to feeding programmes. The cut-offs commonly used are <12.5cm: total malnutrition and <11.0cm: severe malnutrition, among children aged 12-59 months.

	Total* malnutrition	Moderate malnutrition	Severe malnutrition
Children 6.0-59.9 mths	• <-2Z scores WFH *or* 80% median WFH *and/or* nutritional oedema	• -3 to <-2 Z scores WFH *or* 70% to <80% median WFH	• <-3Z scores WFH or <70% median WFH *and/or* nutritional oedema

* sometimes known as global malnutrition

There are no agreed anthropometric cut-offs for malnutrition in infants below six months, apart from the presence of nutritional oedema. The NCHS/CDC growth references are of limited use since they are drawn from a population of babies fed artificially, whereas breastfed babies grow at a different rate. This means that malnutrition will tend to be overestimated in this age group. It is important to assess infant feeding practices, particularly access to breast milk, and any medical conditions in order to determine whether malnutrition in this age group may be a problem.

Other age groups: older children, adolescents, adults and older people

There are no internationally accepted definitions of acute malnutrition in other age groups. This is partly because ethnic differences in growth start to become apparent after the age of five years, meaning that it is impractical to use a single reference population to compare all ethnic groups. A further reason is that, in most circumstances, information on the nutritional status of the group aged 6-59 months is sufficient for planners to make their decisions, and thus there has been little impetus to undertake research into malnutrition in other age groups.

However, in major nutritional emergencies, it may be necessary to include older children, adolescents, adults or older people in nutrition assessments or nutritional programmes. Surveys of age groups other than children aged 6-59 months should only be undertaken if:

- a thorough contextual analysis of the situation is undertaken. This should include an analysis of the causes of malnutrition. Only if the results of this analysis suggest that the nutritional status of young children does not reflect the nutritional status of the general population should a nutrition survey for another age group be considered;
- technical expertise is available to ensure quality of data collection, adequate analysis and correct presentation and interpretation of results;
- the resource and/or opportunity costs of including other age groups in a survey have been considered;
- clear and well-documented objectives for the survey are formulated.

Research on defining the most suitable indicators of malnutrition for people aged more than 59 months is currently being undertaken, and this information is liable to change in the next few years.

Older children (5-9 years)

In the absence of alternative measures of nutritional status in older children, use of the NCHS/CDC references is recommended to

determine WFH Z score and percentage of the median and the same cut-offs as for younger children should be applied (see table above). As for younger children, nutritional oedema should be assessed.

Adolescents (10-19 years)

There is no clear, tested, agreed definition of malnutrition in adolescents. Guidance on assessment can be found in the list of references in Appendix 9.

Adults (20-59 years)

There is no agreed definition of acute malnutrition in adults, but evidence suggests that cut-offs for severe malnutrition could be lower than a Body Mass Index (BMI) of 16. Surveys of adult malnutrition should aim to gather data on weight, height, sitting height and MUAC measurements. These data can be used to calculate BMI. BMI should be adjusted for Cormic index (the ratio of sitting height to standing height) to make comparisons between populations. Such adjustment can substantially change the apparent prevalence of undernutrition in adults and may have important programmatic ramifications. MUAC measurements should always be taken. If immediate results are needed or resources are severely limited, surveys may be based on MUAC measurements alone.

Because the interpretation of anthropometric results is complicated by the lack of validated functional outcome data and benchmarks for determining the meaning of the result, such results must be interpreted along with detailed contextual information. Guidance on assessment can be found in the references.

For screening individuals for nutritional care admission and discharge, criteria should include a combination of anthropometric indices, clinical signs and social factors (e.g. access to food, presence of carers, shelter, etc). Note that oedema in adults can be caused by a variety of reasons other than malnutrition, and clinicians should assess adult oedema to exclude other causes. Individual agencies should decide on the indicator to determine eligibility for care, taking into account the

known shortcomings of BMI, the lack of information on MUAC and the programme implications of their use. Interim definitions of adult malnutrition for screening for treatment can be found in the references.

MUAC may be used as a screening tool for pregnant women (e.g. as a criterion for entry into a feeding programme). Given their additional nutritional needs, pregnant women may be at greater risk than other groups in the population (see General nutrition support standard 2 on page 140). MUAC does not change significantly through pregnancy. MUAC <20.7 cm (severe risk) and <23.0cm (moderate risk) have been shown to carry a risk of growth retardation of the foetus. The risk is likely to vary according to the population.

Older people

There is currently no agreed definition of malnutrition in older people and yet this group may be at risk of malnutrition in emergencies. WHO suggests that the BMI thresholds for adults may be appropriate for older people aged 60-69 years, but these are subject to the same problems as in younger adults. In addition, accuracy of measurement is problematic because of spinal curvature (stooping) and compression of the vertebrae. Arm span or demi-span can be used instead of height, but the multiplication factor to calculate height varies according to the population. MUAC may be a useful tool for measuring malnutrition in older people but research on appropriate cut-offs is currently still in progress.

Disabled people

No guidelines currently exist for the measurement of individuals with physical disabilities and thus they are often excluded from anthropometric surveys. Visual assessment is necessary. MUAC measurements may be misleading in cases where upper arm muscle might build up to aid mobility. There are alternatives to standard measures of height, including length, arm span, demi-span or lower leg length. It is necessary to consult the latest research findings to determine the most appropriate way of measuring disabled individuals for whom standard weight, height and MUAC measurement is not appropriate.

Appendix 6

Measures of the Public Health Significance of Vitamin A and Iodine Deficiency

Indicators of vitamin A deficiency (xerophthalmia) in children aged 6-71 months

(prevalence of one or more indicators signifies a public health problem)

Indicator	Minimum prevalence
Night blindness (present at 24-71 mths)	> 1%
Bitot spots	> 0.5%
Corneal xerosis/ulceration/keratomalacia	> 0.01%
Corneal scars	> 0.05%

Indicators of iodine deficiency (goitre)

The indicators shown in the table below are those that may be possible to measure in a disaster. The prevalence of at least one and, more definitely, two indicators signifies a public health problem. These indicators of iodine deficiency may be problematic: biochemical indicators may not be possible to measure in many emergency contexts, and clinical assessment risks high levels of inaccuracy. Nevertheless, while assessment of urinary iodine is necessary to obtain a full picture of iodine status, a rough indication of the severity of the situation can be obtained by clinical examination of a valid sample of children aged 6-12 years.

	Severity of public health problem (prevalence)			
Indicator	**Target population**	**Mild**	**Moderate**	**Severe**
Total goitre rate (% of population)	school-age children*	5-19.9	20-29.9	>=30.0
Median urinary iodine level (µg/l)	school-age children*	50-99	20-49	<20

*preferably children aged 6-12 years

Appendix 7

Nutritional Requirements

The following figures can be used for planning purposes in the initial stage of a disaster:

Nutrient	Mean population requirements
Energy	2,100 kcals
Protein	10-12% total energy (52g-63g), but <15%
Fat	17% of total energy (40g)
Vitamin A	1.666 IU (or 0.5mg retinol equivalents)
Thiamine (B1)	0.9mg (or 0.4mg per 1,000 kcal intake)
Riboflavin (B2)	1.4mg (or 0.6mg per 1,000 kcal intake)
Folic acid	160 µg
Niacin (B3)	12.0mg (or 6.6mg per 1,000 kcal intake)
Vitamin B12	0.9 µg
Vitamin C	28.0mg
Vitamin D	3.2 - 3.8 µg calciferol
Iron	22mg (low bio-availability ie 5-9%)
Iodine	150 µg
Magnesium*	201 mg
Zinc*	12.3 mg
Selenium*	27.6 µg
Vitamin E*	8.0 mg alpha-TE
Vitamin K*	48.2 µg
Biotin*	25.3 µg
Pantothenate*	4.6 µg

Reference: WHO, 2000, *Management of Nutrition in Major Emergencies*

*provisional requirements. Reference: FAO/WHO, 2002 *Human Vitamin and Mineral Requirements*. Report of a joint FAO/WHO expert consultation, Bangkok, Thailand. FAO, Rome.

There are two important points to consider before using the requirements listed above. Firstly, the mean per capita requirements for population groups incorporate the requirements of all age groups and both sexes. They are therefore not specific to any single age or sex group and should not be used as requirements for an individual. Secondly, these requirements are based on a particular population profile, as follows:

Group	% of population
0-4 years:	12
5-9 years:	12
10-14 years:	11
15-19 years:	10
20-59 years:	49
60+ years:	7
Pregnant:	2.5
Breastfeeding:	2.5
Male/female:	51/49

As the demographic structure of different populations varies, this will affect the nutritional requirements of the population concerned. For example, if 26% of a refugee population is aged under five, and the population consists of 50% males and 50% females, the energy requirement is reduced to 1,940 kcals.

Energy and protein requirements should be adjusted for the following factors:

– the demographic structure of the population, in particular the percentage of those under five years old and the percentage of females (this may change in populations affected by HIV/AIDS);

– mean adult weights and actual, usual or desirable body weights. Requirements will increase if the mean body weight for adult males

exceeds 60kg and the mean body weight for adult females exceeds 52kg;

– activity levels to maintain productive life. Requirements will increase if activity levels exceed light (ie 1.55 x Basal Metabolic Rate for men and 1.56 x Basal Metabolic Rate for women);

– average ambient temperature and shelter and clothing capacities. Requirements will increase if the mean ambient temperature is less than 20°C;

– the nutritional and health status of the population. Requirements will increase if the population is malnourished and has extra requirements for catch-up growth. HIV/AIDS prevalence may affect average population requirements (see General nutrition support standard 2 on page 140). Whether general rations should be adjusted to meet these needs will depend on current international recommendations.

If it is not possible to incorporate this kind of information into the initial assessment, the figures in the table above may be used as a minimum in the first instance.

Appendix 8

Supply Chain Management Logistics Checklist

1. Purchase contracts provide for delivery-linked payments, the return of damaged goods and penalties for any deviations in fulfilment of the contract, other than in situations of force majeure.
2. Transporters and handling agents assume total liability for food commodities in their care and reimburse any losses.
3. Storage facilities are safe and clean, and protect food commodities from damage and/or loss.
4. Steps are taken at all levels to minimise commodity losses.
5. All losses are identified and accounted for.
6. Commodities in damaged containers are salvaged as far as possible.
7. Commodities are inspected at regular intervals and any suspect commodities are tested. Unfit items are certified and disposed of in accordance with clearly defined procedures and national public health regulations. Recycling of unfit commodities into the market is avoided.
8. Physical inventory counts are undertaken periodically by knowledgeable persons in the area of inventory management not associated with the project under review, and are reconciled with stock balances.
9. Summary inventory reports are compiled at regular intervals and made available to all stakeholders.
10. Waybills properly document all commodity transactions.
11. Stock ledgers provide details of all receipts, issues and balances.
12. Auditing, including process management auditing, is carried out at all levels of the supply chain.
13. Vehicles used to carry food commodities are in good running order;

cargo spaces have no protruding edges that may damage packaging and are adequately protected from bad weather (e.g. by tarpaulins).

14. Vehicles do not carry other commercial and/or hazardous materials along with food commodities.
15. Vehicles have not carried hazardous materials in the past and there are no residues.

Sources: WFP, *Emergency Field Operations Pocketbook* (2002) and CARE, *Food Resource Management* handbook.

Appendix 9

References

Thanks to the Forced Migration Online programme of the Refugee Studies Centre at the University of Oxford, many of these documents have received copyright permission and are posted on a special Sphere link at: http://www.forcedmigration.org

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Notes

Notes

Notes

Chapter 4: Minimum Standards in Shelter, Settlement and Non-Food Items

How to use this chapter

This chapter is divided into two sections, comprising 1) Shelter and Settlement and 2) Non-Food Items: Clothing, Bedding and Household Items. Both sections provide general standards for use in any of several response scenarios, such as the return to and repair of damaged dwellings, accommodation with host families, mass shelter in existing buildings and structures, and temporary planned or self-settled camps. Both sections contain the following:

- *the minimum standards:* these are qualitative in nature and specify the minimum levels to be attained in shelter, settlement and non-food item responses;
- *key indicators:* these are 'signals' that show whether the standard has been attained. They provide a way of measuring and communicating the impact, or result, of programmes as well as the process, or methods, used. The indicators may be qualitative or quantitative;
- *guidance notes:* these include specific points to consider when applying the standard and indicators in different situations, guidance on tackling practical difficulties, and advice on priority issues. They may also include critical issues relating to the standard or indicators, and describe dilemmas, controversies or gaps in current knowledge.

A needs assessment checklist is included as Appendix 1. A list of references, detailing further sources of information that offer select 'how to' guidance, is included as Appendix 2.

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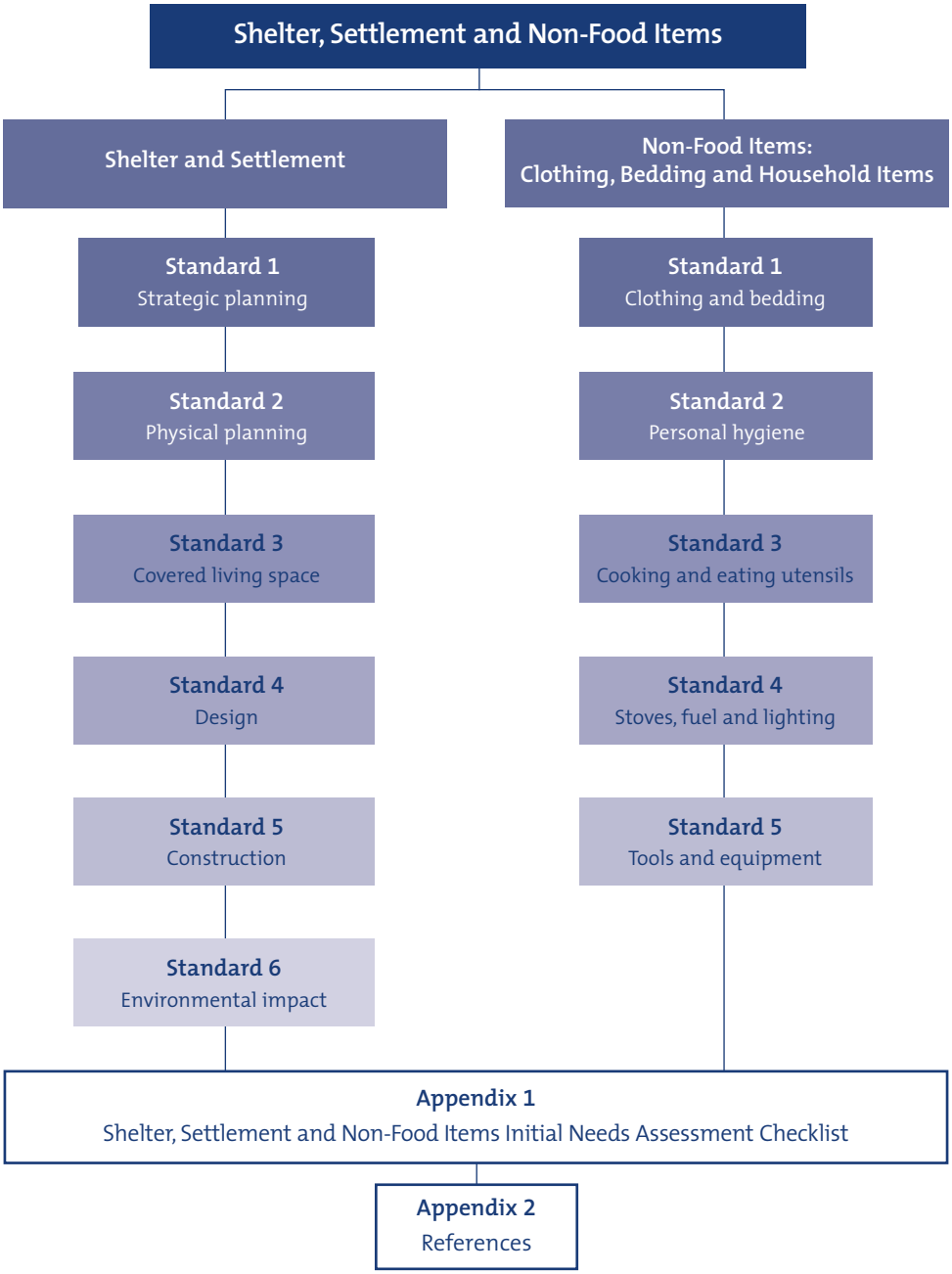
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Introduction

Links to international legal instruments

The Minimum Standards in Shelter, Settlement and Non-Food Items are a practical expression of the principles and rights embodied in the Humanitarian Charter. The Humanitarian Charter is concerned with the most basic requirements for sustaining the lives and dignity of those affected by calamity or conflict, as reflected in the body of international human rights, humanitarian and refugee law. In humanitarian response, shelter and settlement are familiar terms that fall within the scope of the right to housing, which is enshrined in human rights law.

Everyone has the right to adequate housing. This right is recognised in international legal instruments and includes the right to live in security, peace and dignity, and with security of tenure. Key aspects of the right to housing include the availability of services, facilities, materials and infrastructure; affordability; habitability; accessibility; location; and cultural appropriateness. The right to housing also extends to goods and services, such as sustainable access to natural and common resources; safe drinking water; energy for cooking, heating and lighting; sanitation and washing facilities; means of food storage; refuse disposal; site drainage; and emergency services. People should have adequate space and protection from cold, damp, heat, rain, wind or other threats to health, structural hazards and disease vectors. The appropriate siting of settlements and housing should provide access to health-care services, schools, child-care centres and other social facilities and to livelihood opportunities. The way housing is constructed, the building materials used and the policies supporting these must appropriately enable the expression of cultural identity and diversity of housing.

The right to housing is inextricably related to other human rights, including that of protection against forced eviction, harassment and other threats to physical safety and well-being, the right of everyone to be protected against arbitrary displacement from their home or place of habitual residence, and the prohibition of indiscriminate armed attacks on civilian objects.

The Minimum Standards in this chapter are not a full expression of the Right to Housing. However, the Sphere standards reflect the core content of the Right to Housing and contribute to the progressive realisation of this right globally.

The importance of shelter, settlement and non-food items in disasters

Shelter is a critical determinant for survival in the initial stages of a disaster. Beyond survival, shelter is necessary to provide security and personal safety, protection from the climate and enhanced resistance to ill health and disease. It is also important for human dignity and to sustain family and community life as far as possible in difficult circumstances.

Shelter and associated settlement and non-food item responses should support communal coping strategies, incorporating as much self-sufficiency and self-management into the process as possible. Any such responses should also minimise the long-term adverse impact on the environment, whilst maximising opportunities for the affected communities to maintain or establish livelihood support activities.

The most individual level of response to the need for shelter and the maintenance of health, privacy and dignity is the provision of clothing, blankets and bedding. People also require basic goods and supplies to meet their personal hygiene needs, to prepare and eat food, and to provide necessary levels of thermal comfort. Disaster-affected households and those displaced from their dwellings often possess only what they can salvage or carry, and the provision of appropriate non-food items may be required to meet essential needs.

The type of response required to meet the needs of people and households affected by a disaster is determined by key factors including the nature and scale of the disaster and the resulting loss of shelter, the climatic conditions and the local environment, the political and security situation, the context (rural or urban) and the ability of the community to cope. Consideration must also be given to the rights and needs of those who are secondarily affected by the disaster, such as any

host community. Any response should be informed by the steps taken by the affected households in the initial aftermath of the disaster, using their own skills and material resources to provide temporary shelter or to begin the construction of new, longer-term dwellings. Shelter responses should enable affected households to incrementally upgrade from emergency to durable shelter solutions within a reasonably short time and with regard to the constraints on acquiring the additional resources required.

Involving women in shelter and settlement programmes can help ensure that they and all members of the population affected by the disaster have equitable and safe access to shelter, clothing, construction materials, food production equipment and other essential supplies. Women should be consulted about a range of issues such as security and privacy, sources and means of collecting fuel for cooking and heating, and how to ensure that there is equitable access to housing and supplies. Particular attention will be needed to prevent and respond to gender-based violence and sexual exploitation. It is therefore important to encourage women's participation in the design and implementation of shelter and settlement programmes wherever possible.

Links to other chapters

Many of the standards in the other sector chapters are relevant to this chapter. Progress in achieving standards in one area often influences and sometimes even determines progress in other areas. For a response to be effective, close coordination and collaboration are required with other sectors. Coordination with local authorities and other responding agencies is also necessary to ensure that needs are met, that efforts are not duplicated, and that the quality of shelter, settlement and non-food item interventions is optimised.

For example, the complementary provision of adequate water supply and sanitation facilities in areas in which shelter assistance is being provided is necessary to ensure the health and dignity of the affected households. Similarly, the provision of adequate shelter contributes to the health and well-being of displaced households, while essential cooking and eating utensils are required to enable food assistance to be

utilised and nutritional needs met. Reference to specific standards or guidance notes in other technical chapters is made where relevant.

Links to the standards common to all sectors

The process by which an intervention is developed and implemented is critical to its effectiveness. This chapter should be utilised in conjunction with the standards common to all sectors, which cover participation, initial assessment, response, targeting, monitoring, evaluation, aid worker competencies and responsibilities, and the supervision, management and support of personnel (see chapter 1, page 21). In particular, in any response the participation of disaster-affected people – including the vulnerable groups outlined below – should be maximised to ensure its appropriateness and quality.

Vulnerabilities and capacities of disaster-affected populations

The groups most frequently at risk in disasters are women, children, older people, disabled people and people living with HIV/AIDS (PLWH/A). In certain contexts, people may also become vulnerable by reason of ethnic origin, religious or political affiliation, or displacement. This is not an exhaustive list, but it includes those most frequently identified. Specific vulnerabilities influence people's ability to cope and survive in a disaster, and those most at risk should be identified in each context.

Throughout the handbook, the term 'vulnerable groups' refers to all these groups. When any one group is at risk, it is likely that others will also be threatened. Therefore, whenever vulnerable groups are mentioned, users are strongly urged to consider all those listed here. Special care must be taken to protect and provide for all affected groups in a non-discriminatory manner and according to their specific needs. However, it should also be remembered that disaster-affected populations possess, and acquire, skills and capacities of their own to cope, and that these should be recognised and supported.

The Minimum Standards

1 Shelter and Settlement

Shelter assistance is provided to individual households for the repair or construction of dwellings or the settlement of displaced households within existing accommodation or communities. When such dispersed settlement is not possible, shelter is provided collectively in suitable large public buildings or structures, e.g. warehouses, halls, barracks, etc. or in temporary planned or self-settled camps.

Individual household shelter solutions can be short- or long-term, subject to the level of assistance provided, land use rights or ownership, the availability of essential services and social infrastructure, and the opportunities for upgrading and expanding the dwellings.

Shelter and settlement standard 1: strategic planning

Existing shelter and settlement solutions are prioritised through the return or hosting of disaster-affected households, and the security, health, safety and well-being of the affected population are ensured.

Key indicators (to be read in conjunction with the guidance notes)

- Affected households return to the site of their original dwellings where possible (see guidance note 1).
- Affected households who cannot return to the site of their original dwellings settle independently within a host community or with host families where possible (see guidance note 2).
- Affected households who cannot return to the site of their original dwellings or who cannot settle independently within a host

community or with host families are accommodated in mass shelters or in temporary planned or self-settled camps (see guidance note 3).

- Actual or potential threats to the security of the affected population are assessed, and the dwellings or settlements are located at a safe distance from any such external threats (see guidance note 4).
- Risks from natural hazards including earthquakes, volcanic activity, landslides, flooding or high winds are minimised, and the area is not prone to diseases or significant vector risks (see guidance notes 4-5).
- Locations are free of potentially hazardous equipment or material, and existing hazards such as dangerous structures, debris or unstable ground are identified and made safe, or access is restricted and guarded (see guidance notes 4, 6 and 7).
- Land and property ownership and/or use rights for buildings or locations are established prior to occupation and permitted use is agreed as necessary (see guidance note 8).
- Water and sanitation services, and social facilities including health care, schools and places of worship, are available or can be satisfactorily provided (see guidance note 9).
- The transportation infrastructure provides access to the settlement for personal movement and the provision of services (see guidance note 10).
- Where possible, households can access land, markets or services for the continuation or development of livelihood support activities (see guidance note 11).

Guidance notes

1. ***Return:*** the opportunity to return to their own land and dwellings is a major goal for most disaster-affected people. The damaged dwelling and any surrounding land are major household assets for many disaster-affected households. However, return may not always be possible, due to security concerns such as occupation of property or land, continuing violent conflict, ethnic or religious tension, fear of persecution, or landmines and

unexploded ordnance. Shelter provision through the repair of damaged dwellings supports communal coping strategies, retains established settlement patterns and enables the use of existing infrastructure.

2. ***Hosting by families and communities:*** disaster-affected people often prefer to stay in a host community, with other family members or people who share historical, religious or other ties. In cases where this preference cannot be met, hosting by other groups within the community is also possible, with due consideration being given to potential security risks or social conflict. Shelter assistance may include support to expand or upgrade an existing host family shelter and facilities to better accommodate the displaced household, or the provision of an additional separate shelter adjacent to the host family. The resulting increase in population density and demand on social facilities and infrastructure provision should be appraised and addressed. Shelter provision through the construction of additional or extended dwellings in host communities also supports communal coping strategies.

3. ***Collective settlement:*** temporary planned camps should not become a default response. Such shelter solutions may be required in areas where security threats increase the risk to isolated households, or where essential services such as water and food are limited. The provision of mass shelter in large buildings or structures can provide rapid temporary protection from the climate, and may be preferable in cold climates when there are insufficient material resources to provide the required level of thermal comfort within individual dwellings. Although school buildings are often used to accommodate affected families, alternative structures should be sought wherever possible to enable schooling to continue for children from the host and potentially also the displaced community. Care must also be taken to ensure that collective settlements do not themselves become targets for attack or pose a security risk to the surrounding population.

4. ***Risk and vulnerability assessment:*** it is critical that a comprehensive risk and vulnerability assessment is undertaken, including actual or potential security threats and the particular social or economic vulnerabilities of differing social groupings within the affected and any host community (see Initial assessment standard on page 29).

5. ***Natural hazards:*** risks posed by the localised impact of natural hazards such as earthquakes, volcanic activity, landslides, flooding or high winds in any given location should also be assessed. Locations close to buildings or structures vulnerable to earthquake aftershocks, land formations vulnerable to landslides, low-lying sites prone to further lava flows or the build-up of exhaust gases, riverbanks and depressions at risk from further flooding and sites exposed to high winds should be avoided, until the assessed risks of returning to such locations have satisfactorily diminished.

6. ***Hazardous materials and goods:*** potentially hazardous materials and goods can be deposited or exposed following natural disasters such as earthquakes, floods and typhoons; mines and unexploded ordnance can be present due to previous or current conflicts. The presence of such items and the potential risks involved in their removal should be identified by appropriately experienced personnel. The time and expertise required for their safe removal may preclude the use of part or all of any locations affected.

7. ***Structural assessments:*** the stability of building structures in inhabited areas should be appraised by appropriately qualified personnel. Assessments should include the effects of further structural weakening from earthquake aftershocks, further flooding and high winds, etc. For mass shelters, the ability of existing building structures to accommodate any additional loading and the increased risk of the failure of building components such as floors, internal dividing walls, roofs, etc. should be assessed.

8. ***Land and building ownership and usage:*** such issues are often controversial, especially where records may not have been kept or where conflict may have affected possession. Ownership of the site or building(s) should be established and the holders of formal or customary use rights identified to the extent possible. The land or property rights of vulnerable groups should be identified and supported. This includes formal or understood rights of inheritance, particularly following a disaster in which the holder of the rights or title may have died or been displaced.

9. ***Availability of services and facilities:*** existing or repaired services or facilities should be identified and used, where there is sufficient capacity, before the construction of new facilities is considered (see Water Supply, Sanitation and Hygiene Promotion chapter on page 51).

10. ***Access to settlement locations:*** access to the settlement, the condition of local road infrastructure and proximity to airstrips, railheads or ports for the supply of relief assistance should be assessed, taking into account seasonal constraints, hazards and security risks. For mass shelters and temporary planned or self-settled camps, the site itself and any primary storage and food distribution points should be accessible by heavy trucks from an all-weather road. Other facilities should be accessible by light vehicles.

11. ***Livelihood support:*** an understanding of the pre-disaster economic activities of the affected population, and the opportunities within the post-disaster context, should guide the settling of affected populations. This should include land availability and access for cultivation and grazing; the location of and access to market areas; and the availability of and access to local services that may be essential to particular economic activities. The differing social and economic needs and constraints of particular vulnerable groups within the displaced or any host communities should also be assessed and accommodated accordingly (see Food security standards on page 119).

Shelter and settlement standard 2: physical planning

Local physical planning practices are used where possible, enabling safe and secure access to and use of shelters and essential services and facilities, as well as ensuring appropriate privacy and separation between individual household shelters.

Key indicators (to be read in conjunction with the guidance notes)

- Area or cluster planning by family, neighbourhood or village groups as appropriate supports existing social networks, contributes to security and enables self-management by the affected population (see guidance note 1).
- All members of the affected population have safe access to water, sanitary facilities, health care, solid waste disposal, graveyards and

social facilities, including schools, places of worship, meeting points and recreational areas (see guidance notes 2-4).

- Temporary planned or self-settled camps are based on a minimum surface area of 45m^2 for each person (see guidance note 5).
- The surface topography is used or augmented to facilitate water drainage, and the ground conditions are suitable for excavating toilet pits where this is the primary sanitation system (see guidance note 6).
- There are roads and pathways to provide safe, secure and all-weather access to the individual dwellings and facilities (see guidance note 7).
- Mass shelters have openings to enable required access and emergency evacuation, and these openings are positioned so that access is well supervised and does not pose a security threat to occupants (see guidance note 8).
- Vector risks are minimised (see guidance note 9).

Guidance notes

1. ***Cluster planning:*** for collective settlements, the allocation of space within mass shelters and plots within temporary planned camps should be guided by existing social practices and the provision and maintenance of shared resources, including water and sanitation facilities, cooking, food distribution, etc. The plot layout in temporary planned camps should maintain the privacy and dignity of separate households by offsetting door openings and ensuring that each household shelter opens onto common space. Safe, integrated living areas should also be provided for vulnerable groups and displaced communities that comprise a significant number of single adults or unaccompanied children. For dispersed settlements, the principles of cluster planning also apply e.g. groups of households return to a defined geographical area or identify host families in close proximity to one another.

2. ***Access to services and facilities:*** access to essential services, including water supply, toilets, and health and social facilities, should be planned to

maximise the use of existing or repaired facilities whilst minimising the adverse effect on any neighbouring or host communities. Additional facilities or access points should be provided as required to meet the needs of accommodating the target population, and planned to ensure safe access by all inhabitants. The social structure and gender roles of the affected population and the requirements of vulnerable groups should be reflected in the planning and provision of services. Safe play areas should be made available for children, and access to schools and other educational facilities provided where possible (see Water Supply, Sanitation and Hygiene Promotion chapter on page 51 and Health systems and infrastructure standard 5, guidance note 1 on page 267).

3. ***Handling the remains of the dead:*** social customs for dealing with the remains of the dead should be respected. Where customs vary, separate areas should be available for each social group to exercise their own traditions with dignity. Where existing facilities such as graveyards or crematoria are inadequate, alternative locations or facilities should be provided. Graveyards should be at least 30 metres from groundwater sources used for drinking water, with the bottom of any grave at least 1.5m above the groundwater table. Surface water from graveyards must not enter inhabited areas. The affected community should also have access to materials to meet the needs for culturally acceptable funeral pyres and other funeral rites (see also Health systems and infrastructure standard 5, guidance note 8 on page 269).

4. ***Administrative facilities and quarantine areas:*** as required, provision should be made for administrative offices, warehousing and staff accommodation to support disaster response activities, and for quarantine areas (see Control of communicable diseases standard 4 on page 279).

5. ***Surface area:*** the planning guideline of 45m^2 per person includes household plots and the area necessary for roads, footpaths, educational facilities, sanitation, firebreaks, administration, water storage, distribution areas, markets and storage, plus limited kitchen gardens for individual households. Area planning should also consider evolution and growth of the population. If the minimum surface area cannot be provided, consideration should be given to mitigating the consequences of higher-density occupation e.g. separation and privacy between individual households, space for the required facilities, etc.

6. ***Topography and ground conditions:*** for temporary planned camps the site gradient should not exceed 6%, unless extensive drainage and erosion control measures are taken, or be less than 1% to provide for adequate drainage. Drainage channels may still be required to minimise flooding or ponding. The lowest point of the site should be not less than 3 metres above the estimated level of the water table in the rainy season. Ground conditions should also inform the locations of toilets and other facilities and hence the planning of settlements e.g. fissured rock may disperse toilet waste widely; fine clays provide poor percolation and the early failure of toilet pits; volcanic rock makes the excavation of toilet pits difficult (see Excreta disposal standard 2 on page 73 and Drainage standard 1 on page 86).

7. ***Access to shelter locations:*** existing or new access routes should avoid proximity to any hazards. Where possible, such routes should also avoid creating isolated or screened areas that could pose a threat to the personal safety of users. Erosion as a result of the regular use of access routes should be minimised where possible through considered planning (see Shelter and settlement standard 4, guidance note 4 on page 221).

8. ***Access and emergency escape:*** mass shelters should ensure the free access of the occupants whilst enabling adequate supervision by the occupants themselves to minimise any potential security threat. Steps or changes of level close to exits to collective shelters should be avoided, and all stairways and ramps should be provided with handrails. Where possible, occupants with walking difficulties or those unable to walk without assistance should be allocated space on the ground floor, adjacent to exits or along access routes free from changes of level. All occupants of the building should be within an agreed reasonable distance of a minimum of two exits, providing a choice in the direction of escape in case of fire, and these exits should be clearly visible.

9. ***Vector risks:*** low-lying areas, pits, vacant buildings and excavations (such as those resulting from adobe construction) can provide breeding grounds for pests which could pose a health risk to adjacent households (see Vector control standard 2 on page 79).

Shelter and settlement standard 3: covered living space

People have sufficient covered space to provide dignified accommodation. Essential household activities can be satisfactorily undertaken, and livelihood support activities can be pursued as required.

Key indicators (to be read in conjunction with the guidance notes)

- The initial covered floor area per person is at least 3.5m^2 (see guidance notes 1-3).
- The covered area enables safe separation and privacy between the sexes, between different age groups and between separate families within a given household as required (see guidance notes 4-5).
- Essential household activities can be carried out within the shelter (see guidance notes 6 and 8).
- Key livelihood support activities are accommodated where possible (see guidance notes 7-8).

Guidance notes

1. ***Climate and context:*** in cold climates, household activities typically take place within the covered area and disaster-affected people may spend substantial time inside to ensure adequate thermal comfort. In urban settings, household activities typically occur within the covered area as there is usually less adjacent external space that can be used. In hot and humid climates, space to allow for additional air circulation is required to maintain a healthy environment. A covered floor area in excess of 3.5m^2 per person will often be required to meet these considerations. The floor to ceiling height is also a key factor, with greater height being preferable in hot and humid climates to aid air circulation, while a lower height is preferable in cold climates to minimise the internal volume that requires heating. In warmer climates, shaded external space adjacent to the shelter can be established for food preparation, cooking and sleeping.

2. ***Duration:*** in the immediate aftermath of a disaster, particularly in extreme climatic conditions where shelter materials are not readily available, a covered area of less than 3.5m^2 per person may be appropriate to save life and to provide adequate short-term shelter to the greatest number of people in need. In such instances, the shelter response should be designed to reach 3.5m^2 per person as soon as possible, as longer durations may begin to affect the health and well-being of the people accommodated. If 3.5m^2 per person cannot be achieved, or is in excess of the typical space used by the affected or neighbouring population, consideration should be given to the impact on dignity, health and privacy of a reduced covered area. A decision to provide less than 3.5m^2 per person should be highlighted, along with measures to mitigate against any adverse affects on the affected population.

3. ***Roof coverings:*** where materials for a complete shelter cannot be provided, the provision of roofing materials and the required structural support to provide the minimum covered area should be prioritised. The resulting enclosure, however, may not provide the necessary protection from the climate, or security, privacy and dignity, and steps should be taken to meet these needs as soon as possible.

4. ***Cultural practices:*** existing local practices in the use of covered living space, for example sleeping arrangements and the accommodation of extended family members, should inform the covered area required. Consultation should include members of vulnerable groups, as well as those caring for mobility-impaired individuals.

5. ***Safety and privacy:*** women, girls and boys are vulnerable to attack and care should be given to ensuring adequate separation from potential threats to their personal safety. Within individual household shelters, opportunities for internal subdivision should be provided for. In mass shelters, the grouping of related families, well-planned access routes through the building or structure, and materials to screen personal and household space can aid the provision of adequate personal privacy and safety.

6. ***Household activities:*** space should be provided for sleeping, washing and dressing; care of infants, children and the ill or infirm; the storage of food, water, household possessions and other key assets; cooking and eating indoors when required; and the common gathering of the household.

7. ***Design and space provision:*** the flexible use of the covered space provided could potentially accommodate different activities at different times during the day or night. The design of the structure, the location of openings and the opportunities for alternative internal subdivisions should enable the internal and immediately adjacent external space to accommodate livelihood support activities where required.
8. ***Other functions of shelter:*** it should be acknowledged that shelter, in addition to providing protection from the climate, security and privacy for individual households, etc., also serves other purposes. These include the establishing of territorial claims or rights, serving as a location at which to receive relief assistance, and the provision of post-disaster psychosocial support through the reconstruction process. It can also represent a major household financial asset.

Shelter and settlement standard 4: design

The design of the shelter is acceptable to the affected population and provides sufficient thermal comfort, fresh air and protection from the climate to ensure their dignity, health, safety and well-being.

Key indicators (to be read in conjunction with the guidance notes)

- The design of the shelter and the materials used are familiar where possible and culturally and socially acceptable (see guidance note 1).
- The repair of existing damaged shelters or the upgrading of initial shelter solutions constructed by the disaster-affected population is prioritised (see guidance note 2).
- Alternative materials required to provide temporary shelter are durable, practical and acceptable to the affected population (see guidance note 3).
- The type of construction, materials used and the sizing and positioning of openings provides optimal thermal comfort and ventilation (see guidance notes 4-7).

- Access to water supply sources and sanitation facilities, and the appropriate provision of rainwater harvesting, water storage, drainage and solid waste management, complement the construction of shelters (see guidance note 8).
- Vector control measures are incorporated into the design and materials are selected to minimise health hazards (see guidance note 9).

Guidance notes

1. ***Participatory design:*** each affected household should be involved to the maximum extent possible in determining the final form and materials used. Priority should be given to the opinions of those groups or individuals who typically have to spend more time within the shelters. The orientation of the individual shelter or covered area, the sizing and layout of the space provided, the positioning of door and window openings for adequate access, lighting and ventilation, and any internal subdivisions should reflect local practices where these are known to be safe. This should be informed by assessments of existing typical housing forms accommodating the respective needs (see Participation standard on page 28).
2. ***Local shelter initiatives and the repair of damaged buildings:*** disaster-affected populations often improvise shelter solutions using material salvaged from their damaged homes or otherwise locally sourced, using traditional or improvised building techniques. Material support and technical assistance to make one or more rooms habitable within a damaged house or to upgrade improvised shelters may be preferred to unfamiliar or collective shelter solutions. Risks from further natural disasters such as earthquake aftershocks and landslides, potential security threats and issues of reconciliation for households returning to areas affected by conflict, and the health and safety risks posed by damaged infrastructure or buildings, should be addressed.
3. ***Materials and construction:*** where local or familiar materials are not readily available or advisable, designs and materials that are culturally acceptable should be identified through participatory consultation with the affected community. Reinforced plastic sheeting is typically supplied to households in the initial stage of a disaster response, occasionally with rope and support materials such as locally procured timber, plastic tubing or

galvanised steel sections. Such sheeting should meet specifications accepted by the international humanitarian community.

4. ***In warm, humid climates:*** shelters must be oriented and designed to maximise ventilation and minimise entry of direct sunlight. Obstruction to openings, for example by neighbouring shelters, should be avoided to maximise air flow. The roof should have a reasonable slope for rainwater drainage and have large overhangs. The construction of the shelter should be lightweight, as low thermal capacity is required. Seasonal rains should be taken into account and consideration should be given to adequate surface water drainage around the shelter and to raised floors to minimise water ingress. Existing vegetation can increase water absorption into the soil.

5. ***In hot, dry climates:*** construction should be heavy to ensure high thermal capacity, allowing changes in night and day temperatures to alternately cool and heat the interior, or lightweight with adequate insulation. Adequate care should be taken in the structural design of heavy construction in areas with seismic risks. If only plastic sheeting or tents are available, a double-skinned roof with ventilation between the layers to reduce radiant heat gain should be provided. Door and window openings positioned away from the direction of the prevailing wind will help to minimise heating by hot winds and radiation from the surrounding ground. Shade and protection from hot winds can also be gained from adjacent shelters and surrounding natural land forms or trees. Flooring contiguous with the external walling should be provided to minimise sand penetration.

6. ***In cold climates:*** heavy construction with high thermal capacity is required for shelters that are occupied throughout the day. Lightweight construction with low thermal capacity and high insulation is more appropriate for shelters that are occupied only at night. Air flow through the shelter should be kept to the minimum necessary to ensure personal comfort whilst also providing adequate ventilation for space heaters or cooking stoves. Door and window openings should be designed to minimise draughts. Stoves or other forms of space heaters are essential and must be appropriate to the shelter. The loss of body heat through the floor should be minimised by ensuring that the floor is insulated and through the use of insulated sleeping mats, mattresses or raised beds (see Non-food items standard 1 on page 230 and standard 4 on page 234).

7. ***Ventilation:*** adequate ventilation should be provided within the shelter design to maintain a healthy internal environment and to limit the risk of transmission of diseases such as TB spread by droplet infection.
8. ***Local water acquisition, sanitation and waste management practices:*** pre-disaster practices in sourcing safe water and methods of defecation and waste management should be ascertained and the opportunities and constraints of such practices in the post-disaster situation identified. The location of toilets and solid waste management facilities must not compromise the cultural, environmental, security or social aspects of the design or layout of individual shelters or of the settlement (see Water Supply, Sanitation and Hygiene Promotion chapter on page 51).
9. ***Vector risk identification:*** an understanding of local building practices, the patterns of shelter use by displaced people and material selection should inform the shelter design and subsequent vector control measures. Typical risks are posed by mosquitoes, rats and flies and pests such as snakes, scorpions and termites (see Vector control standards 1-3 on pages 76-82).

Shelter and settlement standard 5: construction

The construction approach is in accordance with safe local building practices and maximises local livelihood opportunities.

Key indicators (to be read in conjunction with the guidance notes)

- Locally sourced materials and labour are used without adversely affecting the local economy or environment (see guidance notes 1-2).
- Locally derived standards of workmanship and materials are achieved (see guidance note 3).
- Construction and material specifications mitigate against future natural disasters (see guidance note 4).
- The type of construction and materials used enable the maintenance and upgrading of individual household shelters using locally available tools and resources (see guidance note 5).

- The procurement of materials and labour and the supervision of the construction process are transparent, accountable and in accordance with internationally accepted bidding, purchasing and construction administration practices (see guidance note 6).

Guidance notes

1. ***Sourcing of shelter materials and labour:*** livelihood support should be promoted through the local procurement of building materials, specialist building skills and manual labour. Multiple sources, alternative materials and production processes, or the provision of regionally or internationally sourced materials or proprietary shelter systems are required if the local harvesting and supply of materials is likely to have a significant adverse impact on the local economy or the environment. The re-use of materials salvaged from damaged buildings should be promoted where feasible, either as primary construction materials (bricks or stone masonry, roof timber, roof tiles, etc.) or as secondary material (rubble for foundations or levelling roads, etc.). Ownership of or the rights to such material should be identified and agreed (see Shelter and settlement standard 6, guidance note 3 on page 228).

2. ***Participation of affected households:*** skills training programmes and apprenticeship schemes can maximise opportunities for participation during construction, particularly for individuals lacking the required building skills or experience. Complementary contributions from those less able to undertake physically or technically demanding tasks can include site monitoring and inventory control, the provision of child care or temporary accommodation and catering for those engaged in construction works, and administrative support. Consideration should be given to the other demands on the time and labour resources of the affected population. The inclusion of food-for-work initiatives can provide the necessary food security to enable affected households to actively participate. Single women, female-headed households and women with disabilities are particularly at risk from sexual exploitation in seeking assistance for the construction of their shelter. The provision of assistance from volunteer community labour teams or contracted labour could complement any beneficiary contributions (see Participation standard on page 28).

3. ***Construction standards:*** standards of good practice should be agreed with the relevant authorities to ensure that key safety and performance requirements are met. In locations where applicable local or national building codes have not been customarily adhered to or enforced, incremental compliance should be agreed.

4. ***Disaster prevention and mitigation:*** the design should be consistent with known climatic conditions, be capable of withstanding appropriate wind-loading, and accommodate snow-loading in cold climates. Earthquake resistance and ground bearing conditions should be assessed. Recommended or actual changes to building standards or common building practices as a result of the disaster should be applied in consultation with local authorities and the disaster-affected population.

5. ***Upgrading and maintenance:*** as emergency shelter responses typically provide only a minimum level of enclosed space and material assistance, affected families will need to seek alternative means of increasing the extent or quality of the enclosed space provided. The form of construction and the materials used should enable individual households to incrementally adapt or upgrade the shelter or aspects of the design to meet their longer-term needs and to undertake repairs using locally available tools and materials.

6. ***Procurement and construction management:*** a responsive, efficient and accountable supply chain and construction management system for materials, labour and site supervision should be established that includes sourcing, procurement, transportation, handling and administration, from point of origin to the respective site as required.

Shelter and settlement standard 6: environmental impact

The adverse impact on the environment is minimised by the settling of the disaster-affected households, the material sourcing and construction techniques used.

Key indicators (to be read in conjunction with the guidance notes)

- The temporary or permanent settling of the affected population considers the extent of the natural resources available (see guidance notes 1-2).
- Natural resources are managed to meet the ongoing needs of the displaced and host populations (see guidance notes 1-2).
- The production and supply of construction material and the building process minimises the long-term depletion of natural resources (see guidance notes 2-3).
- Trees and other vegetation are retained where possible to increase water retention, minimise soil erosion and to provide shade (see guidance note 4).
- The locations of mass shelters or temporary planned camps are returned to their original condition, unless agreed otherwise, once they are no longer needed for emergency shelter use (see guidance note 5).

Guidance notes

1. ***Sustainability and the management of environmental resources:*** in environments where the natural resources to sustain a substantial increase in human habitation are limited, efforts should be made to contain non-sustainable demand on the environment. Sustainable external supplies of fuel and managed options for livestock grazing, agricultural production and natural resource-dependent livelihood support activities should be provided. In environments with extensive natural resources that could sustain a substantial increase in human habitation, the affected population

should be dispersed, if necessary, into a number of small settlements, since these are less likely to cause environmental damage than large settlements. Access rights to existing natural resources, such as fuel, water, timber for construction, stone and sand, etc., and the typical use and maintenance of existing land and wooded areas should be identified.

2. ***Mitigating long-term environmental impact:*** where the need to provide shelter for affected populations has a significant adverse impact on the environment, e.g. through the depletion of local natural resources, efforts should be made to minimise the long-term effects through complementary environmental management and rehabilitation activities.

3. ***Sourcing of construction materials:*** the environmental impact of pre-disaster sourcing practices and large-scale post-disaster demands on natural resources, such as water, construction timber, sand, soil and grasses, as well as fuel for the firing of bricks and roof tiles, should be assessed. Customary users, extraction and regeneration rates and the ownership or control of these resources should be identified. Alternative or complementary sources of supply may support the local economy and reduce any long-term adverse impact on the local environment. Multiple sources and the re-use of salvaged materials, alternative materials and production processes (such as the use of stabilised earth blocks) should be specified, together with the adoption of sustainable practices such as complementary replanting or regeneration programmes.

4. ***Erosion:*** an assessment of typical land usage, the distribution of existing vegetation and surface water drainage patterns should be undertaken to assess the impact of any ground clearance that may be required. The use of agricultural or grazing land should be planned to minimise any adverse impact on the local natural habitat. Shelter solutions should be planned to retain existing trees and other vegetation to maintain the soil stabilisation such growth provides and to maximise the opportunities for shade and protection from the climate. Roads, pathways and drainage networks should be planned to make use of natural contours in order to minimise erosion and flooding. Where this cannot be achieved, satisfactory measures to contain any likely erosion should be provided, such as the provision of excavated drainage culverts, piped drainage runs under roadways, or planted earth banks to minimise water run-off (see Drainage standard 1 on page 86).

5. ***Handover:*** the natural regeneration of the environment in and around mass shelters and temporary planned or self-settled camps should be enhanced through appropriate environmental rehabilitation measures during the life of the temporary settlement. The eventual discontinuation of any such temporary settlements should be managed to ensure the satisfactory removal of all material or waste that cannot be re-used or that could have an adverse effect on the environment.

2 Non-Food Items: Clothing, Bedding and Household Items

Clothing, blankets and bedding materials meet the most personal human needs for shelter from the climate and the maintenance of health, privacy and dignity. Basic goods and supplies are required to enable families to meet personal hygiene needs, prepare and eat food, provide thermal comfort and build, maintain or repair shelters.

Non-food items standard 1: clothing and bedding

The people affected by the disaster have sufficient clothing, blankets and bedding to ensure their dignity, safety and well-being.

Key indicators (to be read in conjunction with the guidance notes)

- Women, girls, men and boys have at least one full set of clothing in the correct size, appropriate to the culture, season and climate. Infants and children up to two years old also have a blanket of a minimum 100cmx70cm (see guidance notes 1-4).
- People have access to a combination of blankets, bedding or sleeping mats to provide thermal comfort and to enable separate sleeping arrangements as required (see guidance notes 2-4).
- Those individuals most at risk have additional clothing and bedding to meet their needs (see guidance note 5).
- Culturally appropriate burial cloth is available when needed.

Guidance notes

1. ***Changes of clothing:*** individuals should have access to sufficient changes of clothing to ensure their thermal comfort, dignity and safety. This could entail the provision of more than one set of essential items, particularly underclothes, to enable laundering.

2. ***Appropriateness:*** clothing should be appropriate to climatic conditions and cultural practices, separately suitable for men, women, girls and boys, and sized according to age. Bedding materials where possible should reflect cultural practices and be sufficient in quantity to enable separate sleeping arrangements as required amongst the members of individual households.

3. ***Thermal performance:*** consideration should be given to the insulating properties of clothing and bedding and the effect of wet or damp climatic conditions on their thermal performance. An appropriate combination of clothing and bedding items should be provided to ensure a satisfactory level of thermal comfort is attained. Provision of insulated sleeping mats to combat heat loss through the ground may be more effective than providing additional blankets.

4. ***Durability:*** clothing and bedding provided should be sufficiently durable to accommodate typical wear and likely prolonged usage due to the lack of alternative items.

5. ***Special needs:*** additional changes of clothing should be provided where possible to people with incontinence problems, people with HIV/AIDS and associated diarrhoea, pregnant and lactating women, older people, disabled people and others with impaired mobility. Infants and children are more prone to heat loss than adults due to their ratio of body surface area to mass, and may require additional blankets, etc. to maintain appropriate levels of thermal comfort. Given their lack of mobility, older people and the ill or infirm, including individuals with HIV/AIDS, may also require particular attention, such as the provision of mattresses or raised beds.

Non-food items standard 2: personal hygiene

Each disaster-affected household has access to sufficient soap and other items to ensure personal hygiene, health, dignity and well-being.

Key indicators (to be read in conjunction with the guidance notes)

- Each person has access to 250g of bathing soap per month (see guidance notes 1-3).
- Each person has access to 200g of laundry soap per month (see guidance note 1-3).
- Women and girls have sanitary materials for menstruation (see guidance note 4).
- Infants and children up to two years old have 12 washable nappies or diapers where these are typically used.
- Additional items essential for ensuring personal hygiene, dignity and well-being can be accessed (see guidance note 5).

Guidance notes

1. ***Appropriateness:*** existing cultural practices and familiar products should be assessed in specifying the items supplied. Care should be taken to avoid specifying products that would not be used due to lack of familiarity or that could be misused (e.g. being mistaken for foodstuffs). Where culturally appropriate or preferred, washing powder can be specified instead of laundry soap or the use of suitable alternatives such as ash or clean sand promoted.
2. ***Replacement:*** consideration should be given for consumables to be replaced when necessary.
3. ***Special needs:*** additional quantities of bathing and laundry soap should be provided where possible to people with incontinence problems, people with HIV/AIDS and associated diarrhoea, and older people, disabled people or others with impaired mobility.

4. ***Sanitary protection:*** women and girls should receive appropriate material for menstruation. It is important that these materials are appropriate and discreet and that women are involved in making decisions about what is provided.

5. ***Additional items:*** existing social and cultural practices may require that additional personal hygiene items can be accessed. Subject to availability, these items per person per month could include 75ml/100g of toothpaste; one toothbrush; 250ml of shampoo; 250ml of lotion for infants and children up to two years old; one disposable razor. Per household they could also include one hairbrush and/or comb, and nail clippers.

Non-food items standard 3: cooking and eating utensils

Each disaster-affected household has access to cooking and eating utensils.

Key indicators (to be read in conjunction with the guidance notes)

- Each household has access to a large-sized cooking pot with handle and a pan to act as a lid; a medium-sized cooking pot with handle and lid; a basin for food preparation or serving; a kitchen knife; and two wooden serving spoons (see guidance note 1).
- Each household has access to two 10- to 20-litre water collection vessels with a lid or cap (20-litre jerry can with a screw cap or 10-litre bucket with lid), plus additional water or food storage vessels (see guidance notes 1-2).
- Each person has access to a dished plate, a metal spoon and a mug or drinking vessel (see guidance notes 1-4).

Guidance notes

1. ***Appropriateness:*** items provided should be culturally appropriate and enable safe practices to be followed. Women or those typically overseeing the preparation of food and the collection of water should be consulted when specifying items. Cooking and eating utensils and water collection vessels should be sized to suit older people, people with disabilities and children as required.
2. ***Plastic goods:*** all plastic goods (buckets, bowls, jerry cans, water storage vessels, etc.) should be of food-grade plastic (see also Water supply standard 3, guidance note 1 on page 70).
3. ***Metallic goods:*** all cutlery, bowls, plates and mugs should be of stainless steel or other non-ferrous metal.
4. ***Infant feeding:*** infant feeding bottles should not be provided, unless exceptional circumstances require the provision of breast milk substitutes (see General nutrition support standard 2, guidance note 1 on page 141).

Non-food items standard 4: stoves, fuel and lighting

Each disaster-affected household has access to communal cooking facilities or a stove and an accessible supply of fuel for cooking needs and to provide thermal comfort. Each household also has access to appropriate means of providing sustainable artificial lighting to ensure personal security.

Key indicators (to be read in conjunction with the guidance notes)

- Where food is cooked on an individual household basis, each household has a stove and fuel to meet essential cooking and heating needs (see guidance notes 1-2).
- Environmentally and economically sustainable sources of fuel are identified and prioritised over fuel provided from external sources (see guidance note 3).

- Fuel is obtained in a safe and secure manner, and there are no reports of incidents of harm to people in the routine collection of fuel (see guidance note 4).
- Safe fuel storage space is available.
- Each household has access to sustainable means of providing artificial lighting, e.g. lanterns or candles.
- Each household has access to matches or a suitable alternative means of igniting fuel or candles, etc.

Guidance notes

1. ***Stoves:*** existing local practices should be taken into account in the specification of stove and fuel solutions. Energy-efficient cooking practices should be promoted, including firewood preparation, fire management, food preparation, shared cooking, etc. This could include possible changes to the type of food to be prepared, such as any rations provided by food assistance programmes e.g. pulses require considerable cooking and hence fuel. Where displaced populations are accommodated in mass shelters, communal or centralised cooking and heating facilities are preferable to the provision of individual household stoves, to minimise fire risks and indoor smoke pollution.
2. ***Ventilation:*** if used inside an enclosed area, stoves should be fitted with flues to vent exhaust gases or smoke to the exterior in a safe manner. Alternatively, the positioning of the stoves and weather-protected openings within the shelter enclosure should be utilised to ensure adequate ventilation and to minimise the risk of indoor pollution and respiratory problems. Stoves should be designed to minimise the risk of fire and of indoor and outdoor pollution.
3. ***Sustainable sources of fuel:*** sources of fuel should be managed, and measures taken to replenish and regenerate resources to ensure sustainability of supply.
4. ***Collecting fuel:*** women should be consulted about the location and means of collecting fuel for cooking and heating to address issues of personal safety. The demands of collecting fuel on particularly vulnerable

groups, such as female-headed households and households caring for PLWH/A, should be addressed. Special provisions should be made where possible e.g. the choice of less labour-intensive fuels, the use of fuel-efficient stoves and accessible fuel sources.

Non-food items standard 5: tools and equipment

Each disaster-affected household responsible for the construction or maintenance and safe use of their shelter has access to the necessary tools and equipment.

Key indicators (to be read in conjunction with the guidance notes)

- Where responsible for constructing part or all of their shelters or for carrying out essential maintenance, each household has access to tools and equipment to safely undertake each task (see guidance notes 1-2).
- Training or guidance in the use of the tools and in the shelter construction or maintenance tasks required is provided where necessary (see guidance note 3).
- Materials to reduce the spread of vector-borne disease, such as impregnated mosquito nets, are provided to protect each member of the household (see Vector control standards 1-3 on pages 76-82).

Guidance notes

1. ***Typical tool sets:*** subject to local practices, typical tool sets could include a hammer or mallet, an axe or machete, and a spade or shovel. The specification should be such that the tools can be easily repaired locally with available technologies. Displaced communities should also have access to sufficient tools to excavate surface water drainage channels and to handle the remains of the deceased as appropriate, through the construction of coffins, the excavation of graves and burial pits or the preparation of funeral pyres.

2. ***Livelihood activities:*** where possible, the tools provided should also be appropriate for livelihood support activities.
3. ***Technical assistance:*** female-headed households and other identified vulnerable groups may require assistance from extended family members, neighbours or contracted labour to undertake the designated construction or maintenance tasks.

Appendix 1

Shelter, Settlement and Non-Food Items Initial Needs Assessment Checklist

This list of questions serves as a guide and checklist to ensure that appropriate information is obtained that should influence post-disaster shelter response. The list of questions is not mandatory, and should be used and adapted as appropriate. It is assumed that information on the underlying causes of the disaster, the security situation, the basic demographics of the displaced and any host population and the key people to consult and contact, is separately obtained (see Initial assessment standard on page 29).

1 Shelter and Settlement

Demographics

- How many people comprise a typical household?
- Does the affected community comprise groups of individuals who do not form typical households, such as unaccompanied children, or particular minority groups with household sizes that are not typical?
- How many households are without any or with inadequate shelter and where are they?
- How many people who are not members of individual households are without any or with inadequate shelter and where are they?

Risks

- What is the immediate risk to life of the lack of shelter and inadequate shelter, and how many people are at risk?
- What are the potential risks to the lives, health and security of the affected population through the need for shelter?

- What are the potential risks to and impact on any host populations due to the presence of displaced households?
- What are the potential further risks to lives, health and security of the affected population as a result of the ongoing effects of the disaster on the provision of shelter?
- Who are the vulnerable people in the population, also considering those affected by HIV/AIDS?
- What are the particular risks for the vulnerable people and why?

Household activities

- What household and livelihood support activities typically take place in the shelters of the affected population, and how does the resulting space provision and design reflect these activities?
- What household and livelihood support activities typically take place in the external areas around the shelters of the affected population, and how does the resulting space provision and design reflect these activities?

Materials and design

- What initial shelter solutions or materials have been provided to date by the affected households or other actors?
- What existing materials can be salvaged from the damaged site (if applicable) for use in the reconstruction of shelters?
- What are the typical building practices of the displaced and host populations, and what are the different materials that are used to provide the structural frame and roof and external wall enclosures?
- What alternative design or materials solutions are potentially available and familiar or acceptable to the affected population?
- How can the potential shelter solutions identified accommodate appropriate single and multiple disaster prevention and mitigation concerns?
- How are shelters typically built and by whom?

- How are construction materials typically obtained and by whom?
- How can women, youths and older people be trained or assisted to participate in the building of their own shelters, and what are the constraints?

Local resources and constraints

- What are the current material, financial and human resources of the affected households and the community, and the constraints to meeting some or all of their urgent shelter needs?
- What are the opportunities and constraints of current patterns of land ownership, land usage and the availability of vacant land, in helping to meet urgent shelter needs?
- What are the opportunities and constraints of the host population in accommodating displaced households within their own dwellings or on adjacent land?
- What are the opportunities and constraints of utilising existing, available and unaffected buildings or structures to temporarily accommodate displaced households?
- What is the topographical and environmental suitability of using accessible vacant land to accommodate temporary settlements?
- What are the requirements and constraints of local authority regulations in developing shelter solutions?

Essential services and facilities

- What is the current availability of water for drinking and personal hygiene, and what are the possibilities and constraints in meeting the anticipated sanitation needs?
- What is the current provision of social facilities (health clinics, schools, places of worship, etc.) and what are the constraints and opportunities of accessing these facilities?

Host community and environmental impact

- What are the issues of concern for the host community?
- What are the organisational and planning issues of accommodating the displaced households within the host community or within temporary settlements?
- What are the environmental concerns in providing the necessary shelter assistance (construction materials and access) and in supporting the displaced households (fuel, sanitation, waste disposal, grazing for animals if appropriate)?
- What opportunities are present for building local shelter and settlement provision and management capacities?
- What livelihood support opportunities can be provided through the sourcing of materials and the construction of shelter and settlement solutions?

2 Non-Food Items: Clothing, Bedding and Household Items

Clothing and bedding

- What is the customary provision of clothing, blankets and bedding for women, men, children and infants, pregnant and lactating women and older people, and what are the particular social and cultural considerations?
- How many women and men of all ages, children and infants have inadequate or insufficient clothing, blankets or bedding to provide protection from the adverse effects of the climate and to maintain their health, dignity and well-being, and why?
- What is the immediate risk to life of the lack of adequate clothing, blankets or bedding, and how many people are at risk?
- What are the potential risks to the lives, health and personal safety of the affected population through the need for adequate clothing, blankets or bedding?

- Which social groups are most at risk, and why? How can these groups be best supported to empower themselves?

Personal hygiene

- What essential items to address personal hygiene issues did a typical household have access to before the disaster?
- What essential items do affected households no longer have access to?
- What are the particular needs of women, girls, children and infants?
- What additional items are considered socially or culturally important to maintain the health and dignity of the affected people?

Cooking and eating, stoves and fuel

- What cooking and eating utensils did a typical household have access to before the disaster?
- How many households do not have access to sufficient cooking and eating utensils, and why?
- What form of stove for cooking and heating did a typical household have access to, where did the cooking take place in relation to the existing shelter and the surrounding area, and what fuel was typically used?
- How many households do not have access to a stove for cooking and heating, and why?
- How many households do not have access to adequate supplies of fuel for cooking and heating, and why?
- What are the opportunities and constraints, in particular the environmental concerns, of sourcing adequate supplies of fuel for the displaced households and the host community as appropriate?
- What is the impact on the women in the displaced community of sourcing adequate supplies of fuel?
- What cultural and customary use and safe practice considerations should be taken into account?

Tools and equipment

- What basic tools to construct, maintain or repair a shelter do the households have access to?
- What livelihood support activities can also utilise the basic tools for shelter construction, maintenance and repair?
- Does the climate or natural environment require a ground covering to maintain appropriate standards of health and dignity, and what appropriate material solutions can be provided?
- What vector control measures, particularly the provision of mosquito nets, are required to ensure the health and well-being of households?

Appendix 2

References

Thanks to the Forced Migration Online programme of the Refugee Studies Centre at the University of Oxford, many of these documents have received copyright permission and are posted on a special Sphere link at: http://www.forcedmigration.org

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Notes

Notes

Chapter 5: Minimum Standards in Health Services

How to use this chapter

This chapter is divided into three main sections: Health Systems and Infrastructure; Control of Communicable Diseases; and Control of Non-Communicable Diseases. The organisation of the chapter promotes a systems approach to the design, implementation, monitoring and evaluation of health services during a disaster. This is the most reliable means of ensuring that priority health needs are identified and met in an efficient and effective manner. Principles such as supporting national and local health systems, coordination and standardisation are stressed throughout.

Each of the sections contains the following:

- *the minimum standards:* these are qualitative in nature and specify the minimum levels to be attained in the provision of health services;
- *key indicators:* these are 'signals' that show whether the standard has been attained. They provide a way of measuring and communicating the impact, or result, of programmes as well as the process, or methods, used. The indicators may be qualitative or quantitative;
- *guidance notes:* these include specific points to consider when applying the standard and indicators in different situations, guidance on tackling practical difficulties, and advice on priority issues. They may also include critical issues relating to the standard or indicators, and describe dilemmas, controversies or gaps in current knowledge.

Appendices at the end of the chapter include a checklist for assessments, sample data collection forms, formulas for calculating rates of mortality and morbidity, and a select list of references, which point to sources of information on both general issues and specific technical issues relating to this chapter.

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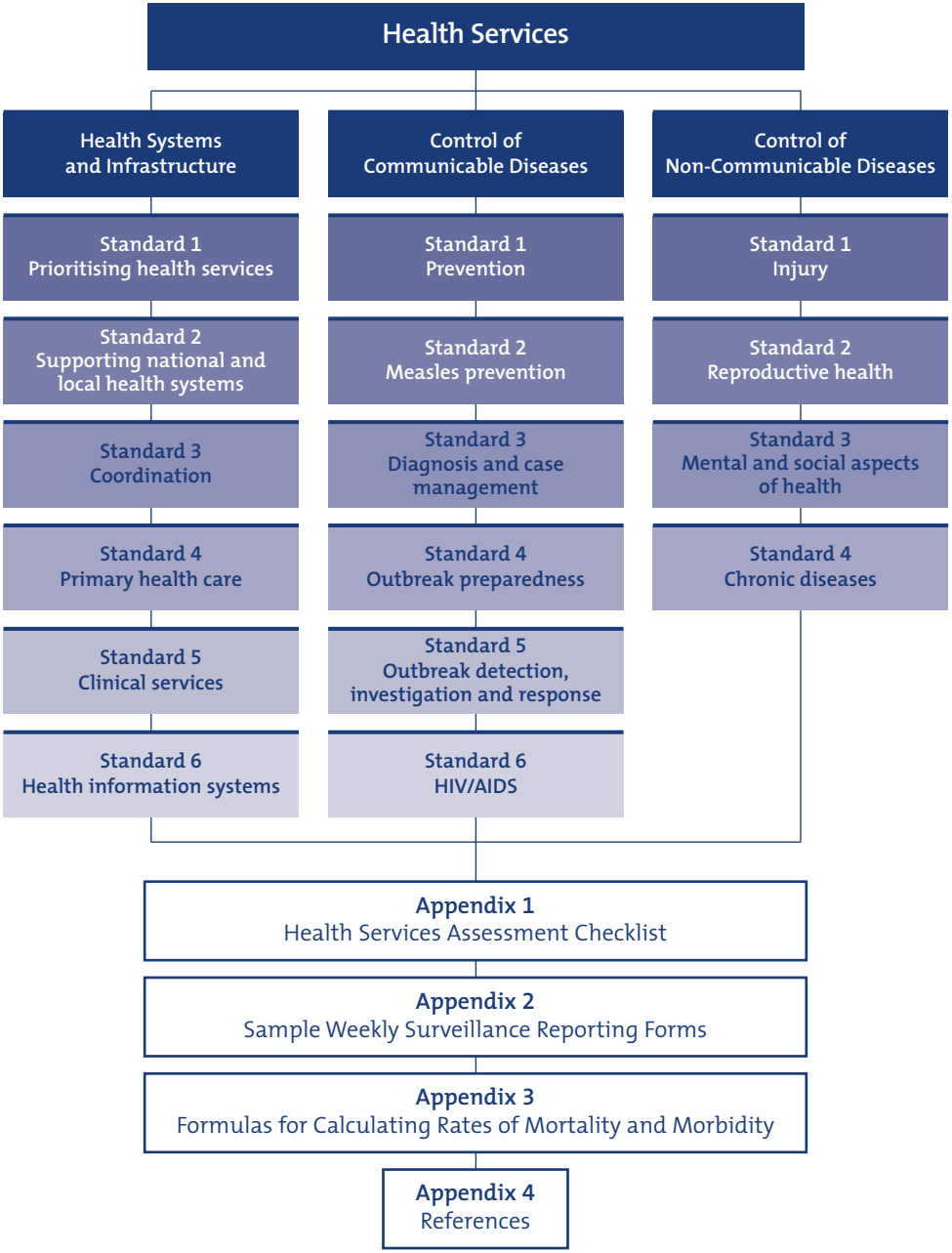
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Introduction

Links to international legal instruments

The Minimum Standards in Health Services are a practical expression of the principles and rights embodied in the Humanitarian Charter. The Humanitarian Charter is concerned with the most basic requirements for sustaining the lives and dignity of those affected by calamity or conflict, as reflected in the body of international human rights, humanitarian and refugee law.

Everyone has the right to health, as recognised in a number of international legal instruments. This embraces not only the right to equal access to health care but also to the underlying determinants of health, all of which involve the fulfilment of other human rights, such as access to safe water and adequate sanitation; an adequate supply of safe food, nutrition and housing; healthy environmental conditions; access to health-related education and information; non-discrimination; and human dignity and the affirmation of individual self-worth.

The right to health can be assured only if the population is protected, if the professionals responsible for the health care system are well trained and committed to universal ethical principles and professional standards, if the system in which they work is designed to meet minimum standards of need, and if the state is disposed to establish and secure these conditions of safety and stability. Essential to this human rights perspective are the issues of dignity and equity, and the obligations of states and non-state actors in fulfilling the individual's right to health. In times of armed conflict, civilian hospitals and medical facilities may in no circumstances be the object of attack, and health and medical staff have the right to be respected and protected.

The Minimum Standards in this chapter are not a full expression of the Right to Health. However, the Sphere standards reflect the core content of the Right to Health and contribute to the progressive realisation of this right globally.

The importance of health services in disasters

Health care is a critical determinant for survival in the initial stages of a disaster. Disasters almost always have significant impacts on the public health and well-being of affected populations. The public health impacts may be described as direct (e.g. injury, psychological trauma) or indirect (e.g. increased rates of infectious diseases, malnutrition, complications of chronic diseases). These indirect health impacts are usually related to factors such as inadequate quantities and quality of water, breakdowns in sanitation, interruption in food supplies, disruption of health services, overcrowding and population displacements.

The primary goals of humanitarian response to disasters are to: 1) prevent and reduce excess mortality and morbidity, and 2) promote a return to normalcy. Different types of disaster are associated with differing scales and patterns of mortality and morbidity (see table on page 257), and the public health and medical needs of an affected community will therefore vary according to the type and extent of disaster.

Prioritisation of health services requires a clear understanding of the affected community's prior health status, needs, health risks, resources and capacities. In the early stages of a disaster, information may be incomplete and important public health decisions may have to be made without all of the relevant data being available and/or analysed. A multi-sectoral assessment that includes community representatives should therefore be conducted as soon as possible to determine the public health impact of the disaster, the priority public health needs, the availability of local resources and the requirements for external assistance (see Initial assessment standard on page 29 and Appendix 1).

In general, priority public health interventions are designed to ensure that the greatest health benefit is provided to the greatest number of people. As far as possible, interventions should be based on the principle of evidence-based practice: those with a demonstrated public health benefit are preferred. Such interventions will usually include adequate quantities of safe water, sanitation, nutritional services, food aid/food security, shelter and basic clinical care. Preventive and clinical services should aim primarily to control diseases of epidemic potential.

A mass measles vaccination campaign will be a major priority for populations at risk of a measles outbreak, especially refugees and those affected by complex emergencies. In most disaster settings, referral services and hospital-based care, while important, have a smaller public health impact than primary health care interventions.

Participation of disaster-affected communities in the design, implementation, monitoring and evaluation of health services is essential. During this process there should be efforts to identify and build on existing capacities within the health sector. Building local capacity together with affected populations is probably the most effective means of helping communities to recover from disasters and to prepare them for future disasters. Refugees and internally displaced persons (IDPs) are likely to place additional strains on the health services of host populations. Humanitarian efforts should therefore aim to integrate with and support the health services of host populations as much as possible.

In most disaster situations, women and children are the main users of health care services, and it is important to seek women's views as a means of ensuring that services are equitable, appropriate and accessible for the affected population as a whole. Women can contribute to an understanding of cultural factors and customs that affect health, as well as the specific needs of vulnerable people within the affected population. They should therefore actively participate in the planning and implementation of health care services from the outset.

Links to other chapters

Many of the standards in the other sector chapters are relevant to this chapter. Progress in achieving standards in one area often influences and even determines progress in other areas. For a response to be effective, close coordination and collaboration are required with other sectors. Coordination with local authorities and other responding agencies is also necessary to ensure that needs are met, that efforts are not duplicated, and that the quality of health services is optimised. Reference to specific standards or guidance notes in other technical chapters is made where relevant.

Links to the standards common to all sectors

The process by which a response is developed and implemented is critical to its effectiveness. This chapter should be utilised in conjunction with the standards common to all sectors, which cover participation, initial assessment, response, targeting, monitoring, evaluation, aid worker competencies and responsibilities, and the supervision, management and support of personnel (see chapter 1, page 21). In particular, in any response the participation of disaster-affected people – including the vulnerable groups outlined below – should be maximised to ensure its appropriateness and quality.

Vulnerabilities and capacities of disaster-affected populations

The groups most frequently at risk in emergencies are women, children, older people, disabled people and people living with HIV/AIDS (PLWH/A). In certain contexts, people may also become vulnerable by reason of ethnic origin, religious or political affiliation, or displacement. This is not an exhaustive list, but it includes those most frequently identified. Specific vulnerabilities influence people's ability to cope and survive in a disaster, and those most at risk should be identified in each context.

Throughout the handbook, the term 'vulnerable groups' refers to all these groups. When any one group is at risk, it is likely that others will also be threatened. Therefore, whenever vulnerable groups are mentioned, users are strongly urged to consider all those listed here. Special care must be taken to protect and provide for all affected groups in a non-discriminatory manner and according to their specific needs. However, it should also be remembered that disaster-affected populations possess, and acquire, skills and capacities of their own to cope, and that these should be recognised and supported.

Public Health Impact of Selected Disasters					
Effect	**Complex emergencies**	**Earthquakes**	**High winds (without flooding)**	**Floods**	**Flash floods/ tsunamis**
Deaths	Many	Many	Few	Few	Many
Severe injuries	Varies	Many	Moderate	Few	Few
Increased risk of communicable diseases	High	Small	Small	Varies	Small
Food scarcity	Common	Rare	Rare	Varies	Common
Major population displacements	Common (may occur in heavily damaged urban areas)	Rare	Rare	Common	Varies

Source: adapted from Pan American Health Organization, *Emergency Health Management After Natural Disaster*. Office of Emergency Preparedness and Disaster Relief Coordination: Scientific Publication No. 47. Washington, DC. Pan American Health Organization, 1981.

NB: Even for specific types of disaster, the patterns of morbidity and mortality vary significantly from context to context. For example, the enforcement of building codes can dramatically reduce the number of deaths and serious injuries associated with earthquakes. In some complex emergencies communicable diseases and malnutrition are the major causes of morbidity and mortality, while in others violent trauma is the major cause of mortality and complications of chronic disease a major cause of excess morbidity.

The Minimum Standards

1 Health Systems and Infrastructure

During an emergency response, when mortality rates are frequently elevated or could soon become so, priority humanitarian interventions must focus on urgent survival needs, including basic medical care. Once survival needs have been met, and mortality rates have declined to near-baseline levels, a more comprehensive range of health services should be developed. Throughout all phases of the response, a health systems approach to the design, implementation, monitoring and evaluation of services will contribute to ensuring that the most important needs are met, that coverage is appropriate, that access is optimised, and that quality is promoted.

The standards that follow apply to all disaster settings, but are particularly relevant to resource-poor settings. They are designed primarily to ensure that disaster-affected communities have access to good-quality health services during the disaster response. Promoting the sustainability of health services following disasters is especially important when there has been major disruption of health infrastructure and services. However, ensuring sustainability requires consideration of many different factors, including political, managerial, institutional, financial and technical, and is therefore beyond the scope of this document. Health agencies and staff must bear in mind that frequently decisions made during a disaster response can either help to promote or undermine the longer-term sustainability of services.

Health systems and infrastructure standard 1: prioritising health services

All people have access to health services that are prioritised to address the main causes of excess mortality and morbidity.

Key indicators (to be read in conjunction with the guidance notes)

- The major causes of mortality and morbidity are identified, documented and monitored.
- Priority health services include the most appropriate and effective interventions to reduce excess morbidity and mortality (see guidance note 1).
- All members of the community, including vulnerable groups, have access to priority health interventions (see guidance note 2).
- Local health authorities and community members participate in the design and implementation of priority health interventions.
- There is active collaboration with other sectors in the design and implementation of priority health interventions, including water and sanitation, food security, nutrition, shelter and protection.
- The crude mortality rate (CMR) is maintained at, or reduced to, less than twice the baseline rate documented for the population prior to the disaster (see guidance note 3).
- The under-5 mortality rate (U5MR) is maintained at, or reduced to, less than twice the baseline rate documented for the population prior to the disaster (see guidance note 3).

Guidance notes

1. ***Priority health interventions*** vary according to the context, including the type of disaster and its impact. Basing the design of these interventions on public health principles will ensure that the greatest health benefit is provided to the greatest number of people. Priority public health interventions include adequate supplies of safe water, sanitation,

food and shelter, infectious disease control (e.g. measles vaccination), basic clinical care and disease surveillance. Expanded clinical services, including trauma care, are given higher priority following disasters that are associated with large numbers of injuries, e.g. earthquakes.

2. ***Access to health services:*** access should be based on the principle of equity, ensuring equal access according to need, without any discrimination that could lead to the exclusion of specific groups. In practice, the location and staffing of health services should be organised to ensure optimal access and coverage. The particular needs of vulnerable groups who may not have ready access should be addressed when designing health services. Where user fees are charged, arrangements should be made to ensure that those unable to afford the fees still have access, e.g. fee waivers, vouchers, etc.

3. ***Crude Mortality Rate and Under-5 Mortality Rate:*** the daily crude mortality rate (CMR) is the most specific and useful health indicator to monitor in a disaster situation. A doubling of the baseline CMR indicates a significant public health emergency, requiring immediate response. The average baseline CMR for the least developed countries is approximately 0.38 deaths/10,000 persons/day, with sub-Saharan Africa at 0.44; for industrialised countries the average CMR is approximately 0.25/10,000/day. When the baseline rate is unknown, health agencies should aim to maintain the CMR at below 1.0/10,000/day. The baseline under-5 mortality rate (U5MR) for the least developed countries is approximately 1.03 deaths/10,000 U5s/day, with sub-Saharan Africa at 1.14; for industrialised countries the rate is approximately 0.04/10,000 U5s/day. When the baseline U5MR is unknown, agencies should aim to maintain the rate at below 2.0/10,000 U5s/day (see Appendices 2-3 and the table opposite).

Baseline Reference Mortality Data by Region				
Region	**CMR (deaths/ 10,000/day)**	**CMR emergency threshold**	**U5MR (deaths/ 10,000 U5s/day)**	**U5MR emergency threshold**
Sub-Saharan Africa	0.44	0.9	1.14	2.3
Middle East and North Africa	0.16	0.3	0.36	0.7
South Asia	0.25	0.5	0.59	1.2
East Asia and Pacific	0.19	0.4	0.24	0.5
Latin America and Caribbean	0.16	0.3	0.19	0.4
Central and Eastern European Region/CIS and Baltic States	0.30	0.6	0.20	0.4
Industrialised countries	0.25	0.5	0.04	0.1
Developing countries	0.25	0.5	0.53	1.1
Least developed countries	0.38	0.8	1.03	2.1
World	0.25	0.5	0.48	1.0

Source: UNICEF's *State of the World's Children 2003* (data from 2001).

Health systems and infrastructure standard 2: supporting national and local health systems

Health services are designed to support existing health systems, structures and providers.

Key indicators (to be read in conjunction with the guidance notes)

- Representatives of the Ministry of Health lead the health sector response, whenever possible.
- When the Ministry of Health lacks the necessary capacity, an alternate agency with the requisite capacity is identified to take the lead in the health sector (see guidance notes 1-2).

- Local health facilities are supported and strengthened by responding agencies (see guidance notes 1-2).
- Local health workers are supported and integrated into health services, taking account of gender and ethnic balance (see guidance note 3).
- Health services incorporate or adapt the existing national standards and guidelines of the disaster-affected or host country (see guidance note 4).
- No alternate or parallel health facilities and services are established, including foreign field hospitals, unless local capacities are exceeded or the population does not have ready access to existing services. The lead health authority is consulted on this issue (see guidance note 5).

Guidance notes

1. ***Lead health authority:*** when the Ministry of Health (MOH) lacks capacity to assume the role of lead health authority, a United Nations agency will generally take this responsibility, e.g. WHO, UNHCR, UNICEF. On occasion, when both the MOH and UN agencies lack capacity at regional, district or local level, another participating agency may be required to coordinate activities, at least temporarily. The lead health authority should ensure that responding health agencies support and strengthen the capacities of local health systems. In addition, the lead health authority will be responsible for ensuring that the activities of health agencies are coordinated and complementary.
2. ***Health sector strategy and policy:*** an important responsibility of the lead health authority is to develop an overall strategy and policy for the emergency response within the health sector. Ideally, a policy document should be produced that specifies health sector priorities and objectives and provides a framework for achieving them. This document should be developed after consultation with relevant agencies and community representatives.
3. ***Local health workers:*** health professionals and other health workers from the disaster-affected communities, including skilled/traditional birth attendants, should be integrated into health services where appropriate.

Gender balance, while always preferred, may not be practical in communities where health care providers are predominantly of one sex.

4. ***National standards and guidelines:*** in general, agencies should adhere to the health standards and guidelines of the country where the disaster response is being implemented, including treatment protocols and essential drug lists (see Health systems and infrastructure standard 5). These standards and guidelines should be reviewed in consultation with the MOH or lead health authority early in the disaster response to determine their appropriateness. When they are outdated or do not reflect evidence-based practice, they should be updated.

5. ***Foreign field hospitals:*** occasionally, field hospitals may be the only way to provide health care when existing hospitals are not functioning properly. However, it is usually more effective to provide resources to existing hospitals so that they can start working again or cope with the extra load. It may be appropriate to deploy a field hospital for the immediate care of traumatic injuries (first 48 hours), secondary care of traumatic injuries and routine emergencies (days 3-15), or as a temporary facility to substitute for a damaged local hospital until it is reconstructed (up to several years). In determining whether a field hospital deployment is appropriate, there must be a well-defined need; the field hospital must be able to provide appropriate services; it should not be a drain on local resources; and it must be cost-effective.

Health systems and infrastructure standard 3: coordination

People have access to health services that are coordinated across agencies and sectors to achieve maximum impact.

Key indicators (to be read in conjunction with the guidance notes)

- Coordination mechanisms are established at central level (national or regional) and at field level within the health sector, and between health and other sectors.

- Specific responsibilities of each health agency are clarified and documented in consultation with the lead health authority to ensure optimal coverage of the population and complementarity of services (see guidance note 1).
- Regular health sector coordination meetings are held for local and external partners at both central and field levels (see guidance note 2).

Guidance notes

1. ***Coordination among health agencies:*** regardless of whether the lead health authority is the Ministry of Health or another agency, all organisations in the health sector should coordinate with national and local health services. In refugee settings, agencies should coordinate with the health system of the host country. When several health agencies are operational in the field, coordinated allocation of responsibilities will help to ensure that health sector gaps are met and that duplications are avoided.
2. ***Coordination meetings:*** these should provide a forum in which information is shared, priorities are identified and monitored, common health strategies are developed and adapted, specific tasks are allocated, and standardised protocols and interventions are agreed upon. Meetings should initially be held at least weekly.

Health systems and infrastructure standard 4: primary health care

Health services are based on relevant primary health care principles.

Key indicators (to be read in conjunction with the guidance notes)

- All people have access to health information that allows them to protect and promote their own health and well-being (see guidance note 1).
- Health services are provided at the appropriate level of the health system: household/community, peripheral health facilities, central health facilities, referral hospital (see guidance note 2).

- A standardised referral system is established by the lead health authority and utilised by health agencies. Suitable transportation is organised for patients to reach the referral facility.
- Health services and interventions are based on scientifically sound methods and are evidence-based, whenever possible.
- Health services and interventions utilise appropriate technology, and are socially and culturally acceptable.

Guidance notes

1. ***Health information and education:*** an active programme of community health education and promotion should be initiated in consultation with local health authorities and community representatives. It should take into account health-seeking behaviour and health beliefs of the population. It should provide information on the major endemic health problems, major health risks, the availability and location of health services, and behaviours that protect and promote good health. Public health messages and materials should utilise appropriate language and media, and be culturally sensitive. As far as possible, the content of priority health messages should be consistent among implementing health agencies.
2. ***Mobile clinics:*** during some disasters, it may be necessary to operate mobile clinics in order to meet the needs of isolated or mobile communities that have limited access to care. Experience has demonstrated that when operated appropriately, such clinics can fill a vital need. When operated inappropriately, mobile clinics may be under-utilised, may displace existing health services and represent an inefficient use of limited resources. They should be introduced only following consultation with the lead health authority and with local health representatives.

Health systems and infrastructure standard 5: clinical services

People have access to clinical services that are standardised and follow accepted protocols and guidelines.

Key indicators (to be read in conjunction with the guidance notes)

- The number, level and location of health facilities are appropriate to meet the needs of the population (see guidance notes 1-2).
- The number, skills and gender/ethnic balance of staff at each health facility are appropriate to meet the needs of the population (see guidance notes 1-2).
- Adequate staffing levels are achieved so that clinicians are not required to consistently consult on more than 50 patients per day. If this threshold is regularly exceeded, additional clinical staff are recruited (see Appendix 3).
- Utilisation rates at health facilities are monitored and corrective measures taken if there is over- or under-utilisation (see guidance note 3).
- Standardised case management protocols are established by the lead health authority, and adhered to by health agencies (see guidance note 4).
- A standardised essential drug list is established by the lead health authority, and adhered to by health agencies (see guidance note 4).
- Clinical staff are trained and supervised in the use of the protocols and the essential drug list (see guidance notes 5-6).
- People have access to a consistent supply of essential drugs through a standardised drug management system that follows accepted guidelines (see guidance note 7).
- Drug donations are accepted only if they follow internationally recognised guidelines. Donations that do not follow these guidelines are not used and are disposed of safely.

- Bodies of the deceased are disposed of in a manner that is dignified, culturally appropriate and is based on good public health practice (see guidance note 8).

Guidance notes

1. ***Health facilities and staffing:*** the number and location of health facilities required and the number and skills of staff at each level can vary from context to context. Ensuring the presence of even one female health worker or one representative of a minority ethnic group on a staff may significantly increase the access of women or people from minority groups to health services. The carrying out of acts or activities that jeopardise the neutrality of health facilities, such as carrying arms, is prohibited.

2. ***Staffing levels:*** the following guidelines provide a useful reference, but may need to be adapted according to the context. The term 'qualified health worker' refers to a formally trained clinical provider, such as a physician, nurse, clinical officer or medical assistant.

   a. Community level: one community health worker per 500-1,000 population; one skilled/traditional birth attendant per 2,000 population; one supervisor per 10 home visitors; one senior supervisor.

   b. Peripheral health facility (for approximately 10,000 population): total of two to five staff; minimum of one qualified health worker, based on one clinician per 50 consultations per day; non-qualified staff for administering oral rehydration therapy (ORT), dressings, etc. and for registration, administration, etc.

   c. Central health facility (for approximately 50,000 population): minimum of five qualified health workers, minimum of one doctor; one qualified health worker per 50 consultations per day (out-patient care); one qualified health worker per 20-30 beds, 24-hour services (in-patient care). One non-qualified health worker for administering ORT; one/two for pharmacy; one/two for dressings, injections, sterilisation. One lab technician. Non-qualified staff for registration, security, etc.

   d. Referral hospital: variable. At least one doctor with surgical skills; one nurse for 20-30 beds per shift.

3. ***Utilisation rate of health services:*** attendance at health facilities will help to determine the utilisation rate. There is no definitive threshold for utilisation, as this will vary from context to context, and often from season to season. However, it usually increases significantly among disaster-affected populations. Among stable populations, utilisation rates are approximately 0.5-1.0 new consultations/person/year. Among displaced populations, an average of 4.0 new consultations/person/year may be expected. If the rate is lower than expected, it may indicate inadequate access to health facilities, e.g. due to insecurity or poor capacity of health services. If the rate is higher, it may suggest over-utilisation due to a specific public health problem (e.g. infectious disease outbreak), or under-estimation of the target population. In analysing utilisation rates, consideration should also be given to gender, age, ethnic origin and disability, to ensure that vulnerable groups are not under-represented (see Appendix 3).

4. ***Standardised treatment protocols and essential drug lists:*** most countries have established essential drug lists or national formularies, and many have treatment protocols for the management of common diseases and injuries. These protocols and drug lists should be reviewed in consultation with the Ministry of Health or lead health authority early in the disaster response to determine their appropriateness. Occasionally, alterations to established national protocols and drug lists may be necessary, e.g. if there is evidence of resistance to recommended antibiotics or anti-malarial agents. If protocols and/or essential drug lists do not exist, guidelines established by WHO or UNHCR should be followed, e.g. New Emergency Health Kit.

5. ***Training and supervision of staff:*** health workers should have the proper training and skills for their level of responsibility. Health agencies have an obligation to train staff to ensure that their knowledge is up-to-date. Training and supervision will be high priorities especially where staff have not received continuing education, or new health systems and protocols are introduced. As far as possible, training programmes should be standardised and linked to national programmes.

6. ***Patients' rights:*** many factors associated with disasters may make it difficult to consistently enforce a patient's rights to privacy, confidentiality and informed consent. However, as far as possible, health personnel

should attempt to safeguard and promote these rights. Health facilities and services should be designed in a manner that ensures privacy and confidentiality (see Health systems and infrastructure standard 6, guidance note 3). Informed consent should be sought from patients prior to medical or surgical procedures. Patients have a right to know what each procedure involves, as well as its expected benefits, potential risks, costs and duration.

7. ***Drug management:*** in addition to utilising the essential drug list, health agencies need to establish an effective system of drug management. The goal of such a system is to ensure the efficient, cost-effective and rational use of drugs. This system should be based on the four key elements of the drug management cycle: selection, procurement, distribution and use (see Management Sciences for Health (1997), *Managing Drug Supply. Second Edition).*

8. ***Handling the remains of the dead:*** when disasters result in high mortality, the management of a large number of dead bodies will be required. Bodies should not be disposed of unceremoniously in mass graves, as this cannot be justified as a public health measure, violates important social norms and may waste scarce resources. The mass management of human remains is often based on the false belief that they represent an epidemic hazard if not buried or burned immediately. In fact, the health hazard presented by dead bodies is usually negligible. In only a few special cases do human remains pose health risks and require specific precautions, e.g. deaths resulting from cholera or haemorrhagic fevers. Families should have the opportunity to conduct culturally appropriate funerals and burials. When those being buried are victims of violence, forensic issues should be considered (see also Shelter and settlement standard 2, guidance note 3 on page 217).

Health systems and infrastructure standard 6: health information systems

The design and development of health services are guided by the ongoing, coordinated collection, analysis and utilisation of relevant public health data.

Key indicators (to be read in conjunction with the guidance notes)

- A standardised health information system (HIS) is implemented by all health agencies to routinely collect relevant data on demographics, mortality, morbidity and health services (see guidance notes 1-2 and Appendices 2-3).
- A designated HIS coordinating agency (or agencies) is identified to organise and supervise the system.
- Health facilities and agencies submit surveillance data to the designated HIS coordinating agency on a regular basis. The frequency of these reports will vary according to the context, e.g. daily, weekly, monthly.
- A regular epidemiological report, including analysis and interpretation of the data, is produced by the HIS coordinating agency and shared with all relevant agencies, decision-makers and the community. The frequency of the report will vary according to the context, e.g. daily, weekly, monthly.
- Agencies take adequate precautions for the protection of data to guarantee the rights and safety of individuals and/or populations (see guidance note 3).
- The HIS includes an early warning component to ensure timely detection of and response to infectious disease outbreaks (see Control of communicable diseases standard 5 on page 281).
- Supplementary data from other relevant sources are consistently used to interpret surveillance data and to guide decision-making (see guidance note 4).

Guidance notes

1. ***Health information system (HIS):*** the HIS builds upon the pre-existing surveillance system whenever possible. In some emergencies, a new or parallel system may be required and this is determined in consultation with the lead health authority. The HIS should be designed to be flexible and should evolve over time. During the disaster response health data should include, but not be limited to, the following:

   a. crude mortality rate

   b. under-5 mortality rate

   c. proportional mortality

   d. cause-specific mortality rate

   e. incidence rates for most common diseases

   f. health facility utilisation rate

   g. number of consultations per clinician per day.

2. ***Disaggregation of data:*** data should be disaggregated by age and sex as far as is practical in order to guide decision-making. Detailed disaggregation may be difficult during the early stages of a disaster. However, mortality and morbidity data for children under five years old should be documented from the outset, as this group is usually at special risk. In addition, gender breakdown for mortality and morbidity is useful for detecting gender-specific differences. As time and conditions allow, more detailed disaggregation should be sought, to detect further differences according to age (e.g. 0-11 months, 1-4 years, 5-14 years, 15-49 years, 50-59 years, 60+ years) and sex.

3. ***Confidentiality:*** confidentiality of medical records and data should be ensured. Adequate precautions should be taken to protect the safety of the individual, as well as the data itself. Staff members should never share patient information with anyone not directly involved in the patient's care without the patient's permission. Data that relates to trauma caused by torture or other human rights violations must be treated with the utmost care. Consideration may be given to passing on this information to appropriate actors or institutions, if the individual gives their consent.

4. ***Sources of other data:*** sources of relevant health data include laboratory reports, surveys, case reports, quality of service measurements and other programmatic sectors.

See Appendix 2 for sample weekly mortality and morbidity forms and Appendix 3 for formulas for calculating rates of mortality and morbidity.

2 Control of Communicable Diseases

Increased rates of morbidity and mortality due to communicable diseases occur more frequently in association with complex emergencies than other disasters. In many of these settings, especially those occurring in developing countries, between 60% and 90% of deaths have been attributed to one of four major infectious causes: measles, diarrhoea, acute respiratory infections and malaria. Acute malnutrition is often associated with increased case fatality rates of these diseases, especially among young children. There have also been outbreaks of other communicable diseases, such as meningococcal meningitis, yellow fever, viral hepatitis and typhoid, in certain settings.

Outbreaks of communicable diseases are far less commonly associated with acute onset natural disasters. When they do occur, they are generally associated with disruptions of sanitation and poor water quality. The potential use of biological agents as weapons by terrorists and military forces raises new concerns for disaster response agencies and those involved in humanitarian assistance. The response to incidents involving biological weapons is not specifically addressed in the following standards, although several of the standards and indicators are applicable to such incidents.

Control of communicable diseases standard 1: prevention

People have access to information and services that are designed to prevent the communicable diseases that contribute most significantly to excess morbidity and mortality.

Key indicators (to be read in conjunction with the guidance notes)

- General prevention measures are developed and implemented in coordination with other relevant sectors (see guidance note 1).
- Community health education messages provide individuals with information on how to prevent common communicable diseases and how to access relevant services (see Health systems and infrastructure standard 4 on page 264).
- Specific prevention measures, such as a mass measles vaccination campaign and Expanded Programme on Immunisation (EPI), are implemented as indicated (see guidance note 2 and Control of communicable diseases standard 2).

Guidance notes

1. ***General prevention measures:*** most of these interventions are developed in coordination with other sectors, including:
   - water and sanitation: sufficient water quantity and quality; sufficient sanitation; hygiene promotion; vector control, etc. (see Water, Sanitation and Hygiene Promotion, page 51).
   - food security, nutrition and food aid: access to adequate food and management of malnutrition (see Food Security, Nutrition and Food Aid, page 103).
   - shelter: sufficient and adequate shelter (see Shelter, Settlement and Non-Food Items, page 203).

2. ***Prevention of measles and Expanded Programme on Immunisation (EPI):*** because measles has high potential for outbreaks and mortality, mass vaccination of children against the disease is often a high priority among disaster-affected populations, especially those who are displaced and/or affected by conflict. Vaccination against other childhood diseases through EPI is generally a lesser priority, as outbreaks of these diseases are less frequent and the health risks associated with them are lower. Therefore, other EPI vaccines are generally introduced only when the immediate needs of the population have been met. The exceptions to this guideline include ongoing outbreaks of diseases such as pertussis or diphtheria, when vaccination against these diseases also becomes a priority.

Control of communicable diseases standard 2: measles prevention

All children aged 6 months to 15 years have immunity against measles.

Key indicators (to be read in conjunction with the guidance notes)

- An estimation of measles vaccination coverage of children aged 9 months to 15 years is made at the outset of the emergency response, to determine the prevalence of susceptibility to measles (see guidance note 1).
- If vaccination coverage is estimated to be less than 90%, a mass measles vaccination campaign for children aged 6 months to 15 years (including administration of vitamin A to children aged 6-59 months) is initiated. The vaccination campaign is coordinated with national and local health authorities, including the Expanded Programme on Immunisation (see guidance note 2).
- Upon completion of the campaign:
  - at least 95% of children aged 6 months to 15 years have received measles vaccination;
  - at least 95% of children aged 6-59 months have received an appropriate dose of vitamin A.

- All infants vaccinated between 6-9 months of age receive another dose of measles vaccine upon reaching 9 months (see guidance note 3).
- Routine ongoing vaccination of 9-month-old children is established to ensure the maintenance of the minimum 95% coverage. This system is linked to the Expanded Programme on Immunisation.
- For mobile or displaced populations, an ongoing system is established to ensure that at least 95% of newcomers aged between 6 months and 15 years receive vaccination against measles.

Guidance notes

1. ***Measles prevention:*** measles is one of the most contagious viruses known and can be associated with high mortality rates. Whenever there are crowded emergency settings, large population displacements and high levels of malnutrition, there is a high risk of a measles outbreak. Mass measles vaccination campaigns should therefore be given the highest priority at the earliest possible time in these settings. The necessary personnel, vaccine, cold chain equipment and other supplies to conduct a mass campaign should be assembled as soon as possible. If the vaccination coverage for the population is unknown, the campaign should be carried out on the assumption that the coverage is inadequate.
2. ***Age ranges for measles vaccination:*** some older children may have escaped both previous measles vaccination campaigns and measles disease. These children remain at risk of measles and can serve as a source of infection for infants and young children who are at higher risk of dying from the disease. This is the reason for the recommendation to vaccinate up to the age of 15 years. In resource-poor settings, however, it may not be possible to vaccinate all children aged 6 months to 15 years. In these settings, priority should be given to children aged 6-59 months.
3. ***Repeat measles vaccination for children aged 6-9 months:*** the repeat measles vaccination should be administered as soon as the child reaches 9 months of age, except for children who received their first dose after 8 months of age. These children should receive the repeat dose after a minimum interval of 30 days.

Control of communicable diseases standard 3: diagnosis and case management

People have access to effective diagnosis and treatment for those infectious diseases that contribute most significantly to preventable excess morbidity and mortality.

Key indicators (to be read in conjunction with the guidance notes)

- Standardised case management protocols for diagnosis and treatment of the most common infectious diseases are consistently used (see guidance note 1; see also Health systems and infrastructure standard 5).
- Public health education messages encourage people to seek early care for fever, cough, diarrhoea, etc., especially children, pregnant women and older people.
- In malaria-endemic regions, a protocol is established to ensure early (<24 hours) diagnosis of fever cases and treatment with highly effective first-line drugs (see guidance note 2).
- Laboratory services are available and utilised when indicated (see guidance note 3).
- A tuberculosis control programme is introduced only after consideration of recognised criteria (see guidance note 4).

Guidance notes

1. ***Integrated management of childhood illness:*** where the integrated management of childhood illness (IMCI) has been developed in a country, and clinical guidelines adapted, these guidelines should preferably be incorporated into the standardised protocols. IMCI has been demonstrated to improve the quality of care provided to children under the age of five years.
2. ***Malaria:*** malaria incidence is likely to rise within a few days/weeks of mass population movements in endemic areas. Because of widespread and increasing resistance to chloroquine and sulphadoxine-pyrimethamine

(Fansidar), more efficacious anti-malarial drugs may be required. This will be especially important for non-immune and vulnerable populations exposed to falciparum malaria. Combination therapies utilising artemisinin derivatives are preferable. Drug choice should be determined in consultation with the lead health authority, following a consideration of drug efficacy data. Standardised WHO protocols should be used to evaluate drug efficacy.

3. ***Laboratory services:*** establishing a clinical laboratory is not a priority during the initial phase of most disasters. The most common communicable diseases can usually be diagnosed clinically and treatment will generally be presumptive. Laboratory testing is most useful for confirming the diagnosis during a suspected outbreak for which mass immunisation may be indicated (e.g. meningococcal meningitis) or where culture and antibiotic sensitivity testing may influence case management decisions (e.g. dysentery). Therefore, it will be important to identify an established laboratory either nationally or in another country that can conduct the appropriate microbiological investigations. Guidelines on correct specimen collection and transportation will be required.

4. ***Tuberculosis control:*** a high prevalence of TB has frequently been documented among refugees and other war-affected populations. However, poorly implemented TB control programmes can potentially do more harm than good, by prolonging infectivity and by contributing to the spread of multi-drug-resistant bacilli. While the management of individual patients with TB may be possible during emergencies, a comprehensive programme of TB control should only be implemented following a consideration of recognised criteria (see WHO, *Tuberculosis Control in Refugee Situations: An Interagency Field Manual*). When implemented, TB control programmes in these settings should be integrated with the national/host country programme and follow the well-established DOTS strategy (Directly-Observed Therapy, Short-course).

Control of communicable diseases standard 4: outbreak preparedness

Measures are taken to prepare for and respond to outbreaks of infectious diseases.

Key indicators (to be read in conjunction with the guidance notes)

- An outbreak investigation and control plan is prepared (see guidance note 1).
- Protocols for the investigation and control of common outbreaks are available and distributed to relevant staff.
- Staff receive training in the principles of outbreak investigation and control, including relevant treatment protocols.
- Reserve stocks of essential drugs, medical supplies, vaccines and basic protection material are available and can be procured rapidly (see guidance note 2).
- Sources of vaccines for relevant outbreaks (e.g. measles, meningococcal meningitis, yellow fever) are identified for rapid procurement and use. Mechanisms for rapid procurement are established (see guidance note 2).
- Sites for the isolation and treatment of infectious patients are identified in advance, e.g. cholera treatment centres.
- A laboratory is identified, whether locally, regionally, nationally or in another country, that can provide confirmation of diagnoses (see guidance note 3).
- Sampling materials and transport media for the infectious agents most likely to cause a sudden outbreak are available on-site, to permit transfer of specimens to an appropriate laboratory. In addition, several rapid tests may be stored on-site (see guidance note 4).

Guidance notes

1. ***Outbreak investigation and control plan:*** the following issues should be addressed in the plan:
   a. the circumstances under which an outbreak control team is to be convened;
   b. composition of the outbreak control team, including representatives from appropriate sectors, e.g. health, water and sanitation;
   c. specific roles and responsibilities of organisations and positions on the team;
   d. arrangements for consulting and informing authorities at local and national level;
   e. the resources/facilities available to investigate and respond to outbreaks.
2. ***Reserve stocks:*** on-site reserves should include material to use in response to likely outbreaks. Such stocks might include oral rehydration salts, intravenous fluids, antibiotics, vaccines and consumable medical supplies. Single use/auto-destruct syringes and safe needle containers should be available, to prevent the spread of viral hepatitis and HIV. A pre-packaged cholera kit may be indicated in some circumstances. It may not be practical to keep some stocks on-site, such as meningococcal vaccine. For these items, the mechanisms for rapid procurement, shipment and storage should be determined in advance so that they can be rapidly available.
3. ***Reference laboratories:*** a reference laboratory should also be identified either regionally or internationally that can assist with more sophisticated testing, e.g. antibiotic sensitivity for *Shigella*, serological diagnosis of viral haemorrhagic fevers.
4. ***Transport media and rapid tests:*** sampling materials (e.g. rectal swabs) and transport media (e.g. Cary-Blair, Amies' or Stuarts' media for cholera, *Shigella, E. Coli* and *Salmonella*; Translocate for meningitis) should be available on-site, or readily accessible. In addition, several new rapid tests are available that can be useful in confirming diagnoses of communicable diseases in the field, including malaria and meningitis.

Control of communicable diseases standard 5: outbreak detection, investigation and response

Outbreaks of communicable diseases are detected, investigated and controlled in a timely and effective manner.

Key indicators (to be read in conjunction with the guidance notes)

- The health information system (HIS) includes an early warning component (see guidance notes 1-2).
- Initiation of outbreak investigation occurs within 24 hours of notification.
- The outbreak is described according to time, place and person, leading to the identification of high-risk groups. Adequate precautions are taken to protect the safety of both individuals and data.
- Appropriate control measures that are specific to the disease and context are implemented as soon as possible (see guidance notes 3-4).
- Case fatality rates are maintained at acceptable levels (see guidance note 5):
  - cholera: 1% or lower
  - *Shigella* dysentery: 1% or lower
  - typhoid: 1% or lower
  - meningococcal meningitis: varies (see guidance note 6).

Guidance notes

1. ***Early warning system for infectious disease outbreaks:*** the key elements of such a system will include:
   - case definitions and thresholds defined and distributed to all reporting health facilities;
   - community health workers (CHWs) trained to detect and report potential outbreaks from within the community;

– reporting of suspected outbreaks to the next appropriate level of the health system within 24 hours of detection;

– communications systems established to ensure rapid notification of relevant health authorities, e.g. radio, telephone.

2. ***Confirmation of the existence of an outbreak:*** it is not always straightforward to determine whether an outbreak is present and clear definitions of outbreak thresholds do not exist for all diseases.

   a. Diseases for which a single case may indicate an outbreak: cholera, measles, yellow fever, *Shigella,* viral haemorrhagic fevers.

   b. Meningococcal meningitis: for populations above 30,000, 15 cases/100,000 persons/week in one week indicates an outbreak; however, with high outbreak risk (i.e. no outbreak for 3+ years and vaccination coverage <80%), this threshold is reduced to 10 cases/100,000/week. In populations of less than 30,000, an incidence of five cases in one week or a doubling of cases over a three-week period confirms an outbreak.

   c. Malaria: less specific definitions exist. However, an increase in the number of cases above what is expected for the time of year among a defined population in a defined area may indicate an outbreak.

3. ***Outbreak control:*** control measures must be specifically developed to halt transmission of the agent causing the outbreak. Often, pre-existing knowledge about the agent can guide the design of appropriate control measures in specific situations. In general, response activities include:

   – controlling the source. Interventions may include improving water quality and quantity (e.g. cholera), prompt diagnosis and treatment (e.g. malaria), isolation (e.g. dysentery), controlling animal reservoirs (e.g. plague, Lassa fever).

   – protecting susceptible groups. Interventions may include immunisation (e.g. measles, meningitis, yellow fever), chemoprophylaxis (e.g. malaria prevention for pregnant women), improved nutrition (e.g. acute respiratory infections).

   – interrupting transmission. Interventions may include hygiene promotion (e.g. for all diseases spread by the faeco-oral route), vector control (e.g. malaria, dengue).

(See also chapter 2: Water, Sanitation and Hygiene Promotion on page 51).

4. ***Vector control and malaria:*** during a malaria outbreak, vector control measures such as indoor residual spraying and the distribution of insecticide-treated bed net (ITN) programmes should be guided by entomological assessments and expertise. These interventions require substantial logistical support and follow-up that may not be available in the initial phase of the disaster. For populations that already have a high level of ITN usage (>80%), rapid re-impregnation of nets with pyrethroids may help to stem transmission (see Vector control standards 1-2 on pages 77-81).
5. ***Case fatality rates (CFRs):*** if CFRs exceed these specified levels, an immediate evaluation of control measures should be undertaken, and corrective steps taken to ensure CFRs are maintained at acceptable levels.
6. ***CFRs for meningococcal meningitis:*** the acceptable CFR for meningococcal meningitis varies according to the general context and accessibility to health services. In general, health agencies should aim for a CFR that is as low as possible, though during outbreaks it may be as high as 20%.

Control of communicable diseases standard 6: HIV/AIDS

People have access to the minimum package of services to prevent transmission of HIV/AIDS.

Key indicators (to be read in conjunction with the guidance notes)

- People have access to the following essential package of services during the disaster phase:
  - free male condoms and promotion of proper condom use;
  - universal precautions to prevent iatrogenic/nosocomial transmission in emergency and health-care settings;
  - safe blood supply;

- relevant information and education so that individuals can take steps to protect themselves against HIV transmission;
- syndromic case management of sexually transmitted infections (STIs);
- prevention and management of the consequences of sexual violence;
- basic health care for people living with HIV/AIDS (PLWH/A).

- Plans are initiated to broaden the range of HIV control services in the post-disaster phase (see guidance note 1).

Guidance note

1. ***HIV control:*** during the post-emergency and rehabilitation phase of disasters, the expansion of HIV control activities will be based on an assessment of local needs and circumstances. Involvement of the community, especially people living with HIV/AIDS (PLWH/A) and their carers, in the design, implementation, monitoring and evaluation of the programme will be crucial to its success. In addition to services already implemented during the initial phase, more comprehensive surveillance, prevention, treatment, care and support services should be introduced. The provision of antiretroviral medications to treat PLWH/A is not currently feasible in most post-disaster humanitarian settings, although this may change in the future as financial and other barriers to their use fall. Protection and education programmes to reduce stigma and to protect people against discrimination should be implemented as soon as is feasible.

Note

Caritas Internationalis members cannot endorse standard 6 in the Control of Communicable Diseases section as it relates to the promotion of condom use, or standard 2 in the Control of Non-Communicable Diseases section concerning the Minimum Initial Service Package (MISP). By the same token, Caritas Internationalis members cannot endorse standards related to the use of condoms or the MISP which might appear in other parts of this handbook.

3 Control of Non-Communicable Diseases

Increases in morbidity and mortality due to non-communicable diseases are a common feature of many disasters. Injury is usually the major cause following acute onset natural disasters, such as earthquakes and hurricanes. Injury due to physical violence is also associated with all complex emergencies, and can be a major cause of excess mortality during such crises. The reproductive health (RH) needs of disaster-affected populations have received increased attention in recent years, especially in light of the greater awareness of problems such as HIV/AIDS, gender-based violence, emergency obstetric care needs and the poor availability of even basic RH services in many communities. The need for improved RH programmes has been especially recognised in association with complex emergencies, but it is also relevant to many other types of disaster.

Although difficult to quantify, mental health and psychosocial problems can be associated with any type of disaster and post-disaster setting. The horrors, losses, uncertainties and other stressors associated with disasters can place people at increased risk of various psychiatric, psychological and social problems. Finally, there is evidence to suggest that there is an increased incidence of acute complications from chronic diseases associated with disasters. These complications are generally due to disruptions of ongoing treatment regimens. However, a variety of other stressors may also precipitate an acute deterioration of a chronic medical condition.

Control of non-communicable diseases standard 1: injury

People have access to appropriate services for the management of injuries.

Key indicators (to be read in conjunction with the guidance notes)

- In situations with a large number of injured patients, a standardised system of triage is established to guide health care providers on assessment, prioritisation, basic resuscitation and referral (see guidance notes 1-2).
- Standardised guidelines for the provision of first aid and basic resuscitation are established (see guidance note 3).
- Standardised protocols for the referral of injured patients for advanced care, including surgery, are established. Suitable transportation is organised for patients to reach the referral facility.
- Definitive trauma and surgical services are established only by agencies with appropriate expertise and resources (see guidance note 4).
- In situations with a potentially large number of injured patients, contingency plans for the management of multiple casualties are developed for relevant health care facilities. These plans are related to district and regional plans.

Guidance notes

1. ***Prioritising trauma services:*** in most disasters, it is not possible to determine the number of injured persons who will require clinical care. Following acute onset disasters such as earthquakes, 85-90% of those rescued alive are generally extracted by local emergency personnel or by their neighbours and families within 72 hours. Therefore, in planning relief operations in disaster-prone regions the major emphasis should be on preparing local populations to provide the initial care. It is important to note

that priority health interventions are designed to reduce preventable excess mortality. During armed conflict, most violent trauma deaths occur in insecure regions away from health facilities and therefore cannot usually be prevented by medical care. Interventions that aim to protect the civilian population are required to prevent these deaths. Health interventions implemented during conflict should emphasise community-based public health and primary care, even in situations where there is a high incidence of violent injury.

2. ***Triage:*** triage is the process of categorising patients according to the severity of their injuries or illness, and prioritising treatment according to the availability of resources and the patients' chances of survival. The underlying principle of triage is allocating limited resources in a manner that provides the greatest health benefit to the greatest number. Triage does not necessarily mean that individuals with the most serious injuries receive priority. In the setting of multiple casualties with limited resources, those with severe, life-threatening injuries may, in fact, receive lower priority than those with more survivable injuries. There is no standardised system of triage, and internationally several are in use. Most systems specify between two and five categories of injury, with four being the most common.

3. ***First aid and basic medical care:*** definitive trauma and surgical care may not be readily available, especially in resource-poor settings. But it is important to note that first aid, basic resuscitation and non-operative procedures can be life-saving for even severe injuries. Simple procedures such as clearing the airway, controlling haemorrhage and administering intravenous fluids may help to stabilise individuals with life-threatening injuries before transfer to a referral centre. The quality of the initial medical management provided can therefore significantly affect a patient's chances of survival. Other non-operative procedures, such as cleaning and dressing wounds, and administering antibiotics and tetanus prophylaxis, are also important. Many severely injured patients can survive for days or even weeks without surgery, provided that appropriate first aid, medical and nursing care are provided.

4. ***Trauma and surgical care:*** all health-care providers should be able to provide first aid and basic resuscitation to injured patients. In addition, life-saving triage capacity at strategic points, with a linkage to a referral system, is important. However, definitive trauma care and war surgery are

specialised fields that require specific training and resources that few agencies possess. Inappropriate or inadequate surgery may do more harm than doing nothing. Only organisations and professionals with the relevant expertise should therefore establish these sophisticated services.

Control of non-communicable diseases standard 2: reproductive health

People have access to the Minimum Initial Service Package (MISP) to respond to their reproductive health needs.

Key indicators (to be read in conjunction with the guidance notes)

- An organisation(s) and individual(s) are identified to facilitate the coordination and implementation of the MISP in consultation with the lead health authority (see guidance note 1).
- Steps are taken by health agencies to prevent and manage the consequences of gender-based violence (GBV), in coordination with other relevant sectors, especially protection and community services (see guidance note 2).
- The number of cases of sexual and other forms of GBV reported to health services, protection and security officers is monitored and reported to a designated lead GBV agency (or agencies). Rules of confidentiality are applied to data collection and review.
- The minimum package of services to prevent the transmission of HIV/AIDS is implemented (see Control of communicable diseases standard 6).
- Adequate numbers of clean delivery kits, based on the estimated number of births in a given time period, are available and distributed to visibly pregnant women and skilled/traditional birth attendants to promote clean home deliveries.
- Adequate numbers of midwife delivery kits (UNICEF or equivalent) are distributed to health facilities to ensure clean and safe deliveries.

- A standardised referral system is established and promoted within the community, incorporating midwives and skilled/traditional birth attendants, to manage obstetric emergencies. Suitable transportation is organised for patients to reach the referral facility (see guidance note 3).
- Plans are initiated to implement a comprehensive range of reproductive health services integrated into primary health care as soon as possible (see guidance note 4).

Guidance notes

1. ***Minimum Initial Service Package:*** the MISP is designed to respond to the reproductive health (RH) needs of the affected population in the early phase of a disaster. The MISP is not only a set of equipment and supplies, but also a series of specific health activities. Its objectives are to: identify an organisation(s) or individual(s) to facilitate its coordination and implementation; prevent and manage the consequences of gender-based violence; reduce HIV transmission; prevent excess neonatal and maternal mortality and morbidity; and plan for the provision of comprehensive RH services. The UNFPA RH Kit has been designed specifically to facilitate the implementation of the MISP. It consists of a series of 12 sub-kits that can be used at each sequential level of care: community/health post, health centre and referral centre.
2. ***Gender-based violence (GBV)*** is a common feature of many complex emergencies and even many natural disasters. It includes abuses such as rape, domestic violence, sexual exploitation, forced marriage, forced prostitution, trafficking and abduction. The prevention and management of GBV requires collaboration and coordination among members of the community and between agencies. Health services should include medical management for sexual assault survivors, confidential counselling and referral for other appropriate care. The layout of settlements, distribution of essential items, and access to health services and other programmes should be designed to reduce the potential for GBV. Sexual exploitation of disaster-affected populations, especially children and youth by relief agency staff, military personnel and others in positions of influence must be actively prevented and managed. Codes of conduct should be

developed and disciplinary measures established for any violations (see Aid worker competencies and responsibilities standard on page 40).

3. ***Emergency obstetric care:*** approximately 15% of pregnant women will develop complications that require essential obstetric care and up to 5% of pregnant women will require some type of surgery, including Caesarean section. Basic essential obstetric care services should be established at the health centre level as soon as possible and should include initial assessment; assessment of foetal well-being; episiotomy; management of haemorrhage; management of infection; management of eclampsia; multiple birth; breech delivery; use of vacuum extractor; and special care for women who have undergone genital mutilation. Comprehensive essential obstetric care should be available at the referral hospital as soon as possible and should include Caesarean section; laparotomy; repair of cervical and third-degree vaginal tears; care for the complications of unsafe abortion; and safe blood transfusion.

4. ***Comprehensive reproductive health services:*** health agencies should plan for the subsequent integration of comprehensive RH services into primary health care. RH services should not be established as separate, vertical programmes. In addition to interventions addressed in the MISP, other important elements of comprehensive, integrated RH services include safe motherhood; family planning and counselling; comprehensive GBV services; comprehensive management of STIs and HIV/AIDS; the specific RH needs of youth; and monitoring and surveillance.

Control of non-communicable diseases standard 3: mental and social aspects of health

People have access to social and mental health services to reduce mental health morbidity, disability and social problems.

Key social intervention indicators[1] (to be read in conjunction with the guidance notes)

During the acute disaster phase, the emphasis should be on social interventions.

- People have access to an ongoing, reliable flow of credible information on the disaster and associated relief efforts (see guidance note 1).
- Normal cultural and religious events are maintained or re-established (including grieving rituals conducted by relevant spiritual and religious practitioners). People are able to conduct funeral ceremonies (see guidance note 2).
- As soon as resources permit, children and adolescents have access to formal or informal schooling and to normal recreational activities.
- Adults and adolescents are able to participate in concrete, purposeful, common interest activities, such as emergency relief activities.
- Isolated persons, such as separated or orphaned children, child combatants, widows and widowers, older people or others without their families, have access to activities that facilitate their inclusion in social networks.

[1] Social and psychological indicators are discussed separately. The term 'social intervention' is used for those activities that primarily aim to have social effects. The term 'psychological intervention' is used for interventions that primarily aim to have a psychological (or psychiatric) effect. It is acknowledged that social interventions have secondary psychological effects and that psychological interventions have secondary social effects, as the term 'psychosocial' suggests.

- When necessary, a tracing service is established to reunite people and families.
- Where people are displaced, shelter is organised with the aim of keeping family members and communities together.
- The community is consulted regarding decisions on where to locate religious places, schools, water points and sanitation facilities. The design of settlements for displaced people includes recreational and cultural space (see Shelter and settlement standards 1-2, pages 211-218).

Key psychological and psychiatric intervention indicators

(to be read in conjunction with the guidance notes)

- Individuals experiencing acute mental distress after exposure to traumatic stressors have access to psychological first aid at health service facilities and in the community (see guidance note 3).
- Care for urgent psychiatric complaints is available through the primary health care system. Essential psychiatric medications, consistent with the essential drug list, are available at primary care facilities (see guidance note 4).
- Individuals with pre-existing psychiatric disorders continue to receive relevant treatment, and harmful, sudden discontinuation of medications is avoided. Basic needs of patients in custodial psychiatric hospitals are addressed.
- If the disaster becomes protracted, plans are initiated to provide a more comprehensive range of community-based psychological interventions for the post-disaster phase (see guidance note 5).

Guidance notes

1. ***Information:*** access to information is not only a human right but it also reduces unnecessary public anxiety and distress. Information should be provided on the nature and scale of the disaster and on efforts to establish physical safety for the population. Moreover, the population should be informed on the specific types of relief activities being undertaken by the government, local authorities and aid organisations, and their location.

Information should be disseminated according to principles of risk communication i.e. it should be uncomplicated (understandable to local 12-year-olds) and empathic (showing understanding of the situation of the disaster survivor).

2. ***Burials:*** families should have the option to see the body of a loved one to say goodbye, when culturally appropriate. Unceremonious disposal of bodies of the deceased should be avoided (see Health systems and infrastructure standard 5, guidance note 8 on page 269).

3. ***Psychological first aid:*** whether among the general population or among aid workers, acute distress following exposure to traumatic stressors is best managed following the principles of psychological first aid. This entails basic, non-intrusive pragmatic care with a focus on listening but not forcing talk; assessing needs and ensuring that basic needs are met; encouraging but not forcing company from significant others; and protecting from further harm. This type of first aid can be taught quickly to both volunteers and professionals. Health workers are cautioned to avoid widespread prescription of benzodiazepines because of the risk of dependence.

4. ***Care for urgent psychiatric complaints:*** psychiatric conditions requiring urgent care include dangerousness to self or others, psychoses, severe depression and mania.

5. ***Community-based psychological interventions:*** interventions should be based on an assessment of existing services and an understanding of the socio-cultural context. They should include use of functional, cultural coping mechanisms of individuals and communities to help them regain control over their circumstances. Collaboration with community leaders and indigenous healers is recommended when feasible. Community-based self-help groups should be encouraged. Community workers should be trained and supervised to assist health workers with heavy caseloads and to conduct outreach activities to facilitate care for vulnerable and minority groups.

Control of non-communicable diseases standard 4: chronic diseases

For populations in which chronic diseases are responsible for a large proportion of mortality, people have access to essential therapies to prevent death.

Key indicators (to be read in conjunction with the guidance notes)

- A specific agency (or agencies) is designated to coordinate programmes for individuals with chronic diseases for which an acute cessation of therapy is likely to result in death (see guidance note 1).
- Individuals with such chronic diseases are actively identified and registered.
- Medications for the routine, ongoing management of chronic diseases are available through the primary health care system, provided that these medications are specified on the essential drug list.

Guidance note

1. ***Chronic diseases:*** no generally accepted guidance on the management of chronic diseases during disasters has previously been established. During recent complex emergencies in countries where patients had previously had access to ongoing treatment for chronic diseases, priority was given to those conditions for which an acute cessation of therapy was likely to result in death, including dialysis-dependent chronic renal failure, insulin-dependent diabetes and certain childhood cancers. These were not new programmes, but a continuation of ongoing life-saving therapy. In future disasters, programmes for other chronic diseases may also be relevant. It is not appropriate to introduce new therapeutic regimens or programmes for the management of chronic diseases during the relief effort if the population did not have access to these therapies prior to the disaster. The routine, ongoing management of stable chronic diseases should be available through the primary health care system, using medications from the essential drug list.

Appendix 1

Health Services Assessment Checklist

Preparation

- Obtain available information on the disaster-affected population and resources from host country and international sources.
- Obtain available maps and aerial photographs.
- Obtain demographic and health data from host country and international sources.

Security and access

- Determine the existence of ongoing natural or human-generated hazards.
- Determine the overall security situation, including the presence of armed forces or militias.
- Determine the access that humanitarian agencies have to the affected population.

Demographics and social structure

- Determine the total disaster-affected population and proportion of children under five years old.
- Determine age and sex breakdown of the population.
- Identify groups at increased risk, e.g. women, children, older people, disabled people, people living with HIV/AIDS, members of certain ethnic or social groups.
- Determine the average household size and estimates of female- and child-headed households.
- Determine the existing social structure, including positions of authority/influence and the role of women.

Background health information

- Identify pre-existing health problems and priorities in the disaster-affected area prior to the disaster. Ascertain local disease epidemiology.
- Identify pre-existing health problems and priorities in the country of origin if refugees are involved. Ascertain disease epidemiology in the country of origin.
- Identify existing risks to health, e.g. potential epidemic diseases.
- Identify previous sources of health care.
- Determine the strengths and coverage of local public health programmes in refugees' country of origin.

Mortality rates

- Calculate the crude mortality rate (CMR).
- Calculate the under-5 mortality rate (U5MR: age-specific mortality rate for children under 5 years of age).
- Calculate cause-specific mortality rates.

Morbidity rates

- Determine incidence rates of major diseases that have public health importance.
- Determine age- and sex-specific incidence rates of major diseases where possible.

Available resources

- Determine the capacity of and the response by the Ministry of Health of the country or countries affected by the disaster.
- Determine the status of national health facilities, including total number, classification and levels of care provided, physical status, functional status and access.
- Determine the numbers and skills of available health staff.
- Determine the capacity and functional status of existing public

health programmes, e.g. Expanded Programme on Immunisation (EPI), maternal and child health services.

- Determine the availability of standardised protocols, essential drugs, supplies and equipment.
- Determine the status of existing referral systems.
- Determine the status of the existing health information system (HIS).
- Determine the capacity of existing logistics systems, especially as they relate to procurement, distribution and storage of essential drugs, vaccines and medical supplies.

Consider data from other relevant sectors

- Nutritional status
- Environmental conditions
- Food and food security.

Appendix 2 Sample Weekly Surveillance Reporting Forms

Mortality Surveillance Form 1*

Site .....

Date from Monday .....To Sunday: .....

Total population at beginning of this week: .....

Births this week: .....Deaths this week:.....

Arrivals this week (if applicable):.....Departures this week: .....

Total population at end of week:.....Total under 5 years population: .....

	0-4 yrs		5+ yrs		Total
	male	female	male	female	
Immediate cause					
Acute lower resp. infection					
Cholera (suspected)					
Diarrhoea – bloody					
Diarrhoea – watery					
Injury – non-accidental					
Malaria					
Maternal death – direct					
Measles					
Meningitis (suspected)					
Neonatal (0-28 days)					
Other					
Unknown					
Total by age and sex					
Underlying cause					
AIDS (suspected)					
Malnutrition					
Maternal death – indirect					
Other					
Total by age and sex					

* This form is used when there are many deaths and therefore more detailed information on individual deaths cannot be collected due to time limitations.

– Frequency of reporting (i.e. daily or weekly) depends upon the number of deaths.

– Other causes of mortality can be added according to the context and epidemiological pattern.

– Ages can be further disaggregated (0-11 mths, 1-4 yrs, 5-14 yrs, 15-49 yrs, 50-59 yrs, 60+ yrs) as feasible.

– Deaths should not be reported solely from site health facilities, but should include reports from site and religious leaders, community workers, women's groups and referral hospitals.

– Whenever possible, case definitions should be put on back of form.

Mortality Surveillance Form 2*

Site.....

Date from Monday.....To Sunday: .....

Total population at beginning of this week: .....

Births this week: .....Deaths this week: .....

Arrivals this week (if applicable): .....Departures this week:.....

Total population at end of week:.....Total under 5 years population:.....

			Direct Cause of Death												Underlying Causes						
No	Sex (m, f)	Age (days=d mths=m yrs=y)	Acute lower resp. infection	Cholera (suspected)	Diarrhoea – bloody	Diarrhoea – watery	Injury – non-accidental	Malaria	Maternal death – direct	Measles	Meningitis (suspected)	Neonatal (0-28 days)	Other (specify)	Unknown	AIDS (suspected)	Malnutrition	Maternal death – indirect	Other (specify)	Date (dd/mm /yy)	Location in site (e.g. block no.)	Died in hospital or at home
1																					
2																					
3																					
4																					
5																					
6																					
7																					
8																					
9																					
10																					

* This form is used when there is enough time to record data on individual deaths; it allows analysis by age, outbreak investigation by location and facility utilisation rates.

– Frequency of reporting (i.e. daily or weekly) depends upon the number of deaths.

– Other causes of death can be added as fits the situation.

– Deaths should not be reported solely from site health facilities, but should include reports from site and religious leaders, community workers, women's groups and referral hospitals

– Whenever possible, case definitions should be put on back of form.

Weekly Morbidity Surveillance Reporting Form

Site .....

Date from Monday: ..... To Sunday: .....

Total population at beginning of this week: .....

Births this week: ..... Deaths this week: .....

Arrivals this week (if applicable): ..... Departures this week: .....

Total population at end of week: ..... Total under 5 years population: .....

Morbidity	Under 5 years (new cases)			5 years and over (new cases)			Total	Repeat cases
Diagnosis*	Male	Female	Total	Male	Female	Total	new cases	Total
Acute respiratory infections**								
AIDS (suspected)								
Anaemia								
Cholera (suspected)								
Diarrhoea – bloody								
Diarrhoea – watery								
Eye diseases								
Malaria								
Malnutrition								
Measles								
Meningitis (suspected)								
Injuries – accidental								
Injuries – non-accidental								
Sexually transmitted infections								
Genital ulcer disease								
Male urethral discharge								
Vaginal discharge								
Lower abdominal pain								
Scabies								
Skin diseases (excluding scabies)								
Worms								
Others								
Unknown								
Total								

* More than one diagnosis is possible; diseases can be removed or added as fits the current situation.

** Acute respiratory tract infections: in some countries, this category may be divided into upper and lower tract infections.

– Causes of morbidity can be added or subtracted according to context and epidemiological pattern.

– Ages can be further disaggregated (0-11 mths, 1-4 yrs, 5-14 yrs, 15-49 yrs, 50-59 yrs, 60+ yrs) as feasible.

Visits to health facility	Under 5 years			5 years and over			Total	
	Male	Female	Total	Male	Female	Total	Male	Female
Total visits								

Utilisation rate: Number of visits per person per year to health facility = total number of visits in 1 week / total population x 52 weeks

– Ages can be further disaggregated (0-11 mths, 1-4 yrs, 5-14 yrs, 15-49 yrs, 50-59 yrs, 60+ yrs) as feasible.

Number of consultations per clinician: Number of total visits (new and repeat) / FTE clinician in health facility/ number of days health facility functioning per week.

Appendix 3

Formulas for Calculating Rates of Mortality and Morbidity

Crude Mortality Rate (CMR)

- *Definition:* The rate of death in the entire population, including both sexes and all ages. The CMR can be expressed with different standard population denominators and for different time periods, e.g. deaths per 1,000 population per month or deaths per 1,000 population per year.
- *Formula most commonly used during disasters:*

$$\frac{\text{Total number of deaths during time period}}{\text{Total population}} \times \frac{10{,}000 \text{ persons}}{\text{No. days in time period}}$$

= deaths/10,000 persons/day

Under-5 Mortality Rate (U5MR)

- *Definition:* The rate of death among children below 5 years of age in the population.
- *Formula most commonly used during disasters* (age-specific mortality rate for children less than 5 years)*:*

$$\frac{\text{Total number of deaths in children <5 years during time period}}{\text{Total number of children <5 years}} \times \frac{10{,}000 \text{ persons}}{\text{No. days in time period}}$$

= deaths/10,000 /day

Incidence Rate

- *Definition:* The number of new cases of a disease that occur during a specified period of time in a population at risk of developing the disease.
- *Formula most commonly used during disasters:*

$$\frac{\text{Number of new cases due to specific disease in time period}}{\text{Population at risk of developing disease}} \times \frac{1{,}000 \text{ persons}}{\text{No. months in time period}}$$

= new cases due to specific disease/1,000/month

Case Fatality Rate (CFR)

- *Definition:* The number of people who die of a disease divided by the number of people who have the disease.
- *Formula:*

$$\frac{\text{Number of people dying from disease during time period}}{\text{People who have the disease during time period}} \times 100 = x\%$$

Health Facility Utilisation Rate

- *Definition:* The number of out-patient visits per person per year. Whenever possible, a distinction should be drawn between new and old visits, and new visits should be used to calculate this rate. However, it is often difficult to differentiate between new and old visits, so they are frequently combined as total visits during a disaster.
- *Formula:*

$$\frac{\text{Total number of visits in one week}}{\text{Total population}} \times 52 \text{ weeks}$$

= visits/person/year

Number of Consultations per Clinician per Day

- *Definition:* Average number of total consultations (new and repeat cases) seen by each clinician per day.
- *Formula:*

$$\frac{\text{Total number of consultations (new and repeat)}}{\text{Number FTE* clinicians in health facility}} \div \text{Number of days health facility open per week}$$

* FTE ('full-time equivalent') refers to the equivalent number of clinicians working in a health facility. For example, if there are six clinicians working in the out-patient department but two of them work half-time, then the number of FTE clinicians = 4 full-time staff + 2 half-time staff = 5 FTE clinicians.

Appendix 4

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Thanks to the Forced Migration Online programme of the Refugee Studies Centre at the University of Oxford, many of these documents have received copyright permission and are posted on a special Sphere link at: http://www.forcedmigration.org

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International Federation of the Red Cross and Red Crescent Societies: http://www.ifrc.org

Pan-American Health Organization: http://www.paho.org

United Nations High Commissioner for Refugees: http://www.unhcr.ch

UNICEF: http://www.unicef.org

World Health Organisation: http://www.who.int

Notes

Notes

Annexes

1 Legal Instruments Underpinning the Sphere Handbook

The following instruments inform the Humanitarian Charter and the Minimum Standards in Disaster Response:

Universal Declaration of Human Rights 1948.

International Covenant on Civil and Political Rights 1966.

International Covenant on Economic, Social and Cultural Rights 1966.

International Convention on the Elimination of All Forms of Racial Discrimination 1969.

The four Geneva Conventions of 1949 and their two Additional Protocols of 1977.

Convention relating to the Status of Refugees 1951 and the Protocol relating to the Status of Refugees 1967.

Convention against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment 1984.

Convention on the Prevention and Punishment of the Crime of Genocide 1948.

Convention on the Rights of the Child 1989.

Convention on the Elimination of All Forms of Discrimination Against Women 1979.

Convention relating to the Status of Stateless Persons 1960.

Guiding Principles on Internal Displacement 1998.

2 The Code of Conduct for the International Red Cross and Red Crescent Movement and Non-Governmental Organisations (NGOs) in Disaster Relief

Prepared jointly by the International Federation of Red Cross and Red Crescent Societies and the ICRC[1]

Purpose

This Code of Conduct seeks to guard our standards of behaviour. It is not about operational details, such as how one should calculate food rations or set up a refugee camp. Rather, it seeks to maintain the high standards of independence, effectiveness and impact to which disaster response NGOs and the International Red Cross and Red Crescent Movement aspires. It is a voluntary code, enforced by the will of the organisation accepting it to maintain the standards laid down in the Code.

In the event of armed conflict, the present Code of Conduct will be interpreted and applied in conformity with international humanitarian law.

Note

1. Sponsored by: Caritas Internationalis*, Catholic Relief Services*, The International Federation of Red Cross and Red Crescent Societies*, International Save the Children Alliance*, Lutheran World Federation*, Oxfam*, The World Council of Churches*, The International Committee of the Red Cross (* members of the Steering Committee for Humanitarian Response).

The Code of Conduct is presented first. Attached to it are three annexes, describing the working environment that we would like to see created by Host Governments, Donor Governments and Inter-Governmental Organisations in order to facilitate the effective delivery of humanitarian assistance.

Definitions

NGOs: NGOs (Non-Governmental Organisations) refers here to organisations, both national and international, which are constituted separately from the government of the country in which they are founded.

NGHAs: For the purposes of this text, the term Non-Governmental Humanitarian Agencies (NGHAs) has been coined to encompass the components of the International Red Cross and Red Crescent Movement – The International Committee of the Red Cross, The International Federation of Red Cross and Red Crescent Societies and its member National Societies – and the NGOs as defined above. This code refers specifically to those NGHAs who are involved in disaster response.

IGOs: IGOs (Inter-Governmental Organisations) refers to organisations constituted by two or more governments. It thus includes all United Nations Agencies and regional organisations.

Disasters: A disaster is a calamitous event resulting in loss of life, great human suffering and distress, and large-scale material damage.

The Code of Conduct

Principles of Conduct for The International Red Cross and Red Crescent Movement and NGOs in Disaster Response Programmes

1 The humanitarian imperative comes first

The right to receive humanitarian assistance, and to offer it, is a fundamental humanitarian principle which should be enjoyed by all citizens of all countries. As members of the international community, we recognise our obligation to provide humanitarian assistance wherever it is needed. Hence the need for unimpeded access to affected populations is of fundamental importance in exercising that responsibility. The prime motivation of our response to disaster is to alleviate human suffering amongst those least able to withstand the stress caused by disaster. When we give humanitarian aid it is not a partisan or political act and should not be viewed as such.

2 Aid is given regardless of the race, creed or nationality of the recipients and without adverse distinction of any kind. Aid priorities are calculated on the basis of need alone

Wherever possible, we will base the provision of relief aid upon a thorough assessment of the needs of the disaster victims and the local capacities already in place to meet those needs. Within the entirety of our programmes, we will reflect considerations of proportionality. Human suffering must be alleviated whenever it is found; life is as precious in one part of a country as another. Thus, our provision of aid will reflect the degree of suffering it seeks to alleviate. In implementing this approach, we recognise the crucial role played by women in disaster-prone communities and will ensure that this role is supported, not diminished, by our aid programmes. The implementation of such a universal, impartial and independent policy, can only be effective if we and our partners have access to the necessary resources to provide for such equitable relief, and have equal access to all disaster victims.

3 Aid will not be used to further a particular political or religious standpoint

Humanitarian aid will be given according to the need of individuals, families and communities. Notwithstanding the right of NGHAs to espouse particular political or religious opinions, we affirm that assistance will not be dependent on the adherence of the recipients to those opinions. We will not tie the promise, delivery or distribution of assistance to the embracing or acceptance of a particular political or religious creed.

4 We shall endeavour not to act as instruments of government foreign policy

NGHAs are agencies which act independently from governments. We therefore formulate our own policies and implementation strategies and do not seek to implement the policy of any government, except in so far as it coincides with our own independent policy. We will never knowingly – or through negligence – allow ourselves, or our employees, to be used to gather information of a political, military or economically sensitive nature for governments or other bodies that may serve purposes other than those which are strictly humanitarian, nor will we act as instruments of foreign policy of donor governments. We will use the assistance we receive to respond to needs and this assistance should not be driven by the need to dispose of donor commodity surpluses, nor by the political interest of any particular donor. We value and promote the voluntary giving of labour and finances by concerned individuals to support our work and recognise the independence of action promoted by such voluntary motivation. In order to protect our independence we will seek to avoid dependence upon a single funding source.

5 We shall respect culture and custom

We will endeavour to respect the culture, structures and customs of the communities and countries we are working in.

6 We shall attempt to build disaster response on local capacities

All people and communities – even in disaster – possess capacities as well as vulnerabilities. Where possible, we will strengthen these capacities by employing local staff, purchasing local materials and trading with local companies. Where possible, we will work through local NGHAs as partners in planning and implementation, and co-operate with local government structures where appropriate. We will place a high priority on the proper co-ordination of our emergency responses. This is best done within the countries concerned by those most directly involved in the relief operations, and should include representatives of the relevant UN bodies.

7 Ways shall be found to involve programme beneficiaries in the management of relief aid

Disaster response assistance should never be imposed upon the beneficiaries. Effective relief and lasting rehabilitation can best be achieved where the intended beneficiaries are involved in the design, management and implementation of the assistance programme. We will strive to achieve full community participation in our relief and rehabilitation programmes.

8 Relief aid must strive to reduce future vulnerabilities to disaster as well as meeting basic needs

All relief actions affect the prospects for long-term development, either in a positive or a negative fashion. Recognising this, we will strive to implement relief programmes which actively reduce the beneficiaries' vulnerability to future disasters and help create sustainable lifestyles. We will pay particular attention to environmental concerns in the design and management of relief programmes. We will also endeavour to minimise the negative impact of humanitarian assistance, seeking to avoid long-term beneficiary dependence upon external aid.

9 We hold ourselves accountable to both those we seek to assist and those from whom we accept resources

We often act as an institutional link in the partnership between those who wish to assist and those who need assistance during disasters. We therefore hold ourselves accountable to both constituencies. All our dealings with donors and beneficiaries shall reflect an attitude of openness and transparency. We recognise the need to report on our activities, both from a financial perspective and the perspective of effectiveness. We recognise the obligation to ensure appropriate monitoring of aid distributions and to carry out regular assessments of the impact of disaster assistance. We will also seek to report, in an open fashion, upon the impact of our work, and the factors limiting or enhancing that impact. Our programmes will be based upon high standards of professionalism and expertise in order to minimise the wasting of valuable resources.

10 In our information, publicity and advertising activities, we shall recognise disaster victims as dignified humans, not hopeless objects

Respect for the disaster victim as an equal partner in action should never be lost. In our public information we shall portray an objective image of the disaster situation where the capacities and aspirations of disaster victims are highlighted, and not just their vulnerabilities and fears. While we will cooperate with the media in order to enhance public response, we will not allow external or internal demands for publicity to take precedence over the principle of maximising overall relief assistance. We will avoid competing with other disaster response agencies for media coverage in situations where such coverage may be to the detriment of the service provided to the beneficiaries or to the security of our staff or the beneficiaries.

The Working Environment

Having agreed unilaterally to strive to abide by the Code laid out above, we present below some indicative guidelines which describe the working

environment we would like to see created by donor governments, host governments and the inter-governmental organisations – principally the agencies of the United Nations – in order to facilitate the effective participation of NGHAs in disaster response.

These guidelines are presented for guidance. They are not legally binding, nor do we expect governments and IGOs to indicate their acceptance of the guidelines through the signature of any document, although this may be a goal to work to in the future. They are presented in a spirit of openness and cooperation so that our partners will become aware of the ideal relationship we would seek with them.

Annex I : Recommendations to the governments of disaster-affected countries

1 Governments should recognise and respect the independent, humanitarian and impartial actions of NGHAs

NGHAs are independent bodies. This independence and impartiality should be respected by host governments.

2 Host governments should facilitate rapid access to disaster victims for NGHAs

If NGHAs are to act in full compliance with their humanitarian principles, they should be granted rapid and impartial access to disaster victims, for the purpose of delivering humanitarian assistance. It is the duty of the host government, as part of the exercising of sovereign responsibility, not to block such assistance, and to accept the impartial and apolitical action of NGHAs. Host governments should facilitate the rapid entry of relief staff, particularly by waiving requirements for transit, entry and exit visas, or arranging that these are rapidly granted. Governments should grant over-flight permission and landing rights for aircraft transporting international relief supplies and personnel, for the duration of the emergency relief phase.

3 Governments should facilitate the timely flow of relief goods and information during disasters

Relief supplies and equipment are brought into a country solely for the purpose of alleviating human suffering, not for commercial benefit or gain. Such supplies should normally be allowed free and unrestricted passage and should not be subject to requirements for consular certificates of origin or invoices, import and/or export licences or other restrictions, or to importation taxation, landing fees or port charges.

The temporary importation of necessary relief equipment, including vehicles, light aircraft and telecommunications equipment, should be facilitated by the receiving host government through the temporary waiving of licence or registration restrictions. Equally, governments should not restrict the re-exportation of relief equipment at the end of a relief operation.

To facilitate disaster communications, host governments are encouraged to designate certain radio frequencies, which relief organisations may use in-country and for international communications for the purpose of disaster communications, and to make such frequencies known to the disaster response community prior to the disaster. They should authorise relief personnel to utilise all means of communication required for their relief operations.

4 Governments should seek to provide a coordinated disaster information and planning service

The overall planning and coordination of relief efforts is ultimately the responsibility of the host government. Planning and coordination can be greatly enhanced if NGHAs are provided with information on relief needs and government systems for planning and implementing relief efforts as well as information on potential security risks they may encounter. Governments are urged to provide such information to NGHAs.

To facilitate effective coordination and the efficient utilisation of relief efforts, host governments are urged to designate, prior to disaster, a single point-of-contact for incoming NGHAs to liaise with the national authorities.

5 Disaster relief in the event of armed conflict

In the event of armed conflict, relief actions are governed by the relevant provisions of international humanitarian law.

Annex II : Recommendations to donor governments

1 Donor governments should recognise and respect the independent, humanitarian and impartial actions of NGHAs

NGHAs are independent bodies whose independence and impartiality should be respected by donor governments. Donor governments should not use NGHAs to further any political or ideological aim.

2 Donor governments should provide funding with a guarantee of operational independence

NGHAs accept funding and material assistance from donor governments in the same spirit as they render it to disaster victims; one of humanity and independence of action. The implementation of relief actions is ultimately the responsibility of the NGHA and will be carried out according to the policies of that NGHA.

3 Donor governments should use their good offices to assist NGHAs in obtaining access to disaster victims

Donor governments should recognise the importance of accepting a level of responsibility for the security and freedom of access of NGHA staff to disaster sites. They should be prepared to exercise diplomacy with host governments on such issues if necessary.

Annex III : Recommendations to inter-governmental organisations

1 IGOs should recognise NGHAs, local and foreign, as valuable partners

NGHAs are willing to work with UN and other inter-governmental agencies to effect better disaster response. They do so in a spirit of partnership which respects the integrity and independence of all partners. Inter-governmental agencies must respect the independence and impartiality of the NGHAs. NGHAs should be consulted by UN agencies in the preparation of relief plans.

2 IGOs should assist host governments in providing an overall coordinating framework for international and local disaster relief

NGHAs do not usually have the mandate to provide the overall coordinating framework for disasters which require an international response. This responsibility falls to the host government and the relevant United Nations authorities. They are urged to provide this service in a timely and effective manner to serve the affected state and the national and international disaster response community. In any case, NGHAs should make all efforts to ensure the effective co-ordination of their own services.

In the event of armed conflict, relief actions are governed by the relevant provisions of international humanitarian law.

3 IGOs should extend security protection provided for UN organisations to NGHAs

Where security services are provided for inter-governmental organisations, this service should be extended to their operational NGHA partners where it is so requested.

4 IGOs should provide NGHAs with the same access to relevant information as is granted to UN organisations

IGOs are urged to share all information, pertinent to the implementation of effective disaster response, with their operational NGHA partners.

3 Acknowledgements

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InterAction ◊ Save the Children Alliance ◊ CARE International ◊ The Lutheran World Federation (LWF/ACT) ◊ Voluntary Organisations in Cooperation in Emergencies (VOICE) ◊ Mercy Corps ◊ Action by Churches Together (ACT) ◊ Oxfam GB ◊ Steering Committee for Humanitarian Response ◊ International Committee of the Red Cross ◊ International Federation of Red Cross and Red Crescent ◊ International Council of Voluntary Agencies (ICVA) ◊ Caritas Internationalis

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◊ The United States Department of State Bureau of Refugees and Migration (US-PRM) ◊ The United States Agency for International Development Office of Foreign Disaster Assistance (US-OFDA)

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Many thanks

The Sphere standards and indicators are built on the collective experience and good practice of individuals and agencies active in many different areas of humanitarian work. As with the first edition of the handbook, this revision would have been impossible to undertake without the collaboration of many people around the world. In all, thousands of individuals in 80 countries, representing more than 400 agencies, participated in the process, volunteering significant time and expertise.

The emphasis throughout the development of the handbook was on consultation, with networks of peer review groups involved at all stages of the process. In particular, aid workers based in countries where disasters are a regular occurrence, and who are using the handbook in the field, provided detailed feedback. The result does not represent the view of any one agency. Rather, it represents the active and deliberate will of the humanitarian community to join together to share an extensive body of experience and learning, in an effort to improve the quality and accountability of humanitarian action. Thanks to all who helped to make this a reality.

While Sphere gratefully acknowledges the contribution of everyone who has participated, both in the original handbook and in this revision, it would take more than 40 pages to list individual names and space does not allow this. However, a full listing of all agencies and individuals who have contributed can be found on the Sphere website at: http://www.sphereproject.org

4 Acronyms

ACC/SCN:
United Nations Administrative Committee on Coordination/Subcommittee on Nutrition

ACT:
Action by Churches Together

ALNAP:
Active Learning Network for Accountability in Practice

CDC:
Centers for Disease Control and Prevention

DAC:
Development Assistance Committee (OECD)

FAO:
Food and Agriculture Organisation

IAPSO:
Inter-Agency Procurement Services Office (UNDP)

ICRC:
International Committee of the Red Cross

INFCD:
International Nutrition Foundation for Developing Countries

LWF:
The Lutheran World Federation

MISP:
Minimum Initial Service Package

MSF:
Médecins Sans Frontières

NCHS:
National Centre for Health Statistics

NGO:
Non-governmental organisation

OCHA:
UN Office for Coordination of Humanitarian Affairs

OECD:
Organisation for Economic Cooperation and Development

OFDA:
Office of Foreign Disaster Assistance (USAID)

PTSS:
Programme and Technical Support Section (UNHCR)

SCHR:
Steering Committee for Humanitarian Response

UNDP:
United Nations Development Programme

UNDRO:
United Nations Disaster Relief Organisation

UNEP:
United Nations Environment Programme

UNHCR:
United Nations High Commissioner for Refugees

UNICEF:
United Nations Children's Fund

USAID:
United States Agency for International Development

WCRWC:
Women's Commission for Refugee Women and Children

WFP:
World Food Programme

WHO:
World Health Organisation

WMO:
World Meteorological Organisation

Index

Index

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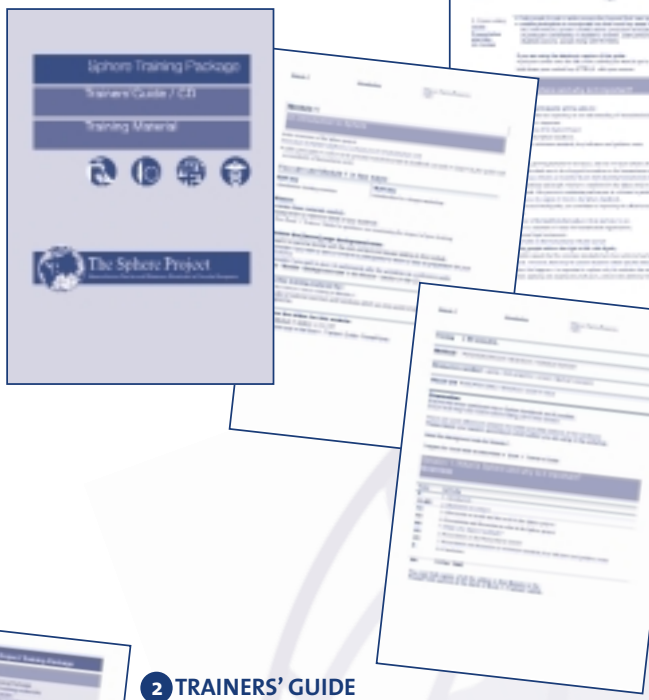

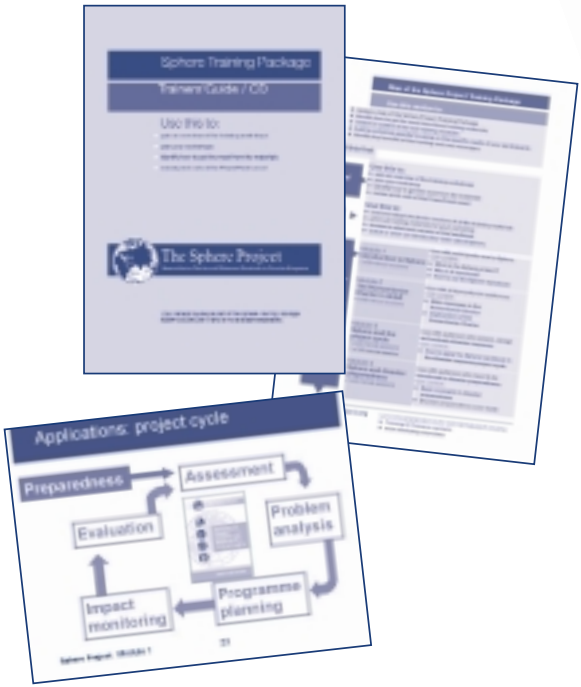

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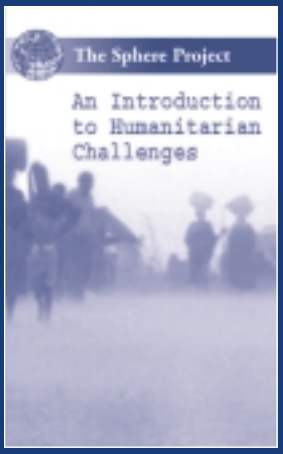

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Humanitarian Charter and Minimum Standards in Disaster Response

The Sphere Humanitarian Charter and Minimum Standards in Disaster Response are a remarkable international initiative aimed at improving the effectiveness and accountability of humanitarian assistance. This new edition of the handbook has been thoroughly revised and updated, taking into account recent developments in humanitarian practice, together with feedback from practitioners in the field, research institutes and cross-cutting experts in protection, gender, children, older people, disabled people, HIV/AIDS and the environment. The revised handbook is the product of an extensive collaborative effort that reflects the collective will and shared experience of the humanitarian community, and its determination to improve on current knowledge in humanitarian assistance programmes.

The cornerstone of this book is the Humanitarian Charter, which is based on the principles and provisions of international humanitarian, human rights and refugee law, and on the principles of the Red Cross and NGO Code of Conduct. It describes the core principles that govern humanitarian action and asserts the right of populations to protection and assistance. The Minimum Standards are organised into an initial chapter that details process standards for the planning and implementation of programmes, together with four technical chapters covering water, sanitation and hygiene promotion; food security, nutrition and food aid; shelter, settlement and non-food items; and health services.

As a practical tool, the Humanitarian Charter can be used to define overarching project goals while the Minimum Standards, together with their supporting indicators and guidance notes, enable an analytical assessment of programme requirements and a framework for monitoring progress and evaluating outcomes. Taken as a whole, Sphere also provides a powerful tool for coordination and advocacy, particularly in its multi-sectoral scope and its linkage of principle to practice.

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2004 EDITION

Small Flows Quarterly
JURIED ARTICLE

The Need for Wastewater Treatment in Latin America:

A Case Study of the Use of Wastewater Stabilization Ponds in Honduras

CONTRIBUTING WRITER WITH PHOTOS BY
Stewart M. Oakley, Ph.D.,
Department of Civil Engineering, California State University

Abstract

This paper discusses the issue of wastewater treatment in developing countries, especially in Latin America, and presents a detailed case study of the use of stabilization pond systems in Honduras. Ten pond systems in Honduras were monitored during dry and wet seasons to develop a database for performance, improving designs, and developing more appropriate effluent standards based on local conditions. The pond systems were monitored for flow rates, helminth eggs, *Shigella* species, *Escherichia coli*, fecal coliforms, and conventional parameters, including BOD_5 and suspended solids (SS). Pond sludges were also monitored for helminth eggs, and percent total solids, volatile solids, and fixed solids. Results show that the majority of ponds have higher flow rates (with lower hydraulic retention times) and much higher organic loading rates than those assumed by designers. Nevertheless, all of the systems monitored removed 100 percent of the influent helminth egg concentrations and satisfy the World Health Organization microbiological guidelines for Category B irrigation with wastewater effluents. *Shigella* species were not detected, and *Escherichia coli* and fecal coliform removal were highly variable. The removal of BOD_5 and SS was typical for stabilization pond systems, and organically overloaded ponds did not exhibit significant difference from underloaded ones. Sludge analyses showed that all pond sludges are heavily contaminated with helminth eggs and that several ponds are in need of desludging. Planning for system expansion, and adequately financing operation and maintenance, including pond desludging, are major issues within municipalities for long-term sustainability. The study concludes that at this time treatment objectives in municipalities should focus on helminth removal, with the objective of using pond effluents for agricultural and aquaculture reuse to enhance long-term sustainability of pond systems

Author's Note: *The perspective presented in this paper is far removed from the technical and regulatory context of wastewater treatment as practiced in the U.S. The paper's purpose is to present to the readers of the* Small Flows Quarterly *the problem of excreta-related infections in developing countries and the goal of effective wastewater treatment as a public health imperative using a natural system technology in a way distinct from the U.S. experience.*

A common scene in Latin America: raw sewage flowing down a street in an urban development near Tegucigalpa, Honduras.

While there is much interest on natural systems for wastewater treatment (WEF, 2001) or decentralized wastewater management systems (Crites and Tchobanoglous, 1998), and while lagoon or waste stabilization pond systems are subsumed within these categories, it is clear that in the U.S., pond systems have long fallen out of favor as a treatment option for municipalities. This is principally a result of increasingly stringent discharge requirements (Metcalf and Eddy, 2003). Although the U.S. Environmental Protection Agency (EPA) has recently published revised editions of its constructed wetlands and onsite wastewater design manuals (EPA, 2000 and 2003), it is doubtful that the waste stabilization pond design manual published over 20 years ago (EPA, 1983) will ever be revised.

Outside the U.S. it is a quite different story. Waste stabilization pond systems have long been promoted in developing countries as the only viable option to help solve the devastating problem of excreta-related disease transmission at an affordable cost (Cairncross and Feachem, 1992; CEPIS/OPS, 2000; Egocheaga and Moscoso, 2004; Feachem, et al., 1983; León and Moscoso, 1996; Mara, 2004; Rolim, 2000; Shuval and Fattal, 2003; and Shuval, et al., 1986). Pond systems in developing countries are typically designed for pathogen removal and agricultural reuse using epidemiologically-based guidelines, such as the World Health Organization's (WHO) microbiological guidelines for wastewater use in agriculture and aquaculture (WHO, 1989). This approach for wastewater treatment is distinct from that taken historically in the U.S. and Europe and is especially distinct from the current focus of U.S. regulation at the state and federal level.

The purpose of this paper is to discuss the issue of wastewater treatment from the perspective of developing countries in Latin America and to present a detailed case study, including extensive monitoring results, of stabilization pond use in Honduras—one of the poorest countries in the Western Hemisphere with typically high prevalence rates of excreta-related infections.

Wastewater Treatment Issues Outside the U.S.

Global Status of Excreta-Related Infections and Wastewater Treatment

The provision of drinking water supply, sewerage, and wastewater treatment for communities throughout the world has been a major component of development projects financed over the last 20 years. This effort started with the International Drinking Water Supply and Sanitation Decade movement (1981 to 1990), which was spearheaded by the World Bank (Cairncross and Feachem, 1993). During the 1990s, the WHO and the United Nations Children's Fund (UNICEF) formed the Joint Monitoring Program for Water Supply and Sanitation, whose overall aim was to improve planning and management within countries by support in monitoring the water supply and sanitation sector (WHO/UNICEF, 2000). The WHO/UNICEF Joint Monitoring Program has presented four assessment reports (1991, 1993, 1996, and 2000). The findings of the latest report (WHO/UNICEF, 2000) can be summarized, in part, as follows with additional information cited from other sources:

- Worldwide approximately 1.1 billion people lack access to improved water sources.
- Approximately 2.4 billion people have no access to any form of improved sanitation.
- Excreted-related infections are a major cause of morbidity and mortality worldwide.
- There are approximately 4 billion cases of diarrhea each year, causing 2.2 million deaths, mostly among children, from diseases associated with lack of safe drinking water, inadequate sanitation, and poor hygiene.
- Intestinal worms (helminths) infect at least 10 percent of the population of the developing world (WHO/UNICEF, 2000), and likely infect up to 24 percent of the world's population (Chan, 1997).
- Protozoan infections probably exhibit a similar prevalence to helminths, and *Entamoeba histolytica* infection is one of the 10 most common infections in the world (Savioli, L. et al., 1992).
- Lack of wastewater treatment is a health hazard in all developing countries. With the exception of the U.S., Canada, and some European countries, the median percentage of urban wastewater treated worldwide is very low as seen in **Table 1**.
- The discharge of untreated wastewater is especially a health hazard where receiving waters are used for drinking water sources, bathing, washing, irrigation, and fisheries.
- Conventional wastewater treatment methods as practiced in the U.S. and Europe are not affordable in developing countries (which is the main reason why they don't exist), nor do they necessarily provide the requisite degree of pathogen removal for the protection of public health, especially parasitic infections.

As a result of the above situation, the professional community concerned with sanitation and public health in developing coun-

Geographic Region	Asia	Latin America & Caribbean	Africa	North America	Europe
Population in yr. 2000, billions	3.68	0.52	0.78	0.31	0.73
Median percentage of wastewater discharges that receive any form of treatment.	35	14	0	90	66

TABLE 1 Wastewater Treatment Worldwide

tries has long concluded that the principal objective of wastewater treatment in areas where excreta-related infections are endemic should be the removal of pathogens using low-cost appropriate technologies, and that generally the most appropriate technology is a waste stabilization pond system (Cairncross and Feachem, 1992; CEPIS/OPS, 2000; Egocheaga and Moscoso, 2004; Feachem, et al., 1983; León and Moscoso,1996; Mara, 2004; Rolim, 2000; Shuval and Fattal, 2003; Shuval, et al., 1986; and WHO/UNICEF, 2000). The pathogen removal efficiencies of various treatment processes as generally cited in the literature are shown in **Table 2**.

Process	Removal, %		Removal, Cycles $\log_{10}$			
	BOD_5	SS	Virus	Bacteria	Helminth Eggs	Protozoan Cysts
Primary Sedimentation	25—40	40—70	0—1	0—1	0—1	0—2
Activated Sludge[1]	55—95	55—95	1—2	0—2	0—1	1—2
Trickling Filters[1]	50—95	50—90	1—2	0—2	0—1	1—2
Disinfection with Chlorine	---	---	0—4	2—6	0—1	0—3
Stabilization Ponds in Series[2]	70—95	55—95[3]	2—4	2—6	2—4 (100%)	2—4 (100%)

1. Preceded and followed by sedimentation.
2. Depending on the number of ponds in series, hydraulic retention time, and physical design.
3. Pond effluents typically have higher SS concentrations in the form of algae although the removal of the influent SS is greater than 90%.

Sources: Feachem *et al.*, 1983; Mara, 2004; Scott, 2003.

TABLE 2 Removal of Pathogens and Conventional Parameters in Various Treatment Processes

This focus on pathogen removal with stabilization pond systems is distinct from the historical objectives of wastewater treatment in developed countries and is especially far removed from current focus on more stringent effluent regulations with the use of increasingly more costly and complicated technologies in the U.S. Nevertheless, the sheer magnitude of the problem of public health and wastewater treatment in developing countries necessitates a different approach (**Figure 1** graphically shows the gap in per capita gross national product among the U.S. and various countries of Latin America, which underscores the need for low-cost solutions not used in the U.S.). In fact, the focus on stabilization ponds for developing countries is within the same spirit of the interest in natural systems for wastewater treatment in the U.S., with emphasis on natural environmental components to provide the desired treatment, and the benefits of fewer operational personnel, less energy consumption, and less sludge production than conventional mechanical systems (WEF, 2001). In this context, it is worthwhile to quote from the classic text, *Sanitation and Disease*, published over twenty years ago and still relevant today for the problem of wastewater treatment in developing countries:

> *"Those whose job is to select and design appropriate systems for the collection and treatment of sewage in developing countries must bear in mind that European and North American practices do not represent the zenith of scientific achievement, nor are they the product of a logical and rational design process. Rather, treatment practices in the developed countries are the product of history, a history that started about 100 years ago . . . . Conventional sewage works were originally developed in order to prevent gross organic pollution in European and North American rivers; they were*

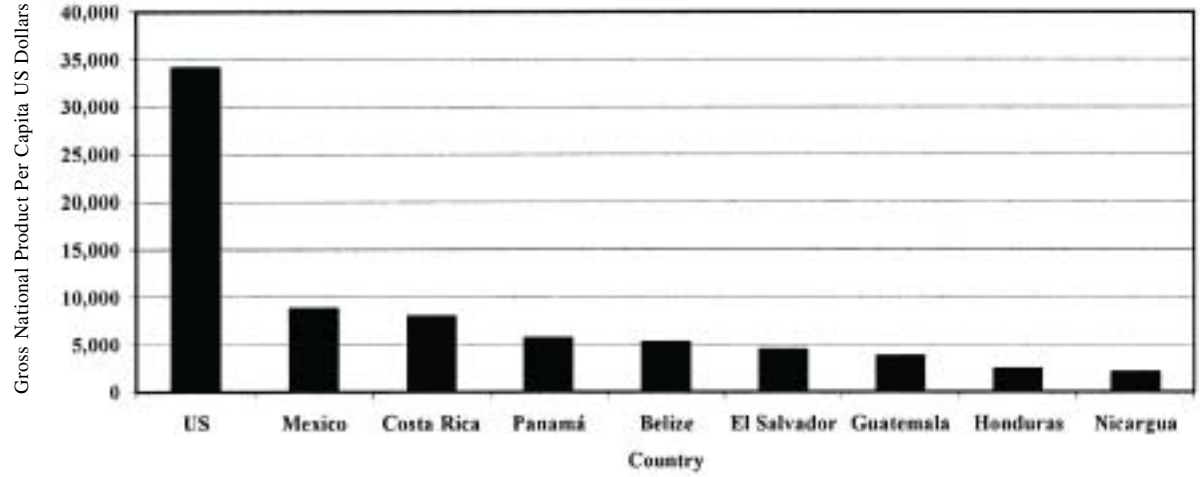


FIGURE 1 Per Capita Gross National Product for the United States, Mexico, and Central America in US Dollars - Year 2000

Raw sewage contaminates the streets of Latin America. This photo was taken in the town of Danlí, Honduras.

never intended to achieve high removal of excreted pathogens. Their use in tropical countries in which excreted infections are endemic is only justifiable in special circumstances, for there is an alternative treatment process much superior in obtaining low survivals of excreted pathogens—the waste stabilization pond system."
(Feachem, et al., 1983, pp. 63–64)

The Situation in Latin America

It is estimated that the urban population of Latin America, with approximately 340,000,000 persons connected to sewers, generates 52,000,000 m^3/day of wastewater (Egocheaga and Moscoso, 2004; WHO/UNICEF, 2000). It is further estimated that only 3,100,000 m^3/day of this wastewater, or 6 percent of what is generated, receives secondary treatment before being discharged into surface waters or reused directly in agriculture or aquaculture (Egocheaga and Moscoso, 2004). Of all the capital cities from Mexico City to Buenos Aires, the vast majority do not treat their wastewaters, to say nothing of the thousands of smaller cities throughout the region. Surface waters—rivers, streams, lakes and coastal areas—are widely contaminated with raw wastewater discharges throughout Latin America.

The problem of wastewater treatment is exacerbated by severe shortages in water quantity for agriculture. Throughout Latin America, there has been an historical tendency to use either raw or diluted wastewaters for irrigation and aquaculture, and it is estimated that at least one million hectares are irrigated with these contaminated sources (Egocheaga and Moscoso, 2004). The effects on public health of excreta-related infections have been devastating and have even had deleterious effects on disease morbidity within the U.S. The following examples are typical and illustrate how the magnitude of the problem is not only local, but also affects populations throughout the hemisphere:

- The cholera epidemic, which began in Peru in 1991, produced 1,199,804 cases with 11,875 deaths between 1991—1997 in 20 countries including the U.S.; it is estimated that the epidemic cost the country of Peru one billion U.S. dollars in tourism and exportation of agricultural products in only 10 weeks (OPS, 1998). The epidemic was caused by the consumption of drinking water and food products contaminated with raw sewage. Cholera, which had not been present in the Western Hemisphere for over 100 years, is now endemic in various countries in Latin America.
- Five outbreaks of cyclosporiasis from 1995 to 2000 in the U.S. and Canada caused by the emerging protozoan pathogen, *Cyclospora cayetanensis*, have been linked to raspberries imported from Guatemala (Bern, et al., 1999; Ho et al., 2002). It is assumed that the raspberries were irrigated or washed with either raw sewage or sewage-contaminated water. The principal route of transmission of *Cyclospora* infections in Guatemala is the water-borne route (Bern, et al., 1999).
- The largest epidemic of hepatitis A in the history of the U.S. occurred in 2003, with more than 700 cases in 4 states, all linked to green onions imported from two farms in Mexico (Fiore, 2004). It is assumed the onions were contaminated with the virus through irrigation or washing with either raw sewage or sewage-contaminated water (Fiore, 2004).

Surface waters obviously play a significant role in the continued transmission of excreta-related infections, since they are commonly used for bathing, washing, drinking water supply, crop irrigation, and the consumption of fish and shellfish. Professional judgment regarding the principal objective of wastewater treatment in the region dictates the removal of fecal pathogens as the first priority of wastewater treatment. This conclusion has been reached many times, and most recently by an exhaustive study of wastewater pollution, treatment, and reuse throughout Latin America published by the Pan American Cen-

ter for Sanitary Engineering and Environmental Science (Egocheaga and Moscoso, 2004). The study concludes that the proper management of domestic wastewater in Latin America should focus on public health as a first priority, with the removal of pathogens as the principal objective of wastewater treatment. The study also concludes that in order to resolve the problem of agricultural demand for water and the sustainability of wastewater treatment in impoverished cities, treatment of wastewater focusing on pathogen removal should be integrated with the productive reuse of the treated wastewater (Egocheaga and Moscoso, 2004; CEPIS/OPS, 2000). The study concludes that the best available technology for accomplishing this goal is wastewater stabilization pond systems, which can most easily meet the WHO guidelines for wastewater reuse in agriculture than any other technology. The WHO guidelines are shown in **Table 3**.

Category	Reuse Conditions	Exposed Group	Intestinal Helminths[b] (Arithmetic Mean Number of Eggs per Liter[c])	Fecal Coliforms (Geometric Mean Number per 100 mL[c])	Wastewater Treatment Expected to Achieve the Required Microbiological Guideline
A	Irrigation of crops likely to be eaten uncooked, sports fields, public parks[d]	Workers Consumers Public	≤ 1	≤ 1,000	A series of stabilization ponds designed to achieve the microbiological quality indicated, or equivalent treatment
B	Irrigation of cereal crops, industrial crops, fodder crops, pasture, and trees[e]	Workers	≤ 1	No standard recommended	Retention in stabilization ponds for 8—10 days or equivalent helminth and fecal coliform removal
C	Localized irrigation of crops in Category B if exposure to workers and the public does not occur	None	Not applicable	Not applicable	Pretreatment as required by irrigation technology but not less than primary sedimentation

a. In specific cases, local epidemiological, sociocultural and environmental factors should be taken into account and the guidelines modified accordingly.
b. *Ascaris* and *Trichuris*, species and hookworms.
c. During the irrigation period.
d. A more stringent guideline limit (≤ 200 fecal coliforms/100mL) is appropriate for public lawns, such as hotel lawns, with which the public may come into direct contact.
e. In the case of fruit trees, irrigation should cease two weeks before fruit is picked, and no fruits should be picked off the ground. Sprinkler irrigation should not be used.

Source: WHO, 1989.

TABLE 3 World Health Organization Recommended Microbiological Guidelines for Wastewater Use in Agriculture

Case Study of Honduras

Background

The provision of water supply and sewerage services for Honduras has been a major component of development projects financed over the last 15 years. Approximately 81 percent of the estimated total population of 6.7 million has access to drinking water, and 70 percent has access to sanitation services (OPS, 2002). In spite of these efforts in the public health sector, however, excreta-related infections are still a major cause of morbidity and mortality. The cholera epidemic, with over 15,378 cumulative cases during 1991 to 2000, and the continued high morbidity of intestinal protozoan and helminth infections as shown in **Table 4**, underscore the persistent public health problems (Girard de Kaminsky, 1996; OPS, 1998, 2002). Surface waters play a significant role in the continued transmission of excreta-related infections, since the vast majority are polluted with wastewater discharges and are commonly used for bathing, washing crop irrigation, and fish and shellfish harvesting. In an attempt to ameliorate the problem, all internationally financed sewerage projects within Honduras now require wastewater treatment as a necessary component.

It has been generally assumed by the professional community in Honduras that waste stabilization ponds are the treatment option of choice because of their effectiveness in pathogen removal and their low operation and maintenance costs (Oakley, et al., 2000).

Parasite	Range of Prevalence in Select Locations 1986—93
Protozoans	
Entamoeba histolytica	2.0–19.5%
Giardia lamblia	2.8–61.0 %
Criptosporidium spp.	3.6–15.0%
Helminths	
Ascaris lumbricoides	5–70%
Anquilostomas	2–6%
Trichuris trichiura	1–32%

TABLE 4 Prevalence of Excreta-Related Parasites in Honduras

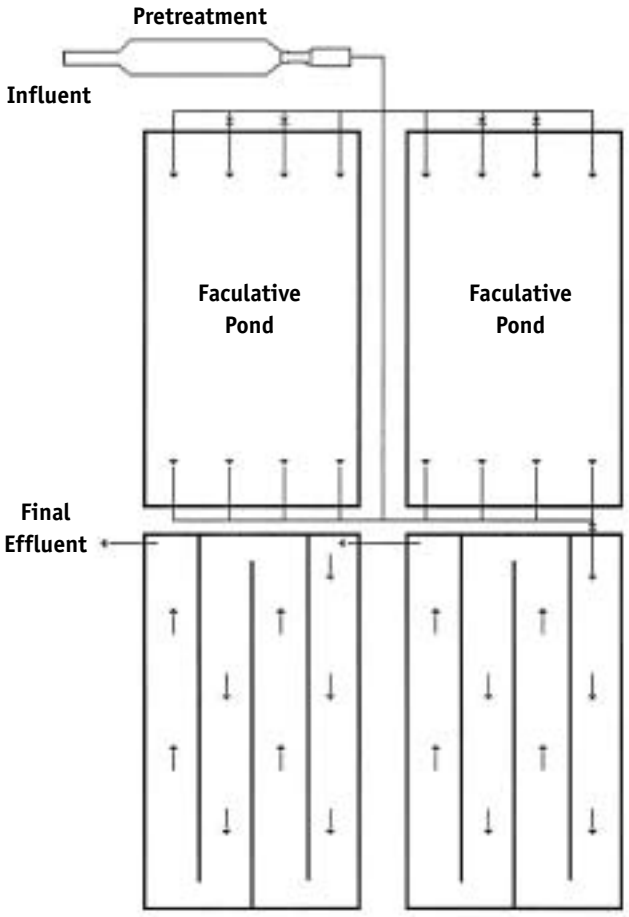
Approximately 21 waste stabilization pond systems have been constructed in the last 10 years. The majority of the pond systems were funded by USAID-Honduras through its Municipal Development Project. This program, which has as its primary goal the institutionalization of more responsive and effective municipal government, works with 34 municipalities representing 50 percent of the Honduran population. **Figure 2** shows a typical design of a pond system, which consists of two facultative ponds in parallel (so one can be taken out of service for desludging), followed by one or two maturation ponds in series.

Issues With Effluent Guidelines

The environmental protection agency for the government of Honduras has promulgated effluent standards for municipal wastewater discharges that are shown in **Table 5**. The standards, which are arbitrary, focus on fecal coliforms and do not address specific pathogen removal, which is much more important where excreta-related infections are endemic (Feachem, et al., 1983; Mara, 2004). It is difficult to meet fecal coliform standards more stringent than 10,000/100mL with stabilization ponds (Oakley, et al., 2000) unless four or five ponds are designed in series (Mara, 2004), which is an added capital and operational expense that should be technically justifiable in poor communities. Because no local data have been available showing specific pathogen removal in pond systems, there has been much confusion among professionals and the public in Honduras as to what type of design is most appropriate for local conditions.

Parameter	Maximum Permissible Concentration
Fecal Coliforms, MPN/100mL	5,000
BOD_5, mg/L	50
SS, mg/L	100

TABLE 5 Effluent Standards Promulgated in Honduras



A typical pond system design, with a bar screen and horizontal grit chamber for pre-treatment, with a battery of two facultative ponds in parallel followed by two maturation ponds in series. Facultative ponds are designed in parallel so one can be taken out of service for desludging every 5 to 10 years.

FIGURE 2 Typical Pond System Design

Manually cleaned horizontal grit chambers—a technology no longer in use in the U.S.—are used for pretreatment because of high grit loads in sewer systems that can prematurely fill ponds. (León, Nicaragua)

Issues With Operation and Maintenance and Sustainability

The responsibility for operation and maintenance of pond systems lies with the municipalities. In an attempt to avoid the problem of abandoned systems that has frequently occurred in other countries, USAID-Honduras has sponsored numerous workshops on waste stabilization pond design, monitoring, and operation and maintenance for professionals, operators, and the general public. This is a continuing process that requires a long-term commitment. There are many institutional factors that cannot be changed easily, such as the ability and political resolve of the municipal governments to charge fees for sewerage and wastewater treatment, and to maintain adequately trained personnel on staff. As an example of the difficulties involved in what would appear to be a simple task, at present, there is not one pond installation in Honduras where an operator measures flow rates at all—let alone on a routine and documented basis.

Objectives

As a result of the problems mentioned above, USAID-Honduras decided to fund a monitoring study for wastewater stabilization pond installations. The objective of this study was to monitor 10 wastewater stabilization pond systems from different climates throughout Honduras during the dry season (March, April, May) and wet seaon (September, October, November) to develop a local database for improving design parameters and operation and maintenance requirements and to assess the long-term sustainability of systems in the municipalities. It was also planned that this study would help contribute to the development of effluent standards for specific pathogen removal rather than fecal coliform removal, and that concrete recommendations based on the results could be made for the minimum number of ponds that should be designed in series to remove specific pathogens, with the goal that the final effluent could be used for agriculture or aquaculture to help foster sustainability. It was hoped that the conclusions would more adequately address the serious public health issues facing financially-strapped municipalities with populations from 1,000 to over 100,000 persons.

A barefoot boy spearfishing in sewage-contaminated water near Iquitos, Peru.

Methodology

Project Design

Ten pond systems were selected at varying locations throughout the country. Eight systems were facultative-maturation pond configurations, one an anaerobic-facultative pond configuration, and one an anaerobic-facultative-maturation pond configuration. All systems were visited for five consecutive days during the dry and wet seasons. Two days were used for the collection of support information, which included age of the system, original design population, physical condition, estimation of accumulated sludge volume using bathymetric methods, level of operation and maintenance, and an evaluation of the long-term sustainability based on municipal support. Each system was then monitored diurnally for three consecutive days.

The influent flow rate was continuously monitored using an ISCO area-velocity flow meter, which allowed an accurate measurement of peak, minimum and mean flow rates. The influent and effluent of each pond within the system were sampled for helminth eggs, *Shigella* species, *Escherichia coli*, fecal coliforms, suspended solids (SS), five-day biochemical oxygen demand (BOD_5), pH, and temperature; dissolved oxygen was also measured at various points within facultative ponds. Sludge samples at the entrance to each primary pond system, whether anaerobic or facultative, were taken with a dredge and analyzed for helminth egg concentrations and percentage total, fixed, and volatile solids.

Rationale for Parameter Selection

A major objective of the project was to monitor pathogens endemic in Honduras using the capabilities of local laboratories, with the idea that routine monitoring could be continued in the future. Fortunately, one national laboratory within the Secretary of Natural Resources and Environment has the capabilities to analyze water and sludge samples for helminth eggs on a routine basis using a methodology originally developed in Mexico; they cannot, however, distinguish viable from nonviable eggs. Unfortunately, the only other analyses in water samples that could be performed within the limits of this study on a routine basis by local laboratories were *Shigella* species (presence-absence test), and the nonpathogenic indicators *Escherichia coli* and fecal coliforms. While it would be highly desirable to monitor for a protozoan pathogen, there are no laboratories in Honduras able to perform the analyses in water samples at this time.

The final selected parameters

for pathogens were, therefore, helminth eggs in water, sludge samples, and *Shigella* species (presence-absence) in water. *Escherichia coli* and fecal coliforms were also chosen, despite their limitations for indicating pathogen removal, because they could be easily monitored routinely in water samples and used for comparison with other studies in the literature. It was also hoped that *Escherichia coli* would be more representative of bacterial removal than fecal coliforms.

The conventional parameters of SS, BOD_5, pH, temperature and dissolved oxygen were selected to assess system performance in terms of organic loadings. Sludge samples at the entrance to each primary pond system, whether anaerobic or facultative, were taken with a dredge and analyzed for helminth egg concentrations and percentage total, fixed, and volatile solids. The objective of sludge sampling was to estimate degradation and accumulation rates, the extent of grit entering the system, and the public health risks of sludge handling due to helminth egg concentrations.

Sampling and Analytical Methods

With the exception of the helminth analyses, all samples were analyzed according to *Standard Methods* (APHA, 1995). The samples for helminth eggs, SS, and BOD_5 were 24-hour flow-weighted composites, while those for *Shigella* species, *Escherichia coli* and fecal coliforms were grab samples taken at different times throughout a 24-hour period. The sludge samples were taken daily with the dredge (approximately 1.0 L) over the three-day period at the entrance to each pond where sludge depth was estimated to be greatest; this method is limited and was meant only to give a rough idea of sludge characteristics since sludge cores give a much more accurate account of deposition and decomposition processes and helminth survival rates (Nelson, et al., 2004).

Results

Flow rates, Hydraulic Retention Times, and Organic Loading Rates

Table 6 presents the results of pond flow rate monitoring, calculated hydraulic retention times, mean influent BOD5 concentrations, and organic surface loading rates. Basing the measured influent flow rate on the original design populations, the calculated per capita flow rates ranged from 92 to 514 liters per person per day (Lppd), and the majority are much higher than the typical design assumption of 100 to 120 Lppd. The higher flows are likely due to increased connections due to population growth, illegal connections from commercial and industrial sources, and inflow and infiltration into the sewer system. The increase is significant from what was originally assumed in the design and exemplifies the resiliency of pond systems for developing countries—mechanical systems such as activated sludge could never handle such an increase over the original design flow.

As a result of the higher measured flow rates, the calculated hydraulic retention times are shorter and the organic surface loading rates higher than anticipated from the original designs. Only two facultative pond systems satisfied the

Pond System	Mean Influent Flow Rate m^3/day	Original Design Population	Per Capita Flow Based on Design Population Lppd	Area of Primary Pond Ha	Hydraulic Retention Time, Days				Mean Influent BOD_5 mg/L	Organic Surface Loading Rate kg BOD_5 / Ha-day	Organic Volumetric Loading Rate g BOD_5 / m^3-day
					F/A[1]	F/M[2]	M	Total			
Catacamas East[3]	2,580	5,350	482	1.02	5.0	3.7		8.7	400	1,011	80
Catacamas West	945	3,400	278	1.38	23.0	4.2		27.1	437	300	
Morocelí	218	705	309	0.12	7.0	7.0		14.0	220	410	
Tela[3]	2,726	5,306	514	0.42	2.6	4.3	2.6	9.5	114	737	44
Catacamas East[3]	2,639	5,350	493	1.02	4.9	3.6		8.5	296	765	60
Catacamas West	902	3,400	265	1.38	24.1	4.4		28.4	294	193	
Danlí[3]	5,150	10,000	515	0.99	2.4	4.8		7.2	205	1,066	85
Juticalpa[4]	3,510	11,422	307	1.23	6.1	3.4		9.5	177	505	
El Progreso[4]	2,932	23,000	127	2.83	20.9	13.9		34.8	71	74	
Tela[3]	2,121	5,306	400	0.42	3.3	5.5	3.4	12.2	62	313	19
Trinidad	1,816	6,108	297	0.98	7.8	6.2		14.1	76	141	

*The systems at Pajuiles and Villanueva are not included because of difficulties measuring flow rates.
1. F/A: facultative or anaerobic. The systems at Danlí and Tela consist of an anaerobic pond followed by a secondary facultative pond. Tela has a third maturation pond in series.
2. F/M: Facultative or maturation pond.
3. The hydraulic retention time was calculated using the net volume of the primary ponds (design volume minus volume of accumulated sludge).
4. Only one battery of two in parallel was monitored.

TABLE 6 Results of Measured Flow Rates, Hydraulic Retention Times, and Loading Parameters for Monitored Pond Systems

WHO guideline of an eight- to 10-day minimum detention time for helminth egg removal; nevertheless, as will be discussed below, all of the systems met the WHO guidelines for 100 percent helminth egg removal.

The mean influent BOD_5 was found to vary greatly among systems, ranging from 71 to 437 mg/L. As a result of higher than expected flow rates and influent BOD_5 values, the organic surface loading rates of the majority of facultative ponds exceeded the estimated maximum loadings for the latitudes and climates of Honduras, which is estimated to be between 280 to 350 kg BOD_5/ha/day as shown in **Figure 3**. In spite of this, the overall BOD_5 removal was about what would be expected for normally loaded stabilization pond systems as discussed below. Once again this shows the resiliency of pond systems to handle widely varying loading rates and still maintain adequate treatment levels.

Table 6 also shows that those ponds that were designed as anaerobic ponds (Danlí and Tela) were operating below the range of optimum volumetric loading rates for anaerobic ponds of 100 to 300 g BOD_5/m^3/day, and that one overloaded facultative pond (Catacamas East), was approaching the volumetric loading of an anaerobic pond. Nevertheless, none of these ponds exhibited odor problems, and their performance was similar to the other, lesser loaded ponds, again demonstrating the resiliency and wide margin of safety typical of pond systems.

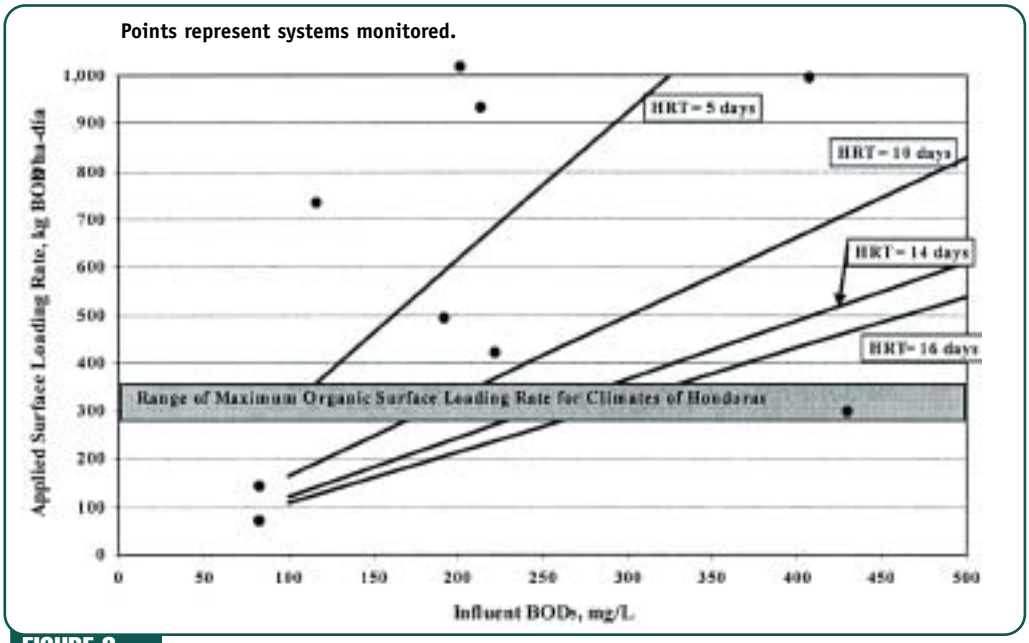


FIGURE 3 Organic Surface Loading Rate Versus Influent BOD_5 for Various Hydraulic Retention Times (HRT)

Pond System	Arithmetic Mean Helminth Egg Concentration Eggs/L (Range of Values in Parentheses)			Arithmetic Mean Helminth Egg Concentration in Facultative Pond Sludges[1]
	Influent Wastewater	Facultative Pond Effluent[1]	Maturation Pond Effluent	Eggs/gram dry weight (Range in Parentheses)
Catacamas E. Dry Season	13 (9–18)	0	0	53 (13–84)
Wet Season	33 (24–48)	0	0	308 (247–356)
Catacamas W. Dry Season	84 (42–133)	0	0	303 (282–499)
Wet Season	29 (24–48)	0	0	674 (520–960)
Danlí Wet Season	45 (30–58)	2 (0–7)	0	467 (30–1,164)
Juticalpa Wet Season	9 (0–20)	0	0	35 (8–53)
Morocelí Dry Season	15 (0–24)	0	0	189 (126–295)
Pajuiles Dry Season	744 (720–792)	29 (22–42)	0	4,473 (3,720–5,299)
El Progreso Wet Season	6 (3–9)	0	0	62 (15–141)
Tela Dry Season	9 (4–16)	0	0	1 (1–2)
Wet Season	2 (0–4)	0	0	50 (18–108)
Trinidad Wet Season	6 (4–8)	0	0	15 (0–20)
Villanueva Dry Season	55 (18–72)	3 (0–16)	0	718 (270–1,075)

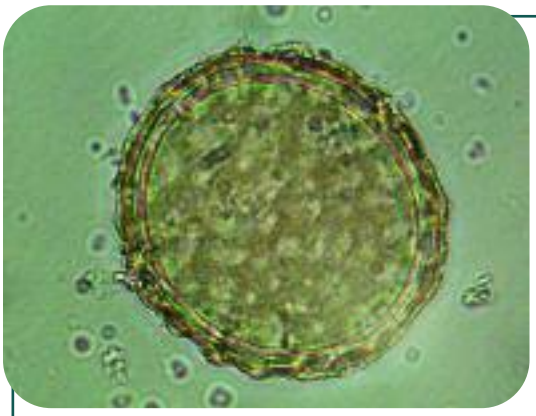
1. The system in Danlí was designed as an anaerobic pond followed by a facultative pond.

TABLE 7 Helminth Egg Removal Wastewater Stabilization Pond Systems in Honduras

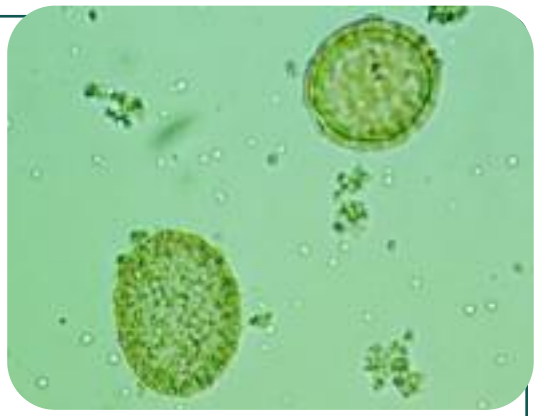
Helminth Egg Removal

Table 7 shows the results of helminth egg monitoring. The arithmetic mean concentration of helminth eggs in raw wastewater ranged from 9 to 744 eggs/L. The helminths found in raw wastewater and sludges were, in order of abundance, *Ascaris lumbricoides*, *Trichuris trichiura*, and Anquilostomas (hookworm), and reflect the prevalence of helminth infections found in the general population. (Examples of eggs found in raw wastewater are shown in **Plate 1**.) With the exception of three ponds (Danlí, Pajuiles, and Villanueva), all of the facultative ponds removed 100 percent of the influent helminth eggs.

The ponds at Danlí and Villanueva were anaerobic and likely

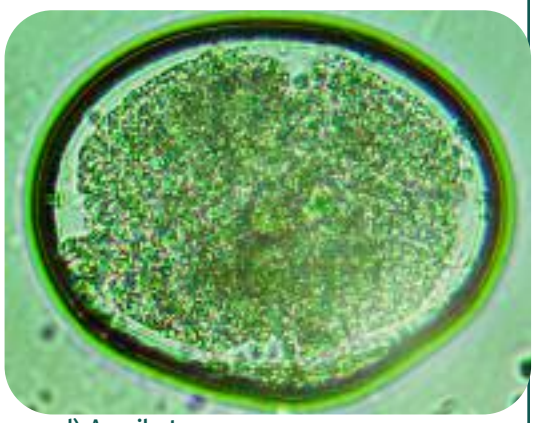


a) *Ascaris lumbricoides* (fertile)



b) *Ascaris lumbricoides* (fertile and unfertile)

c) *Trichuris trichiura*



d) Anquilostomas

PLATE 1: Examples of helminth eggs found in all of the raw wastewaters sampled throughout Honduras, which illustrates the widespread problem of infections. Because there is no immunity to parasitic infections, as long as the environment is contaminated transmission will continue to occur. Eggs are approximately 50 µm in diameter, a size that can easily be removed by sedimentation in facultative ponds.

Photos courtesy of Dr. Gilberto Padilla

At least four maturation pond systems have crocodiles, which feed on turtles and birds. Frogs are also abundant in several maturation pond systems. (Santa Cruz de Yojoa, Honduras.)

did not achieve 100 percent removal as a result of insufficient hydraulic detention time or resuspension with rising gases from anaerobic digestion. The carryover of helminth eggs in the facultative pond at Pajuiles could have been due to the burrowing activity of turtles or crocodiles observed in the pond.

Table 7 also shows the results for helminth egg concentrations in facultative or anaerobic pond sludges. The concentrations ranged greatly among systems, from a mean of one egg per gram dry sludge at Tela to 4,473 eggs per gram dry sludge at Pajuiles. Although no differentiation was made between viable and nonviable eggs, the results in **Table 7** leave no doubt that pond sludges pose a serious health risk with helminth eggs and need to be properly managed during pond desludging operations and ultimate disposal.

Shigella Species

The presence of *Shigella* species was not detected throughout the study. One of the problems with measuring bacterial pathogens is that they are likely present in wastewater only during an outbreak or epidemic episode; after the episode passes they are only present in asymptomatic carriers in very small concentrations that are difficult to detect in wastewater.

Fecal Coliforms and *Escherichia coli*

The results of fecal coliform and *Escherichia coli* $\log_{10}$ removal are shown in **Table 8** and

Figures 4 to 7. For facultative ponds it appears that it may be possible to achieve a 2.0 $\log_{10}$ removal of both fecal coliforms and *E. coli* if the hydraulic detention time is greater than 10 days. The maturation pond results (Figures 6 and 7) are much more inconsistent and do not show a correlation between hydraulic detention time and bacteria removal. These results exemplify the difficulty in using fecal coliforms or *Escherichia coli* as indicators of bacterial pathogens for wastewater as has been reported in the literature (Feachem, et al., 1983; and Mara, 2004.)

Conventional Wastewater Constituents

The conventional wastewater constituent analyses of BOD_5 and SS (Table 8) show that each pond system is functioning as would be expected in terms of performance and removal efficiencies, in spite of being loaded above their original designs. Dissolved oxygen analyses and visual inspection showed that four as-designed facultative ponds (Catacamas East, Morocelí and Villanueva) were not facultative and were functioning as anaerobic ponds. In spite of being anaerobic, however, the ponds performed well in terms of removal of BOD_5, SS, fecal coliforms, *Escherichia coli* and helminth eggs, and they did not have any serious odor problems.

Solids Analyses in Facultative Sludges

Desludging of ponds has been found to be a significant expense for poor municipalities if it is not planned for and budgeted years in advance (Oakley, et al., 2000). Pond sludge analyses were therefore performed to develop parameters on sludge accumulation rates, including grit loads. The facultative pond sludge analyses summarized in Table 9 show that the percent total solids ranged from 11.6 to 15.5 percent, volatile solids from 23.9 to 31.4 percent, and fixed solids from 68.0 to 76.1 percent. The high percentage of fixed solids is a result of the effect of inorganic solids entering the ponds from lack of grit chambers.

The volume of sludge in each facultative pond was measured by taking soundings on a grid from a launch. Sludge accumulation rates were then calculated by using the measured flow rates and the number of years the pond system had been in operation. Grit accumulation rates were then estimated from the results of the sludge solids analyses by assuming that pond sludge without grit should have a volatile solids content of approximately 50 percent after digestion (Metcalf and Eddy, 2003).

The results in Table 9 show that sludge accumulation rates per 1,000m^3 of wastewater treated are

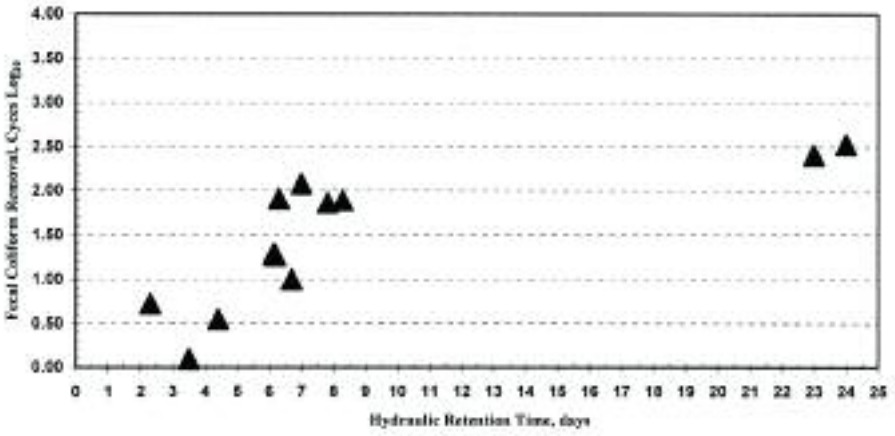


FIGURE 4 Fecal Coliform Removal in Faculative Ponds in Honduras

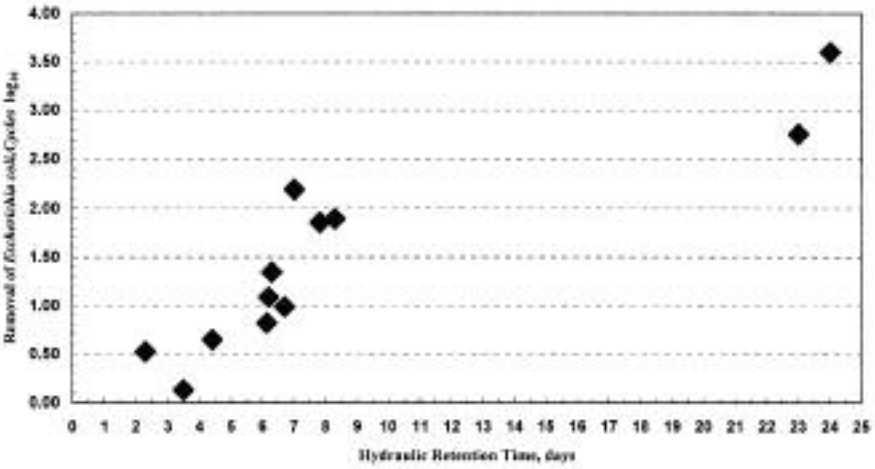


FIGURE 5 Removal of *Escherichia coli* in Facultative Ponds in Honduras

Parameter	Mean[1] (Range of Values)	
	Influent	Final System Effluent
Escherichia coli, NMP/100mL	2.71E+07 (1.22E+06—8.96E+08)	2.89E+04 (2.71E+02—1.17E+07)
Fecal Coliforms, NMP/100mL	4.7E+07 (2.84E+06—2.01E+09)	5.47E+04 (6.21E+02—1.47E+07)
BOD_5, mg/L	206 (62—438)	56 (19—93)
Filtered BOD_5, mg/L	------	37 (11—91)
SS, mg/L	207 (66—383)	72 (24—135)

1. Fecal coliform and *Escherichia coli* concentrations are geometric means. All others are arithmetic means.

TABLE 8 Summary of Monitoring Results for *E. coli*, Fecal Coliforms, BOD_5, and SS for all Systems Monitored, Wet and Dry Seasons

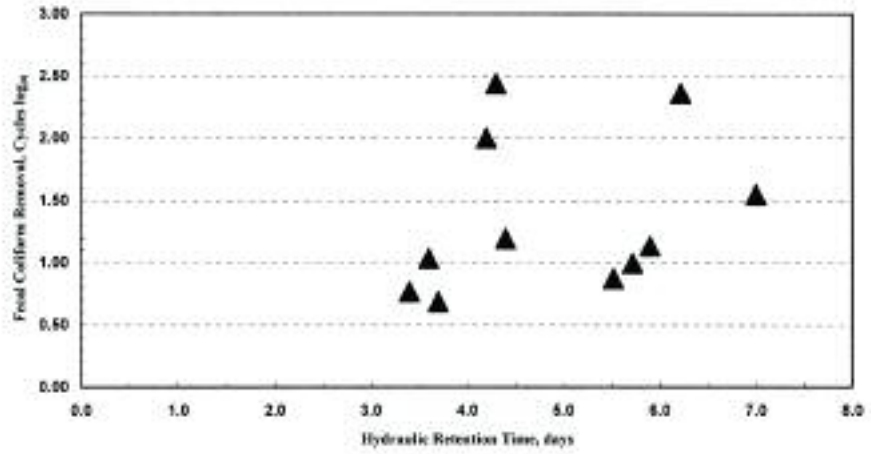


FIGURE 6 Fecal Coliform Removal in Maturation Ponds in Honduras

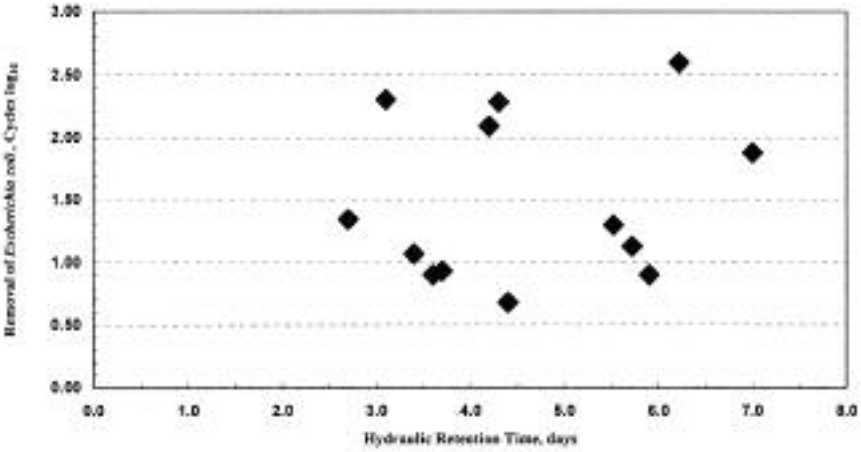


FIGURE 7 Removal of *Escherichia coli* in Maturation Ponds in Honduras

Parameter	Range of Values
Total solids, %	11.6—15.5
Volatile solids, %	23.9—31.4
Fixed solids, %	68.0—76.1
Estimated grit accumulation in primary ponds, $m^3/1{,}000m^3$	0.010—0.085
Measured sludge accumulation in primary ponds, $m^3/1{,}000m^3$	0.224—0.548

TABLE 9 Summary of Results for Primary Pond Sludges

an order of magnitude lower than accumulation rates from conventional processes (Metcalf and Eddy, 2003), which is another advantage of stabilization ponds since sludge handling is kept to a minimum. If facultative ponds are not overloaded, a pond with a 10-day detention time can most likely operate up to 10 years or more without the need for desludging.

Grit accumulation is estimated to be approximately 5 percent of total sludge accumulation as shown in **Table 9**. While this does not appear to be significant, during storm events, significant quantities of grit can enter primary ponds and cause blockages at inlets, and even prematurely fill a pond (Oakley, et al., 2000). For this reason it is recommended that grit chambers be installed in all systems.

Physical Condition, Monitoring, Operation and Maintenance, and Sustainability Issues

Table 10 presents a summary of the physical conditions, monitoring, operation and maintenance, and sustainability issues encountered in the systems assessed in this study. Most installations are physically well maintained, but many are hydraulically and organically overloaded without accurate flow measuring devices and grit chambers. At least three installations are in urgent need of desludging.

Monitoring in all installations is nonexistent, and nowhere are flow rates measured or samples taken for laboratory analysis. The few installations where attempts were made to measure sludge ac-

Physical Condition	Routine Monitoring	Maintenance	Personnel	Plans for Expansion and Sludge Removal	Sustainability
Most systems are hydraulically and organically overloaded, without accurate flow measurement devices and grit chambers. Several systems are in urgent need of desludging.	None of the systems monitored measure flow rates or have sampling programs. Only a few have attempted to monitor accumulation of sludge in primary ponds.	Most of the systems have adequate physical maintenance of the installation.	While most systems have permanent operators assigned to operate and maintain the installation, all lack training in measurement of flow rates, sampling, and measurement of sludge accumulation.	None of the municipalities have plans for installation expansion, even though many are arriving at their hydraulic and organic limits. No municipality has planned, let alone prepared a budget, for the desludging of primary ponds.	Most installations have technical and financial support for maintenance, and most have public acceptance. The major problem in all municipalities is long-term planning for plant expansion and sludge removal.

TABLE 10 Summary of Physical Condition, Operation and Maintenance, and Sustainability Issues in Monitored Systems

In the barrio of Belem in Iquitos, Perú, hundreds of persons live in houses over the river in which raw sewage is discharged from the city of Iquitos. In addition, each house has its own latrine above the water. In this photo a woman washes dishes next to the latrine on the left.

cumulation had sludge depths approaching the water surface at the inlets! Adequate operator training is a key issue to help resolve these problems.

The wherewithal of the municipality to properly manage the installation and plan for the future, though, is the key to sustainability. The majority of installations have rudimentary technical support to train and pay an operator to physically maintain the system, and the public generally accepts pond systems as a public health benefit. None of the municipalities, however, adequately plan for system expansion, nor measure increased loads (nor how to manage them) as growing populations continuously connect to the sewer systems. As primary ponds reach levels where desludging is imperative, there is a real possibility that an installation could be abandoned because of operation and maintenance costs, which, unfortunately, is a common problem throughout Latin America.

Discussion and Conclusions

In a country such as Honduras, where wastewater treatment essentially does not exist, the only realistic option that has a possibility of success in helping solve serious public health problems is the introduction of wastewater stabilization pond systems. Even these simple resilient pond systems, however, will fail if their design, implementation, operation and maintenance, planning, and municipal commitment are not suited to local needs and conditions. The results of this project have enabled the following observations and conclusions to be drawn.

Effluent Standards and Wastewater Reuse

Parasitic infections, such as helminth infections, are the major public health problem related to excreta-related infections as indicated in the ubiquitous presence of helminth eggs in raw wastewaters throughout the country. Since the project results dramatically showed that every pond system removed 100 percent of influent helminth eggs, and since helminth eggs can be routinely monitored in local laboratories, it makes more sense to initially orient treatment objectives and effluent standards on helminth egg removal rather than on an arbitrary level of fecal coliform concentration that has no demonstrated relation to problem pathogens, and which is difficult to achieve without designing numerous ponds in series. Using this conceptual framework, wastewater treatment in municipalities using two ponds in series can easily meet WHO´s Category B requirements for restricted irrigation, transforming what was once a serious public health problem into a potential resource for agriculture. This, in poor municipalities, is much more preferable than proposing more lagoons in series at a greater cost, or more complex technologies using disinfection, which are beyond the technical and financial capabilities of the municipalities.

As far as concern for bacterial pathogens, the literature shows that

A well-designed and maintained facultative pond. (Masaya, Nicaragua)

they typically exist in concentrations 3 or 4 orders of magnitude lower than fecal coliforms (Feachem, et al., 1983). Studies performed in Latin America have shown that a 3-cycle $\log_{10}$ removal of fecal coliforms removes essentially all of the bacterial pathogens of concern (León and Moscoso, 1996; Mara and Cairncross, 1989). As an example, **Figure 8** shows the results of removal of *Vibrio cholerae* 01 as compared to fecal coliforms in the waste stabilization pond system of San Juan in Lima, Perú at the height of the cholera epidemic in 1991 (León and Moscoso, 1996). The highest concentration of *Vibrio cholerae* 01 measured in raw sewage was only 2,700 MPN/100mL as compared to 5.2 E+08 MPN/100mL for fecal coliforms. The first facultative pond essentially removed the vast majority of *Vibrio cholerae* 01, and no significant concentrations remained in the effluents of the first or second maturation ponds. Until further studies can show more detailed survival of various bacterial pathogens in pond systems, in would seem that two ponds in series that remove at least 3, $\log_{10}$ cycles of fecal coliforms should remove the vast majority of bacterial pathogens.

Pathogenic protozoa pose another concern, but at present they cannot be analyzed for in wastewater treatment systems on a routine basis. Various studies have suggested, however, that they are effectively removed in stabilization pond systems (Scott, 2003).

System Design for Pathogen Removal

The results of this study suggest the following recommendations for systems design:

- All systems should be designed using flows measured in the field instead of assuming per capita flow rates. Because there is no historical record of flows and their increase with time, much caution needs to be used in the design and useful life of systems.
- Horizontal grit chambers should be designed for all systems to ensure that primary ponds do not prematurely fill with grit.
- It is best to avoid anaerobic ponds since their increased loadings require desludging more frequently (at least every three years), which is an added expense and risk for the municipality.
- Two facultative pond systems in parallel with at least a 10-day detention time followed by one maturation pond with at least a 5-day detention should remove 100 percent of helminth eggs, satisfy WHO's Category B for restricted irrigation, and reasonably ensure removal of bacterial and protozoan pathogens. This design also allows for the maximum interval of desludging and hence the minimum need for sludge handling.
- All designs should incorporate agricultural (or aquaculture) reuse as an integral part of the system using the WHO guidelines. This, hopefully, would help municipalities look at wastewater treatment in a more positive light than they have in the past and foster sustainability.

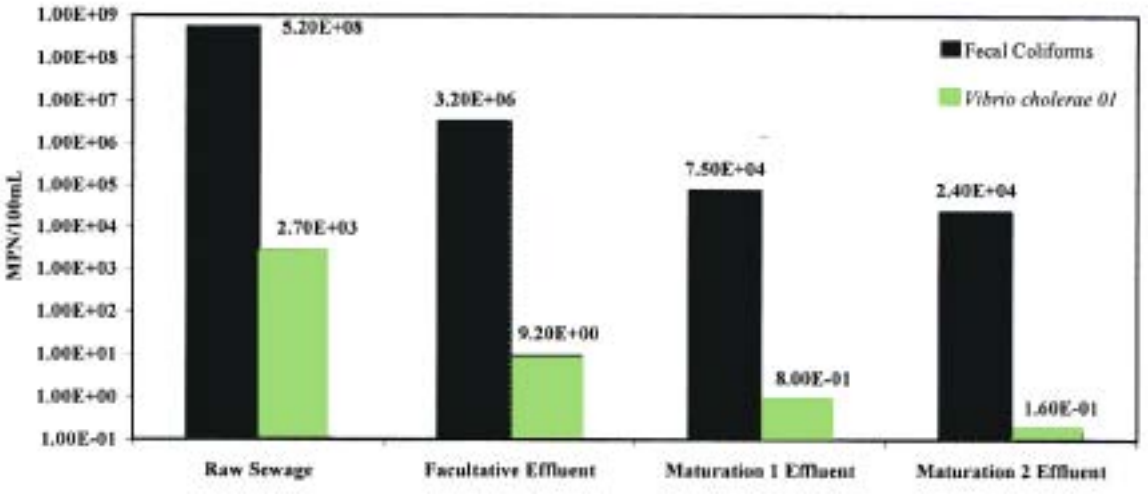
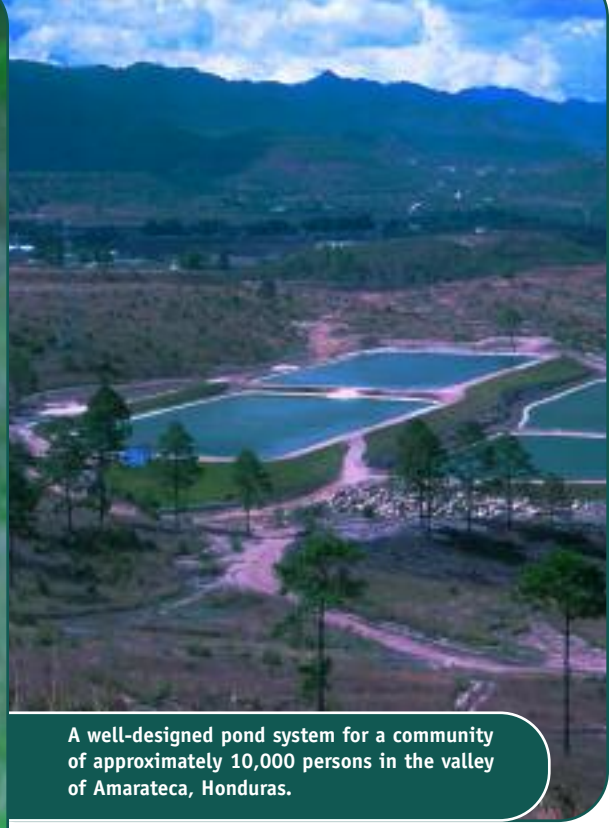


FIGURE 8 Removal of Fecal Coliforms and *Vibrio cholerae 01* in San Juan Pond System, Lima, Peru, in 1991. Source: Leon and Moscoso, 1996.

A girl collects polluted water for domestic water supply-a serious problem throughout Latin America. (Flores, Guatemala)



A well-designed pond system for a community of approximately 10,000 persons in the valley of Amarateca, Honduras.

Sustainability

Sustainability is by far the most important issue for wastewater treatment in Honduras. It makes little sense to argue over technological details and removal efficiencies if the municipalities themselves do not have the infrastructure and the financial capabilities to adequately operate, plan for expansion, and desludge their systems. Latin America has historically had serious problems making drinking water systems sustainable, and the median ratio of urban drinking water tariff to unit cost of production is less than one for the Region (WHO/UNICEF, 2000). If there is difficulty in making drinking water systems sustainable, it is obvious that wastewater treatment will be even more formidable a task. It is for this reason that waste stabilization pond systems integrated with agricultural or aquaculture reuse offer the best promise to help address some of this hemisphere's most serious public health problems.

Acknowledgements

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Field Note

Water and Sanitation Program

An international partnership to help the poor gain sustained access to improved water supply and sanitation services

Learning the Fundamentals of Hygiene Promotion

A Review of Three Large-Scale Projects in India

Community design and implementation is the key to effective and sustainable hygiene promotion.

SANITATION AND HYGIENE PROMOTION SERIES: 3

South Asia Region

SUMMARY

Taking a back seat to water supply, hygiene promotion had not kept pace with the new sector thrust towards a demand-driven approach, but is now catching up in the new generation Rural Water Supply and Sanitation projects. Hygiene promotion strategies across India and the world are finally receiving attention.

In the early nineties when hygiene promotion strategies were introduced in India, there was very little to learn from international experience in the field. Most of these activities emphasized 'providing of messages' rather than participatory processes in hygiene promotion. This trend changed around the mid-nineties and 'new' approaches have been attempted in externally-funded projects in India. These new approaches have not evolved in isolation, but have developed over projects and active learning has taken place during the project cycle.

A number of large-scale Rural Water Supply and Sanitation projects in India have been recently completed, or are in their mature or final stages. Follow-on projects in Maharashtra, Karnataka and Uttar Pradesh are under consideration. As these and other projects are brought into form, it is timely to consider the lessons learned and bring hygiene promotion in line with new demand-responsive approaches.

Introduction

The integration of sanitation with drinking water projects is a relatively recent development. A major objective of drinking water projects is to improve health, productivity and enhance the quality of life of people, including women, children and the poor. Numerous studies and observations indicate that the provision of water supply without hygiene promotion and sanitation reduces the impact on people's health and well-being and may further deteriorate the quality of the environment, including sanitation and drainage. Keeping these lessons in mind, currently all externally-assisted Rural Water Supply and Sanitation (RWSS) projects in India include an integrated package of water supply, sanitation and hygiene promotion. However, the nature of these efforts and the manner of their implementation differ. The effectiveness of the hygiene promotion components and the World Bank's learning agenda in this field is reviewed here. It needs to be mentioned that the sector is in a learning phase in India and across the globe.

Three World Bank-assisted projects in the states of Maharashtra, Karnataka and Uttar Pradesh recently participated in a review of their hygiene promotion work to learn from experience, and to take the first step in building a body of 'better practice' for hygiene promotion in India.

The objectives of the review were:

- to identify design factors which contributed to or detracted from the sustainability of hygiene promotion in large projects in India
- to draw some preliminary assumptions for better practice
- to create a platform for exchange of ideas and experiences about hygiene promotion and jointly develop approaches and recommend processes for longer-term work.

WHAT IS HYGIENE PROMOTION?

Hygiene promotion includes strategies that encourage or facilitate a process whereby people assess, make considered choices, demand, effect, and sustain hygienic and healthy behaviors. This would encompass personal, domestic, and environmental hygiene practices and any action or initiative taken to erect barriers to disease.

Brief Description

Both the Maharashtra and Karnataka projects were undertaken when there was little international experience of good hygiene promotion. The Maharashtra project started in 1991 and the Karnataka project in 1993. By the time the Uttar Pradesh project came through in 1996, participatory approaches were in use internationally and these techniques were used very effectively in the Swajal project.

MAHARASHTRA: The Hygiene and Sanitation Education (HSE) component of the Maharashtra Rural Water Supply and Environmental Sanitation Project combines awareness campaigning with interpersonal contacts using didactic approaches. Hygiene promotion is defined as creating an enabling environment, and hygiene education is defined as awareness creation and access to technologies to consolidate behavior.

KARNATAKA: A multi-channel, message-based IEC (Information, Education and Communication) approach was used. A combination of interventions were employed using folk as well as mass media, group work, house visits, regular group and interpersonal contacts. There were occasions when concerted mass education plans were also used. Non-Governmental Organizations (NGOs) were effectively included in the project to implement the hygiene promotion component.

UTTAR PRADESH: The HP component of the Uttar Pradesh Rural Water Supply and Environmental Sanitation, Swajal project, is called Health and Sanitation Awareness (HESA). The approach to hygiene promotion is primarily participatory. HESA is developed and monitored through SARAR (Self-esteem, Associative Strengths, Resourcefulness, Action Planning and Responsibility) tools and Healthy Homes Surveys, together with message-based IEC sample sessions. A unique feature of Swajal is the involvement of villagers – during the planning phase – in developing their own HESA plans for the subsequent implementation phase. On a statewide basis, a social marketing campaign has been planned.

Review Findings

Project Design

Hygiene Promotion Strategy and its Integration into Overall RWSS Design

None of the three projects framed clear objectives for hygiene promotion during project preparation. While hygiene promotion strategies in the cases of Maharashtra and Karnataka were neither designed nor implemented until later in the project, in Uttar Pradesh, the strategy was to enable local people to assess their own hygiene and sanitation problems and set targets and objectives.

MAHARASHTRA: Goals and objectives were defined for the hygiene promotion component only when water became available in the project villages. At the onset of hygiene promotion, six specific behavioral objectives were set, focusing on hand-washing, appropriate storage of water above ground level, and use of hygienic methods to draw water from household containers. Later, four additional target behaviors were added

BASIC FACTS: THREE STATE PROJECTS PARTICIPATING IN THE REVIEW

State	Maharashtra	Karnataka	Uttar Pradesh
Project Name	Maharashtra Rural Water Supply and Environmental Sanitation Project (MRWS-ES Project)	Karnataka Integrated Rural Water Supply and Environmental Sanitation Project (KIRWS-ES Project)	Uttar Pradesh Rural Water Supply and Sanitation Project (UP-RWS-ES Project/Swajal Project)
Project Period	1991 – 1999	1993 – 2000	1996 – 2002
Total Loan Amount	US$ 101.9 Million	US$ 92 Million	US$ 59.6 Million
No. of Villages	564 Villages in 10 Districts	1,111 Villages in 12 Districts	1,000 Villages in 15 Districts
Project Development Goal(s)	Raise standard of living through improved health and productivity by expanding access to potable rural water supply systems and environmental sanitation	Raise standard of living through improved health and productivity by expanding access to potable rural water supply systems and environmental sanitation	• Deliver sustainable health and hygiene benefits to the rural population through improvements in water supply and environmental sanitation services, which will increase rural incomes through time savings and income opportunities for women, and • Promote the long-term sustainability of the RWSS Sector in UP by identifying and implementing an appropriate policy framework and strategic plan
Design Population	1.06 Million	4.8 Million	1.2 Million
Name of Hygiene Promotion Component	Hygiene and Sanitation Education (HSE)	Health Sanitation and Hygiene Education (HSHE)	Health and Environmental Sanitation Awareness (HESA)
Goals of Hygiene Promotion Component	To improve the health status of rural people	To create greater community awareness of the causes of water/sanitation-related health problems	To reduce morbidity by generating a demand for safe water and sanitation
Methodology	Awareness campaign with interpersonal contacts	Multi-channel IEC approach, with combination of folk and mass media	• Combination of Participatory methods (SARAR and PRA) • Focus on Healthy Homes Survey: a community self-monitoring tool
Target Group	The broad community	Village Water and Sanitation Committees, Community-based Organizations and Households	Women, Schools and Village Water and Sanitation Committees

for sanitation, emphasizing construction and maintenance of latrines, construction of soakage pit or garden and construction of compost pit. However, the targets of achievement in a one-year period were set at a high range, between 40% and 95%. At the project's completion, these targets were naturally found to have been too ambitious.

KARNATAKA: The hygiene promotion component was initiated a few years after the project began. At that point, promotion of personal, domestic, and environmental practices; proper practices for collection, handling and storage of water; construction and use of latrines; creating awareness for the maintenance of the drainage system and sustainable operation and maintenance of water supply schemes were set as objectives. Provision was made for village-by-village diagnosis and setting of priorities by fieldworkers, which proved effective.

UTTAR PRADESH: Key design factors for hygiene promotion are included in the Swajal project and the hygiene promotion component is integrated with each phase of the subproject cycle. At the project level, only 'improvement' in environmental and domestic hygiene has been set as the objective. The communities are expected to set their own goals, strategies and indicators. Project management generally aims to focus on hygiene related to the availability and quality of water supply.

When should the hygiene promotion component be implemented and how does it integrate into other components? It should start right at the beginning, as part of effective pre-planning and selection of communities, to help villagers make informed decisions about whether to opt into the project, and identify their priorities. Early entry is key. At the same time, it is important to lay emphasis only on core behavioral changes at the early stages.

Hygiene promotion's next critical phase is 'post-implementation' – once the water is flowing and latrines, soak-pits, drainage, and garbage pits, etc., have been built. It is then that effective use, hygiene practices, and environmental consequences can be assessed and dealt with. The task of hygiene promotion is not over when the project period ends. Post-construction support is critical.

Approaches

Methods and Tools

All the three projects adopted multi-channel message-based IEC, with UP going a step further to combine some participatory methods as well.

MAHARASHTRA: Flip charts and posters were the main tools of field-workers, along with messages through radio, television spots, processions, etc. This project also developed district action plans. Of the approaches used, interpersonal contacts with adults, and competitions among schoolchildren, were found most effective.

KARNATAKA: A multi-channel village-based strategy was adopted. Local village health facilitators made house-to-house visits using flip charts, cards and similar communication materials. Meetings and orientations for other village groups were held, as also school programs.

UTTAR PRADESH: Efforts have been made to mobilize and facilitate the community to collect information on their health status, and their creativity is used to develop a community action plan for hygiene promotion. SARAR tools and the Healthy Homes Surveys have been introduced for this purpose. These have been found to be very effective.

There is a need for greater use of participatory and interpersonal methods

Safe disposal of excreta and proper maintenance of latrines are integral components of any hygiene promotion program.

to achieve hygiene promotion goals and objectives. Participatory approaches can be very useful for effective behavior change. Media also has a role to play, especially folk media that has the in-built advantages of being culturally acceptable, and film, which is very popular in India. However, the role of such mass media is of creating an overall climate, while interactive methods alone can produce changes in attitudes and behaviors. Although many methods and tools have been utilized across the projects, the underlying intents and characteristics of each need to be better understood, and then applied strategically. Thus their use can be made to better fit the varied learning needs of the community as it makes decisions to improve hygiene and sanitation conditions and practices.

Training Strategies

Designing and implementing effective, multilevel, multidisciplinary, experiential and field-based training strategies for hygiene promotion is the key to strengthening capacity. The timing of the training is also essential: training just prior to the activities ensures that lessons learned are not lost before needed. Besides, sound capacity building requires more than training: good incentives, management support and follow-up are crucial. Technical staff also need good exposure to hygiene promotion to better understand the rationale for their 'devices', and for purposes of coordination.

MAHARASHTRA and KARNATAKA: Training in these states reflects the message-based approach. Short orientations and lecture-mode training were the dominant trend, with a few exceptions. Training of Village Health Facilitators (VHFs), for example, consisted mostly of lectures for only one day – though they are the key frontline workers.

UTTAR PRADESH: Training was more field-based, experiential, and hands-on, and a core session lasted 12 days. More experienced NGOs were found to be a good means of training newer NGOs entering the project.

Hand-washing is an effective way to reduce morbidity.

Political Will and Policy Climate

Hygiene promotion benefits can be strengthened by extending the numbers and levels, from which stakeholders and policy makers support it. Learning from on-going practice can be fed back into effective policy discussions. Developing high level allies, facilitating issue-focused consultations and making links between hygiene promotion and specific health problems are some ways to build political will.

In Uttar Pradesh, the project has focused on a number of techniques to build political will. Use of Observation Study Tours of higher level administrative officials and water and sanitation staff, horizontal cross visits among NGOs, and large assemblies of women across the projects' communities are some of the techniques used. Maharashtra and Karnataka have used public figures to endorse their work and project materials to increase legitimacy.

Space for Local Initiative

All the project staff noted that rigid technical designs and package inputs stifled local energy. This discouraged local innovation and inventiveness. As in water supply, hygiene promotion needs to be more demand-responsive. Local initiatives should be encouraged, studied and spread across the projects. For example, in Karnataka, some NGOs found that Village Health Facilitators (VHFs) could be sustained in their hygiene promotion work if they also took on the additional paid job of collecting water charges from the users. Another Gram Panchayat agreed to cross-subsidize and provide land for group latrines where land was in short supply. Similarly, the formation of women's self-help groups was a boost to sanitation-related activities.

Allocation of Project Resources

All the projects reviewed included criteria that excluded communities with adequate supplies of safe water. This approach may need to be revisited as increasingly more communities in India are assured access to water supply. However, the review also highlighted that hygiene promotion should not stand alone in communities where water supplies were inadequate and rejected the notion of programs that do not integrate water supplies. Hygiene promotion cannot be effectively carried out in such situations.

Institutional Strategy

Roles and Responsibilities

In all the projects, NGOs were found to be particularly good at outreach. NGOs have the advantage of being able to sharply focus on, concentrate on, and penetrate deeply into communities with whom they have bonds of trust.

MAHARASHTRA: NGOs ran into conflict with Block Development Officers whom they saw as 'top-down' prescriptive managers who did not believe in

HEALTHY HOMES SURVEY (HHS)

A Community Monitoring Tool for Hygiene Promotion

This tool can be used by the community to regularly monitor the personal, domestic and environmental health and hygiene of their village and promote behavioral change. The methodology:

1. IDENTIFY ATTRIBUTES OF A HEALTHY HOME

- Invite one member (preferably a woman) from each house in the cluster.
- In a non-directive and participatory manner, ask them to list out the attributes of a healthy home. This might include household hygiene, management of drinking water, safe disposal of infant excreta, hand-washing after defecation and before eating, use of latrine, clean drains, etc.

2. CATEGORIZE ATTRIBUTES

- Ask the groups to categorize the indicators into three main headings – personal, domestic and environmental.
- The facilitator introduces the cards with pictures of the attributes and the participants are asked to discuss each one, prioritize them and then compare the list with the one they had determined at the previous HHS.
- The attributes are finalized by the cluster groups.

3. ASSESS THE STATUS OF THE COMMUNITY VIS-À-VIS THE FINALIZED LIST OF ATTRIBUTES

- The women cluster group members use the Secret Ballot/Pocket Chart method to ascertain the situation vis-à-vis **Personal Hygiene.** Totals are tallied and divided by the number of women present to find out the average for the group.
- To ascertain the situation vis-à-vis **Domestic Hygiene,** a group visits each and every house in the cluster and decides whether a home is healthy or unhealthy.
- To assess the situation vis-à-vis **Environmental Sanitation,** the same group members walk around in their cluster and observe the hygiene situation. They then rate the overall community as 'healthy' or 'unhealthy'. The results of Environmental Sanitation (ES) situation is also to be recorded visually on a community map.

4. SHARE HHS FINDINGS

- The results of the HHS, along with the date of the survey, are discussed in cluster women's groups.
- The results of the village as a whole are discussed in a community-wide meeting.

5. FINALIZE TARGETS

Based on the findings of the HHS and subsequent discussions, the community decides on targets of improvement in health and hygiene of the village at all three levels – personal, domestic and environmental.

6. FINALIZE INTERVENTIONS

Based on the village hygiene promotion targets, the cluster women's group decides what activities should be taken up to achieve the targets. Activities include:

- Need-based hygiene promotion sessions, their frequency, timings and place.
- Training and their curricula.
- Selecting IEC material according to the requirement of sessions.
- Deciding the number, frequency and strategy of various quiz and other competitions such as Healthy Baby Shows.
- Deciding the strategy of involving children, young girls and boys to act as change agents for hygiene promotion.
- Deciding the frequency of HHS.

7. COMMUNITY MONITORING

- Healthy Homes Surveys are conducted periodically – at least once in a quarter.
- While discussing the result of the survey, the community compares the results with the previous survey results.
- The community may also review the criteria (attributes).
- The community may also redesign existing strategy.

community participation. The project thus took active steps to arbitrate and was able to achieve 'a workable' relationship. Currently, the Project's Planning and Monitoring Unit (PPMU) believes that an integrated team of government functionaries at district, block and local levels and an NGO-led team of Health, Management and Engineering specialists should directly focus on village-based organizations in future projects, and that NGOs should be integrated at the district and state levels too.

KARNATAKA: The World Bank introduced NGOs for outreach, which was a contentious measure at the start since the government wanted to use its own functionaries. An agreement was finally reached by which the Government of Karnataka would test the use of its functionaries in one district, while the NGOs worked in 11 districts. After the first phase, it was found that NGOs produced good results in the field. In Phase 1, problems of hardware delivery were acute: NGOs only concentrated on the software, and as a result felt they had little credibility just 'pushing health messages'. At Project level, it is now agreed that a single window for both hardware and software is needed for the next project which integrates community development, health, engineering, and other disciplines. This will give hygiene promotion more credibility and focus.

UTTAR PRADESH: From the beginning of the Project, a 'one-window' support for communities for community development, hygiene promotion, and hardware for water and environmental sanitation was arranged. This built strong trust and transparency with communities. A consolidated spearhead group such as a Self-Help Group has been created, from which the required specialized groups were formed. Staff and NGOs also identified the need for building long-term linkages between communities and support services, such as health clinics.

Gender and Poverty

As currently practised, hygiene promotion focuses specifically on women; however some men are involved 'by default', for example, if they happen to be in a general group, such as a youth club. Such strategies not only ignore 'half the problem' in terms of changing attitudes and practices, they may also aggravate already unfair burdens on women's time and effort. Besides, when projects monitor hygiene promotion, they rarely disaggregate information by gender and poverty with regard to workloads, time inputs, and decision-making power. These are serious issues and must be taken into consideration in updating hygiene promotion strategies for future projects.

Monitoring and Evaluation (M&E)

Performance monitoring across projects was undertaken, measuring inputs to outputs. Sometimes performance was tied to payments, to ensure that a certain number of activities had been completed. Often in reporting, performance data was presented as the main evidence of project progress, though it gave little insight into results or outcomes. For performance monitoring, a sample-survey type IEC baseline was completed in l994 in Karnataka. It reviewed a number of limited behaviors related to water and sanitation, and implications for use of mass media. In Maharashtra, an impact study was conducted in 1995-96, covering water supply delivery in one district. Another impact study was conducted in 1997, covering all the project districts through sample surveys done by the Health and Family Welfare Training Centers. Two other impact studies, improving on the earlier methodology, are currently being planned. In Uttar Pradesh, both conventional and participatory impact assessments have been put into place. A sample-survey KAP baseline study for one of the project batches was conducted focusing on knowledge and practices. A post-study is being planned. A participatory Healthy Homes Survey technique has proven to be very popular both as an effective change mechanism and a solid participatory impact monitoring tool.

A health education meeting serves as an effective forum for discussing hygiene practice.

Process monitoring was used to varying degrees in all the three projects. Process monitoring is a management tool designed to help organizations become more participatory and demand-responsive. Its development was a response to the need for field research data to be incorporated to improve project responsiveness to community demands, to maximize impact and improve the likelihood of sustainable outcomes. In Karnataka, process monitoring was informally conducted through monthly meetings in which implementation issues were discussed. Maharashtra also had regular review meetings. Uttar Pradesh has similarly built in feedback on project processes through meetings with support organizations.

Planning the M&E systems, their design and implementation, are major priorities in strengthening hygiene promotion in large-scale projects in India. Existing systems mostly emphasize performance monitoring, which has its uses, but does not help to significantly improve the processes by which hygiene promotion is achieved. This can be accomplished by more systematic process monitoring. The key to M&E design is a *shared stakeholder process* for the selection and design of M&E indicators and strategies.

Recommendations for New Projects

It is evident that the design of the hygiene promotion component needs a greater level of effort during preparation and integration with other processes for water supply and sanitation services. The key lesson is that greater emphasis is needed on the creation, use, and extension of participatory methods and tools for hygiene promotion. Only these decentralized initiatives can help overcome resistance to deeply-seated attitudes and practices, and help make the links to felt priorities.

In sum, it needs to be acknowledged that these World Bank projects have catalyzed discussions on the links between water supply, sanitation and hygiene education; discussion that has been critically lacking in the sector and in government programs. Most government schemes have focused on the construction of latrines rather than on improving overall hygiene. It is now being recognized that hygiene education programs that focus on the delivery of simple hygiene awareness messages fail because they do not recognize the strengths of decentralization and participatory approaches.

KEY LESSONS OF THE REVIEW

¤ **Foster increased use of participatory methods and tools –** The creation, use and extension of participatory methods and tools have provided good results. These help overcome resistance to deeply-seated attitudes and practices and facilitate links to felt priorities. At the same time, use of mass, folk and community media builds an effective climate for change.

¤ **Facilitate communities to set their own objectives –** It is essential to facilitate stakeholder analysis of design factors at conception and set goals and objectives for hygiene promotion. Hygiene promotion is more effective where communities are allowed to set their own specific objectives. It is seen that a focus on three core behaviors – hand-washing, safe disposal of excreta and use of safe water – are enough to start up hygiene and sanitation programs for maximum impact.

¤ **Establish unified multidisciplinary teams to present a single organizational support 'window' to communities** – Institutional responsibilities need to be clear and simple. A unified multidisciplinary team can build the capacity of community-based groups and facilitate the implementation of demand-responsive projects. Dedicated NGOs have demonstrated their strengths in project-specific roles as support organizations.

¤ **Provide focused well-timed training at local levels –** Training strategies need to involve all stakeholders. There is a need to avoid long gaps between training and expected performance.

¤ **Include incentives to support capacity –** Sound capacity building requires more than training; it should include good incentives and management support.

¤ **Develop political will** – Hygiene promotion is seen to work best where a broad political will has been generated that supports effective policies and generates popular support.

¤ **Update gender strategy to ensure shared and equitable roles for men and women –** Overall, women and girls are given the major burden of hygiene and sanitation – both in terms of promotional tasks and responsibility for hygiene in the home and community. Strategies need to be more equitable and aim to ensure that men and boys take more responsibility and share in related work and tasks.

¤ **Design effective M&E systems through facilitated stakeholder analysis and planning** – These tools need to be practical and simple, defining its uses for each level in the project. Where they provide adequate precision, participatory impact tools have been useful. Structured process monitoring is useful as an internal management tool. Stakeholder involvement in designing M&E makes it more effective.

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1. Marketing Sanitation in Rural India
2. New Approaches to Promoting Sanitation in Rural Bangladesh

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The Water and Sanitation Program is an international partnership to help the poor gain sustained access to improved water supply and sanitation services. The Program's funding partners are the Governments of Australia, Belgium, Canada, Denmark, Germany, Italy, Japan, Luxembourg, the Netherlands, Norway, Sweden, Switzerland, and the United Kingdom; the United Nations Development Programme, and The World Bank.

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India – Environmental (Protection) Act, 1986

05/23/1986

THE ENVIRONMENT (PROTECTION) ACT, 1986

No. 29 OF 1986

[23rd May, 1986.]

An Act to provide for the protection and improvement of environment and for matters connected there with:

WHEREAS the decisions were taken at the United Nations Conference on the Human Environment held at Stockholm in June, 1972, in which India participated, to take appropriate steps for the protection and improvement of human environment;

AND WHEREAS it is considered necessary further to implement the decisions aforesaid in so far as they relate to the protection and improvement of environment and the prevention of hazards to human beings, other living creatures, plants and property;

BE it enacted by Parliament in the Thirty-seventh Year of the Republic of India as follows:-

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CHAPTER I

PRELIMINARY

1.SHORT TITLE, EXTEND AND COMMENCEMENT

(1) This Act may be called the Environment (Protection) Act, 1986.

(2) It extends to the whole of India.

(3) It shall come into force on such date as the Central Government may, by notification in the Official Gazette, appoint and different dates may be appointed for different provisions of this Act and for different areas.[1]

2.DEFINITIONS

In this Act, unless the context otherwise requires,--

(a) "environment" includes water, air and land and the inter-relationship which exists among and between water, air and land, and human beings, other living creatures, plants, micro-organism and property;

(b) "environmental pollutant" means any solid, liquid or gaseous substance present in such concentration as may be, or tend to be, injurious to environment;

(c) "environmental pollution" means the presence in the environment of any environmental pollutant;

(d) "handling", in relation to any substance, means the manufacture, processing, treatment, package, storage, transportation, use, collection, destruction, conversion, offering for sale, transfer or the like of such substance;

(e) "hazardous substance" means any substance or preparation which, by reason of its chemical or physico-chemical properties or handling, is liable to cause harm to human beings, other living creatures, plant, micro-organism, property or the environment;

(f) "occupier", in relation to any factory or premises, means a person who has, control over the affairs of the factory or the premises and includes in relation to any substance, the person in possession of the substance;

(g) "prescribed" means prescribed by rules made under this Act.

CHAPTER II

GENERAL POWERS OF THE CENTRAL GOVERNMENT

3. POWER OF CENTRAL GOVERNMENT TO TAKE MEASURES TO PROTECT AND IMPROVE ENVIRONMENT

(1) Subject to the provisions of this Act, the Central Government, shall have the power to take all such measures as it deems necessary or expedient for the purpose of protecting and improving the quality of the environment and preventing controlling and abating environmental pollution.

(2) In particular, and without prejudice to the generality of the provisions of sub-section (1), such measures may include measures with respect to all or any of the following matters, namely:--

(i) co-ordination of actions by the State Governments, officers and other authorities--

(a) under this Act, or the rules made thereunder, or

(b) under any other law for the time being in force which is relatable to the objects of this Act;

(ii) planning and execution of a nation-wide programme for the prevention, control and abatement of environmental pollution;

(iii) laying down standards for the quality of environment in its various aspects;

(iv) laying down standards for emission or discharge of environmental pollutants from various sources whatsoever:

Provided that different standards for emission or discharge may be laid down under this clause from different sources having regard to the quality or composition of the emission or discharge of environmental pollutants from such sources;

(v) restriction of areas in which any industries, operations or processes or class of industries, operations or processes shall not be carried out or shall be carried out subject to certain safeguards;

(vi) laying down procedures and safeguards for the prevention of accidents which may cause environmental pollution and remedial measures for such accidents;

(vii) laying down procedures and safeguards for the handling of hazardous substances;

(viii) examination of such manufacturing processes, materials and substances as are likely to cause environmental pollution;

(ix) carrying out and sponsoring investigations and research relating to problems of environmental pollution;

(x) inspection of any premises, plant, equipment, machinery, manufacturing or other processes, materials or substances and giving, by order, of such directions to such authorities, officers or persons as it may consider necessary to take steps for the prevention, control and abatement of environmental pollution;

(xi) establishment or recognition of environmental laboratories and institutes to carry out the functions entrusted to such environmental laboratories and institutes under this Act;

(xii) collection and dissemination of information in respect of matters relating to environmental pollution;

(xiii) preparation of manuals, codes or guides relating to the prevention, control and abatement of environmental pollution;

(xiv) such other matters as the Central Government deems necessary or expedient for the purpose of securing the effective implementation of the provisions of this Act.

(3) The Central Government may, if it considers it necessary or expedient so to do for the purpose of this Act, by order, published in the Official Gazette, constitute an authority or authorities by such name or names as may be specified in the order for the purpose of exercising and performing such of the powers and functions (including the power to issue directions under section 5) of the Central Government under this Act and for taking measures with respect to such of the matters referred to in sub-section (2) as may be mentioned in the order and subject to the supervision and control of the Central Government and the provisions of such order, such authority or authorities may exercise and powers or perform the functions or take the measures so mentioned in the order as if such authority or authorities had been empowered by this Act to exercise those powers or perform those functions or take such measures.

4. APPOINTMENT OF OFFICERS AND THEIR POWERS AND FUNCTIONS

(1) Without prejudice to the provisions of sub-section (3) of section 3, the Central Government may appoint officers with such designation as it thinks fit for the purposes of this Act and may entrust to them such of the powers and functions under this Act as it may deem fit.

(2) The officers appointed under sub-section (1) shall be subject to the general control and direction of the Central Government or, if so directed by that Government, also of the authority or authorities, if any, constituted under sub- section (3) of section 3 or of any other authority or officer.

5. POWER TO GIVE DIRECTIONS

Notwithstanding anything contained in any other law but subject to the provisions of this Act, the Central Government may, in the exercise of its powers and performance of its functions under this Act, issue directions in writing to any person, officer or any authority and such person, officer or authority shall be bound to comply with such directions.[3]

Explanation--For the avoidance of doubts, it is hereby declared that the power to issue directions under this section includes the power to direct--

(a) the closure, prohibition or regulation of any industry, operation or process; or

(b) stoppage or regulation of the supply of electricity or water or any other service.

6. RULES TO REGULATE ENVIRONMENTAL POLLUTION

(1) The Central Government may, by notification in the Official Gazette, make rules in respect of all or any of the matters referred to in section 3.

(2) In particular, and without prejudice to the generality of the foregoing power, such rules may provide for all or any of the following matters, namely:--

(a) the standards of quality of air, water or soil for various areas and purposes;[4]

(b) the maximum allowable limits of concentration of various environmental pollutants (including noise) for different areas;

(c) the procedures and safeguards for the handling of hazardous substances;[5]

(d) the prohibition and restrictions on the handling of hazardous substances in different areas;[6]

(e) the prohibition and restriction on the location of industries and the carrying on process and operations in different areas;[7]

(f) the procedures and safeguards for the prevention of accidents which may cause environmental pollution and for providing for remedial measures for such accidents.[8]

CHAPTER III

PREVENTION, CONTROL, AND ABATEMENT OF ENVIRONMENTAL POLLUTION

7. PERSONS CARRYING ON INDUSTRY OPERATION, ETC., NOT TO ALLOW EMISSION OR DISCHARGE OF ENVIRONMENTAL POLLUTANTS IN EXCESS OF THE STANDARDS

No person carrying on any industry, operation or process shall discharge or emit or permit to be discharged or emitted any environmental pollutants in excess of such standards as may be prescribed.[9]

8. PERSONS HANDLING HAZARDOUS SUBSTANCES TO COMPLY WITH PROCEDURAL SAFEGUARDS

No person shall handle or cause to be handled any hazardous substance except in accordance with such procedure and after complying with such safeguards as may be prescribed.[10]

9. FURNISHING OF INFORMATION TO AUTHORITIES AND AGENCIES IN CERTAIN CASES

(1) Where the discharge of any environmental pollutant in excess of the prescribed standards occurs or is apprehended to occur due to any accident or other unforeseen act or event, the person responsible for such discharge and the person in charge of the place at which such discharge occurs or is apprehended to occur shall be bound to prevent or mitigate the environmental pollution caused as a result of such discharge and shall also forthwith--

(a) intimate the fact of such occurrence or apprehension of such occurrence; and

(b) be bound, if called upon, to render all assistance,

to such authorities or agencies as may be prescribed.[11]

(2) On receipt of information with respect to the fact or apprehension on any occurrence of the nature referred to in sub-section (1), whether through intimation under that sub-section or otherwise, the authorities or agencies referred to in sub-section (1) shall, as early as practicable, cause such remedial measures to be taken as necessary to prevent or mitigate the environmental pollution.

(3) The expenses, if any, incurred by any authority or agency with respect to the remedial measures referred to in sub-section (2), together with interest (at such reasonable rate as the Government may, by order, fix) from the date when a demand for the expenses is made until it is paid, may be recovered by such authority or agency from the person concerned as arrears of land revenue or of public demand.

10. POWERS OF ENTRY AND INSPECTION

(1) Subject to the provisions of this section, any person empowered by the Central Government in this ehalf[12] shall have a right to enter, at all reasonable times with such assistance as he considers necessary, any place--

(a) for the purpose of performing any of the functions of the Central Government entrusted to him;

(b) for the purpose of determining whether and if so in what manner, any such functions are to be performed or whether any provisions of this Act or the rules made thereunder orany notice, order, direction or authorisation served, made, given or granted under this Act is being or has been complied with;

(c) for the purpose of examining and testing any equipment, industrial plant, record, register, document or any other material object or for conducting a search of any building in which he has reason to believe that an offence under this Act or the rules made thereunder has been or is being or is about to be committed and for seizing any such equipment, industrial plant, record, register, document or other material object if he has reason to believe that it may furnish evidence of the commission of an offence punishable under this Act or the rules made thereunder or that such seizure is necessary to prevent or mitigate environmental pollution.

(2) Every person carrying on any industry, operation or process of handling any hazardous substance shall be bound to render all assistance to the person empowered by the Central Government under sub-section (1) for carrying out the functions under that sub-section and if he fails to do so without any reasonable cause or excuse, he shall be guilty of an offence under
this Act.

(3) If any person wilfully delays or obstructs any persons empowered by the Central Government under sub-section (1) in the performance of his functions, he shall be guilty of an offence under this Act.

(4) The provisions of the Code of Criminal Procedure, 1973, or, in relation to the State of Jammu and Kashmir, or an area in which that Code is not in force, the provisions of any corresponding law in force in that State or area shall, so far as may be, apply to any search or seizures under this section as they apply to any search or seizure made under the authority of a warrant
issued under section 94 of the said Code or as the case may be, under the corresponding provision of the said law.

11. POWER TO TAKE SAMPLE AND PROCEDURE TO BE FOLLOWED IN CONNECTION THEREWITH

(1) The Central Government or any officer empowered by it in this behalf,[13] shall have power to take, for the purpose of analysis, samples of air, water, soil or other substance from any factory, premises or other place in such manner as may be prescribed.[14]

(2) The result of any analysis of a sample taken under sub-section (1) shall not be admissible in evidence in any legal proceeding unless the provisions of sub-sections (3) and (4) are complied with.

(3) Subject to the provisions of sub-section (4), the person taking the sample under sub-section (1) shall--

(a) serve on the occupier or his agent or person in charge of the place, a notice, then and there, in such form as may be prescribed, of his intention to have it so analysed;

(b) in the presence of the occupier of his agent or person, collect a sample for analysis;

(c) cause the sample to be placed in a container or containers which shall be marked and sealed and shall also be signed both by the person taking the sample and the occupier or his agent or person;

(d) send without delay, the container or the containers to the laboratory established or recognised by the Central Government under section 12.

(4) When a sample is taken for analysis under sub-section (1) and the person taking the sample serves on the occupier or his agent or person, a notice under clause (a) of sub-section (3), then,--

(a) in a case where the occupier, his agent or person wilfully absents himself, the person taking the sample shall collect the sample for analysis to be placed in a container or containers which shall be marked and sealed and shall also be signed by the person taking the sample, and

(b) in a case where the occupier or his agent or person present at the time of taking the sample refuses to sign the marked and sealed container or containers of the sample as required under clause (c) of sub-section (3), the marked and sealed container or containers shall be signed by the person taking the samples, and the container or containers shall be sent without delay by the person taking the sample for analysis to the laboratory established or recognised under section 12 and such person shall inform the Government Analyst appointed or recognised under section 12 in writing, about the wilfull absence of the occupier or his agent or person, or, as the case may be, his refusal to sign the container or containers.

12.ENVIRONMENTAL LABORATORIES

(1) The Central Government[15] may, by notification in the Official Gazette,--

(a) establish one or more environmental laboratories;

(b) recognise one or more laboratories or institutes as environmental laboratories to carry out the functions entrusted to an environmental laboratory under this Act.[16]

(2) The Central Government may, by notification in the Official Gazette, make rules specifying--

(a) the functions of the environmental laboratory;[17]

(b) the procedure for the submission to the said laboratory of samples of air, water, soil or other substance for analysis or tests, the form of the laboratory report thereon and the fees payable for such report;[18]

(c) such other matters as may be necessary or expedient to enable that laboratory to carry out its functions.

13. GOVERNMENT ANALYSTS

The Central Government may by notification in the Official Gazette, appoint or recognise such persons as it thinks fit and having the prescribed qualifications[19] to be Government Analysts for the purpose of analysis of samples of air, water, soil or other substance sent for analysis to any environmental laboratory established or recognised under sub-section (1) of section 12.

14. REPORTS OF GOVERNMENT ANALYSTS

Any document purporting to be a report signed by a Government analyst may be used as evidence of the facts stated therein in any proceeding under this Act.

15. PENALTY FOR CONTRAVENTION OF THE PROVISIONS OF THE ACT AND THE RULES, ORDERS AND DIRECTIONS

(1) Whoever fails to comply with or contravenes any of the provisions of this Act, or the rules made or orders or directions issued thereunder, shall, in respect of each such failure or contravention, be punishable with imprisonment for a term which may extend to five years with fine which may extend to one lakh rupees, or with both, and in case the failure or contravention continues, with additional fine which may extend to five thousand rupees for every day during which such failure or contravention continues after the conviction for the first such failure or contravention.

(2) If the failure or contravention referred to in sub-section (1) continues beyond a period of one year after the date of conviction, the offender shall be punishable with imprisonment for a term which may extend to seven years.

16. OFFENCES BY COMPANIES

(1) Where any offence under this Act has been committed by a company, every person who, at the time the offence was committed, was directly in charge of, and was

responsible to, the company for the conduct of the business of the company, as well as the company, shall be deemed to be guilty of the offence and shall be liable to be proceeded against and punished accordingly:

Provided that nothing contained in this sub-section shall render any such person liable to any punishment provided in this Act, if he proves that the offence was committed without his knowledge or that he exercised all due diligence to prevent the commission of such offence.

(2) Notwithstanding anything contained in sub-section (1), where an offence under this Act has been committed by a company and it is proved that the offence has been committed with the consent or connivance of, or is attributable to any neglect on the part of, any director, manager, secretary or other officer of the company, such director, manager, secretary or other officer shall also deemed to be guilty of that offence and shall be liable to be proceeded against and punished accordingly.

Explanation--For the purpose of this section,--

(a) "company" means any body corporate and includes a firm or other association of individuals;

(b) "director", in relation to a firm, means a partner in the firm.

17. OFFENCES BY GOVERNMENT DEPARTMENTS

(1) Where an offence under this Act has been committed by any Department of Government, the Head of the Department shall be deemed to be guilty of the offence and shall be liable to be proceeded against and punished accordingly.

Provided that nothing contained in this section shall render such Head of the Department liable to any punishment if he proves that the offence was committed without his knowledge or that he exercise all due diligence to prevent the commission of such offence.

(2) Notwithstanding anything contained in sub-section (1), where an offence under this Act has been committed by a Department of Government and it is proved that the offence has been committed with the consent or connivance of, or is attributable to any neglect on the part of, any officer, other than the Head of the Department, such officer shall also be deemed to be guilty of that offence and shall be liable to be proceeded against and punished accordingly.

CHAPTER IV

MISCELLANEOUS

18. PROTECTION OF ACTION TAKEN IN GOOD FAITH

No suit, prosecution or other legal proceeding shall lie against the Government or any officer or other employee of the Government or any authority constituted under this Act or any member, officer or other employee of such authority in respect of anything which is done or intended to be done in good faith in pursuance of this Act or the rules made or orders or directions issued thereunder.

19. COGNIZANCE OF OFFENCES

No court shall take cognizance of any offence under this Act except on a complaint made by--

(a) the Central Government or any authority or officer authorised in this behalf by that Government,[20] or

(b) any person who has given notice of not less than sixty days, in the manner prescribed, of the alleged offence and of his intention to make a complaint, to the Central Government or the authority or officer
authorised as aforesaid.

20. INFORMATION, REPORTS OR RETURNS

The Central Government may, in relation to its function under this Act, from time to time, require any person, officer, State Government or other authority to furnish to it or any prescribed authority or officer any reports, returns, statistics, accounts and other information and such person, officer, State Government or other authority shall be bound to do so.

21. MEMBERS, OFFICERS AND EMPLOYEES OF THE AUTHORITY CONSTITUTED UNDER SECTION 3 TO BE PUBLIC SERVANTS

All the members of the authority, constituted, if any, under section 3 and all officers and other employees of such authority when acting or purporting to act in pursuance of any provisions of this Act or the rules made or orders or directions issued thereunder shall be deemed to be public servants within the meaning of section 21 of the Indian Penal Code (45 of 1860).

22. BAR OF JURISDICTION

No civil court shall have jurisdiction to entertain any suit or proceeding in respect of anything done, action taken or order or direction issued by the Central Government or any other authority or officer in pursuance of any power conferred by or in relation to its or his functions under this Act.

23. POWERS TO DELEGATE

Without prejudice to the provisions of sub-section (3) of section 3, the Central Government may, by notification in the Official Gazette, delegate, subject to such conditions and limitations as may be specified in the notifications, such of its powers and functions under this Act [except the powers to constitute an authority under sub-section

(3) of section 3 and to make rules under section 25] as it may deem necessary or expedient, to any officer, State Government or other authority.

24. EFFECT OF OTHER LAWS

(1) Subject to the provisions of sub-section (2), the provisions of this Act and the rules or orders made therein shall have effect notwithstanding anything inconsistent therewith contained in any enactment other than this Act.

(2) Where any act or omission constitutes an offence punishable under this Act and also under any other Act then the offender found guilty of such offence shall be liable to be punished under the other Act and not under this Act.

25. POWER TO MAKE RULES

(1) The Central Government may, by notification in the Official Gazette, make rules for carrying out the purposes of this Act.

(2) In particular, and without prejudice to the generality of the foregoing power, such rules may provide for all or any of the following matters, namely--

(a) the standards in excess of which environmental pollutants shall not be discharged or emitted under section 7;[21]

(b) the procedure in accordance with and the safeguards in compliance with which hazardous substances shall be handled or caused to be handled under section 8;[22]

(c) the authorities or agencies to which intimation of the fact of occurrence or apprehension of occurrence of the discharge of any environmental pollutant in excess of the prescribed standards shall be given and to whom all assistance shall be bound to be rendered under sub-section (1) of section 9;[23]

(d) the manner in which samples of air, water, soil or other substance for the purpose of analysis shall be taken under sub-section (1) of section 11;[24]

(e) the form in which notice of intention to have a sample analysed shall be served under clause (a) of sub section (3) of section 11;[25]

(f) the functions of the environmental laboratories,[26] the procedure for the submission to such laboratories of samples of air, water, soil and other substances for analysis or test;[27] the form of laboratory report; the fees payable for such report and other matters to enable such laboratories to carry out their functions under sub-section (2) of section 12;

(g) the qualifications of Government Analyst appointed or recognised for the purpose of analysis of samples of air, water, soil or other substances under section 13;[28]

(h) the manner in which notice of the offence and of the intention to make a complaint to the Central Government shall be given under clause (b) of section 19;[29]

(i) the authority of officer to whom any reports, returns, statistics, accounts and other information shall be furnished under section 20;

(j) any other matter which is required to be, or may be,prescribed.

26. RULES MADE UNDER THIS ACT TO BE LAID BEFORE PARLIAMENT

Every rule made under this Act shall be laid, as soon as may be after it is made, before each Hose of Parliament, while it is in session, for a total period of thirty days which may be comprised in one session or in two or more successive sessions, and if, before the expiry of the session immediately following the session or the successive sessions aforesaid, both Houses agree in making any modification in the rule or both Houses agree that the rule should not be made, the rule shall thereafter have effect only in such modified form or be of no effect, as the case may be; so, however, that any such modification or annulment shall be without prejudice to the validity of anything previously done under that rule.

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[1] It came into force in the whole of India on 19th November, 1986 vide Notification No. G.S.R. 1198(E) dated 12-11-86 published in the Gazette of India No. 525 dated 12-11-86.

[2] The Central Government has delegated the powers vested m it under section 5 of the - Act to the State Governments of Andhra Pradesh, Assam, Bihar, Gujarat, Haryana, Himachal Pradesh, Karnatalca, Kerala, Madhya Predesh, Mizoram, Orissa, Rajasthan, Sikkim and Tamil Nadu subject to the condition that the Central Government may revoke such delegation of Powers in respect of all or any one or more of the State Governments or may itself invoke the provisions of section 5 of the Act, if in the opinion of the Central Government such a course of action is necessary in public interest, (Notification No, S.O. 152 (E) dated 10-2-88 published in Gazette No. 54 of the same date). These Powers have been delegated to the following State Governments also on the same terms:

Meghalaya, Punjab and Uttar Pradesh vide Notification No. S.0.389 (E) dated 14-4-88 published in the Gazette No. 205 dated 144-88;

Maharashtra vide Notification No. S.O. 488(E) dated 17-5-88 published in the Gazette No. 255 dated 17-5-88;

Goa and Jammu & Kashmir vide Notification No. S.O. 881 (E~ dated 22-9-88; published in the Gazette No. 749 dated 2.9.88.

West Bengal Manipur vide Notificadon N. S.O. 408 (E) dated 6-6-89; published in the Gazette No. 319 dated 6-6-89;

Tripura vide Notification No. S.O. 479 (E) dated 25-7-91 published in thc Gazene No. 414 dated 25-7-91.

[3] For issuing directions see r.4 of Enviromnent (Protection) Rules, 1986.

[4] See r. 3 of Environment (Protection) Rules, 1986 and Schedules thereto.

i. Schedule I lists the standards for emission or discharge of environmental pollutants from the industries, processes or operations and their maximum allowable limits of concentration;

ii. Schedule II lists general standards for discharge of effluents and their maximum limits of concentration allowable;

iii. Schedule III lists ambient air quality standards in respect of noise and its maximum allowable limits; and

iv. Schedule IV lists standards for emission of smoke, vapour etc. from motor vehicles and maximum allowable limits of their emission.

[5] See r. 13 of Environment (Protection) Rules, 1986, and

i. Hazardous Wastes (Management and Handling) Rules, 1989;

ii. Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989; and

iii. Rules for the Manufacture, Use, Import, Export and Storage of Hazardous Micro organisms, Genetically-engineered organisms or Cells.

[6] Rule 13 SUPRA.

[7] See r. 5 of Environment (Protection) Rules, 1986.

[8] See r. 12 of Environment (Protection) Rules and Schedule 11, and relevant provisions of Hazardous Wastes (Management and Handling) Rules, Manufacture, Storage and Import of Hazardous Chemicals Rules and Rules for the Manufacture, Use, Import Export and Storage of hazardous Micro-organisms, Genetically Engineered Organisms or Cells.

[9] See r. 3 of Environment (Protection) Rules, 1486 and Schedule I.

[10] See r. 13 of Environment (Protection) Rules, 1986 and

i. Hazardous Wastes (Management and Handling) Rules, 1989;

ii. Manufacture, Storage and h7lporl of Hazardous Chemicals Rules, 1989; and

iii. Rules for the Manufacture, Use Import, Export and Storage of Hazardous Micro organisms, Genetically Engineered organisms or Cells.

[11] For authorities or agencies see r. 12 of Environment (Protection) Rules, 1986 and Schedule

[12] The Central Govt. has empowered 60 persons listed in the Table (p. 251) vide S.O. 83 (E) published in the Gazette of India No. 66 dated 16-2-87 and S.O. 63 (E) published in the Gazette of India No. 42 dated 18-1-88.

[13] In excercise of powers conferred under sub-section (i) of section 11 the Central Government has empowered 60 officers listed in the Table (p. 254) vide S.O. 84. (E) published in the Gazette No. 66 dated 16-2-87 and S.O. 62(E) published in the Gazette No. 42 dated 18-l-88.

[14] For procedure for taking samples see r. 6 of Environment (Protection) Rules, 1986, also.

[15] The Central Government has delegated its powers under clause (b) of sub-section (i) of section 12 and section 13 of the Act to the Central Pollution Control Board vide Notification No. S.O. 145 (E) dated 21-2-91 published in the Gazette No. 128 dated 27-2-91.

[16] The list of laboratories/institutes recognised as environmental laboratories: and the persons recognised as Govt. Analysts is given in the table (p. 223).

[17] See r. 9 of Environment (Protection) Rules, 1986.

[18] See r. 8 of Environment (Protection) Rules, 1986.

[19] For qualifications of Govt. Analyst see r. 10 of Environment (Protection) Rules, 1986.

[20] In exercise of powers conferred under clause (a)of section l9, the Central-Government has authorised the officers and authorities listed in the Table (p. 238) vide S.O. 394 (E) published in the Gazette No. 185 dated 164-87, S.O. 237(E) published in the Gazette No. 171 dated 29-3-89 and S.O. 656(E) dated 21-8-89 published in the Gazette No. 519 dated 21-8-89.

[21] See footnote 2 on Page 213.

[22] See footnote 3 on Page 213.

[23] See footnote I on Page 214.

[24] See r.6 of Environment (Protection) Rules, 1986.

[25] See r. 7 of Environment (Protection) Rules, 1986.

[26] See r. 9 of Environment (Protection) Rules, 1986.

[27] For the procedure for submission of samples to laboratories and the form of laboratory report see r. 8 of Environment (Protection) Rules, 1986.

[28] See r. 10 of Environment (Protection) Rules, 1986.

[29] See r. 11 of Environment (protection) Rules, 1986.

India – Environmental (Protection) Act, 1986

05/23/1986

THE ENVIRONMENT (PROTECTION) ACT, 1986

No. 29 OF 1986

[23rd May, 1986.]

An Act to provide for the protection and improvement of environment and for matters connected there with:

WHEREAS the decisions were taken at the United Nations Conference on the Human Environment held at Stockholm in June, 1972, in which India participated, to take appropriate steps for the protection and improvement of human environment;

AND WHEREAS it is considered necessary further to implement the decisions aforesaid in so far as they relate to the protection and improvement of environment and the prevention of hazards to human beings, other living creatures, plants and property;

BE it enacted by Parliament in the Thirty-seventh Year of the Republic of India as follows:-

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CHAPTER I

PRELIMINARY

1.SHORT TITLE, EXTEND AND COMMENCEMENT

(1) This Act may be called the Environment (Protection) Act, 1986.

(2) It extends to the whole of India.

(3) It shall come into force on such date as the Central Government may, by notification in the Official Gazette, appoint and different dates may be appointed for different provisions of this Act and for different areas.[1]

2.DEFINITIONS

In this Act, unless the context otherwise requires,--

(a) "environment" includes water, air and land and the inter-relationship which exists among and between water, air and land, and human beings, other living creatures, plants, micro-organism and property;

(b) "environmental pollutant" means any solid, liquid or gaseous substance present in such concentration as may be, or tend to be, injurious to environment;

(c) "environmental pollution" means the presence in the environment of any environmental pollutant;

(d) "handling", in relation to any substance, means the manufacture, processing, treatment, package, storage, transportation, use, collection, destruction, conversion, offering for sale, transfer or the like of such substance;

(e) "hazardous substance" means any substance or preparation which, by reason of its chemical or physico-chemical properties or handling, is liable to cause harm to human beings, other living creatures, plant, micro-organism, property or the environment;

(f) "occupier", in relation to any factory or premises, means a person who has, control over the affairs of the factory or the premises and includes in relation to any substance, the person in possession of the substance;

(g) "prescribed" means prescribed by rules made under this Act.

CHAPTER II

GENERAL POWERS OF THE CENTRAL GOVERNMENT

3. POWER OF CENTRAL GOVERNMENT TO TAKE MEASURES TO PROTECT AND IMPROVE ENVIRONMENT

(1) Subject to the provisions of this Act, the Central Government, shall have the power to take all such measures as it deems necessary or expedient for the purpose of protecting and improving the quality of the environment and preventing controlling and abating environmental pollution.

(2) In particular, and without prejudice to the generality of the provisions of sub-section (1), such measures may include measures with respect to all or any of the following matters, namely:--

(i) co-ordination of actions by the State Governments, officers and other authorities--

(a) under this Act, or the rules made thereunder, or

(b) under any other law for the time being in force which is relatable to the objects of this Act;

(ii) planning and execution of a nation-wide programme for the prevention, control and abatement of environmental pollution;

(iii) laying down standards for the quality of environment in its various aspects;

(iv) laying down standards for emission or discharge of environmental pollutants from various sources whatsoever:

Provided that different standards for emission or discharge may be laid down under this clause from different sources having regard to the quality or composition of the emission or discharge of environmental pollutants from such sources;

(v) restriction of areas in which any industries, operations or processes or class of industries, operations or processes shall not be carried out or shall be carried out subject to certain safeguards;

(vi) laying down procedures and safeguards for the prevention of accidents which may cause environmental pollution and remedial measures for such accidents;

(vii) laying down procedures and safeguards for the handling of hazardous substances;

(viii) examination of such manufacturing processes, materials and substances as are likely to cause environmental pollution;

(ix) carrying out and sponsoring investigations and research relating to problems of environmental pollution;

(x) inspection of any premises, plant, equipment, machinery, manufacturing or other processes, materials or substances and giving, by order, of such directions to such authorities, officers or persons as it may consider necessary to take steps for the prevention, control and abatement of environmental pollution;

(xi) establishment or recognition of environmental laboratories and institutes to carry out the functions entrusted to such environmental laboratories and institutes under this Act;

(xii) collection and dissemination of information in respect of matters relating to environmental pollution;

(xiii) preparation of manuals, codes or guides relating to the prevention, control and abatement of environmental pollution;

(xiv) such other matters as the Central Government deems necessary or expedient for the purpose of securing the effective implementation of the provisions of this Act.

(3) The Central Government may, if it considers it necessary or expedient so to do for the purpose of this Act, by order, published in the Official Gazette, constitute an authority or authorities by such name or names as may be specified in the order for the purpose of exercising and performing such of the powers and functions (including the power to issue directions under section 5) of the Central Government under this Act and for taking measures with respect to such of the matters referred to in sub-section (2) as may be mentioned in the order and subject to the supervision and control of the Central Government and the provisions of such order, such authority or authorities may exercise and powers or perform the functions or take the measures so mentioned in the order as if such authority or authorities had been empowered by this Act to exercise those powers or perform those functions or take such measures.

4. APPOINTMENT OF OFFICERS AND THEIR POWERS AND FUNCTIONS

(1) Without prejudice to the provisions of sub-section (3) of section 3, the Central Government may appoint officers with such designation as it thinks fit for the purposes of this Act and may entrust to them such of the powers and functions under this Act as it may deem fit.

(2) The officers appointed under sub-section (1) shall be subject to the general control and direction of the Central Government or, if so directed by that Government, also of the authority or authorities, if any, constituted under sub- section (3) of section 3 or of any other authority or officer.

5. POWER TO GIVE DIRECTIONS

Notwithstanding anything contained in any other law but subject to the provisions of this Act, the Central Government may, in the exercise of its powers and performance of its functions under this Act, issue directions in writing to any person, officer or any authority and such person, officer or authority shall be bound to comply with such directions.[3]

Explanation--For the avoidance of doubts, it is hereby declared that the power to issue directions under this section includes the power to direct--

(a) the closure, prohibition or regulation of any industry, operation or process; or

(b) stoppage or regulation of the supply of electricity or water or any other service.

6. RULES TO REGULATE ENVIRONMENTAL POLLUTION

(1) The Central Government may, by notification in the Official Gazette, make rules in respect of all or any of the matters referred to in section 3.

(2) In particular, and without prejudice to the generality of the foregoing power, such rules may provide for all or any of the following matters, namely:--

(a) the standards of quality of air, water or soil for various areas and purposes;[4]

(b) the maximum allowable limits of concentration of various environmental pollutants (including noise) for different areas;

(c) the procedures and safeguards for the handling of hazardous substances;[5]

(d) the prohibition and restrictions on the handling of hazardous substances in different areas;[6]

(e) the prohibition and restriction on the location of industries and the carrying on process and operations in different areas;[7]

(f) the procedures and safeguards for the prevention of accidents which may cause environmental pollution and for providing for remedial measures for such accidents.[8]

CHAPTER III

PREVENTION, CONTROL, AND ABATEMENT OF ENVIRONMENTAL POLLUTION

7. PERSONS CARRYING ON INDUSTRY OPERATION, ETC., NOT TO ALLOW EMISSION OR DISCHARGE OF ENVIRONMENTAL POLLUTANTS IN EXCESS OF THE STANDARDS

No person carrying on any industry, operation or process shall discharge or emit or permit to be discharged or emitted any environmental pollutants in excess of such standards as may be prescribed.[9]

8. PERSONS HANDLING HAZARDOUS SUBSTANCES TO COMPLY WITH PROCEDURAL SAFEGUARDS

No person shall handle or cause to be handled any hazardous substance except in accordance with such procedure and after complying with such safeguards as may be prescribed.[10]

9. FURNISHING OF INFORMATION TO AUTHORITIES AND AGENCIES IN CERTAIN CASES

(1) Where the discharge of any environmental pollutant in excess of the prescribed standards occurs or is apprehended to occur due to any accident or other unforeseen act or event, the person responsible for such discharge and the person in charge of the place at which such discharge occurs or is apprehended to occur shall be bound to prevent or mitigate the environmental pollution caused as a result of such discharge and shall also forthwith--

(a) intimate the fact of such occurrence or apprehension of such occurrence; and

(b) be bound, if called upon, to render all assistance,

to such authorities or agencies as may be prescribed.[11]

(2) On receipt of information with respect to the fact or apprehension on any occurrence of the nature referred to in sub-section (1), whether through intimation under that sub-section or otherwise, the authorities or agencies referred to in sub-section (1) shall, as early as practicable, cause such remedial measures to be taken as necessary to prevent or mitigate the environmental pollution.

(3) The expenses, if any, incurred by any authority or agency with respect to the remedial measures referred to in sub-section (2), together with interest (at such reasonable rate as the Government may, by order, fix) from the date when a demand for the expenses is made until it is paid, may be recovered by such authority or agency from the person concerned as arrears of land revenue or of public demand.

10. POWERS OF ENTRY AND INSPECTION

(1) Subject to the provisions of this section, any person empowered by the Central Government in this ehalf[12] shall have a right to enter, at all reasonable times with such assistance as he considers necessary, any place--

(a) for the purpose of performing any of the functions of the Central Government entrusted to him;

(b) for the purpose of determining whether and if so in what manner, any such functions are to be performed or whether any provisions of this Act or the rules made thereunder orany notice, order, direction or authorisation served, made, given or granted under this Act is being or has been complied with;

(c) for the purpose of examining and testing any equipment, industrial plant, record, register, document or any other material object or for conducting a search of any building in which he has reason to believe that an offence under this Act or the rules made thereunder has been or is being or is about to be committed and for seizing any such equipment, industrial plant, record, register, document or other material object if he has reason to believe that it may furnish evidence of the commission of an offence punishable under this Act or the rules made thereunder or that such seizure is necessary to prevent or mitigate environmental pollution.

(2) Every person carrying on any industry, operation or process of handling any hazardous substance shall be bound to render all assistance to the person empowered by the Central Government under sub-section (1) for carrying out the functions under that sub-section and if he fails to do so without any reasonable cause or excuse, he shall be guilty of an offence under
this Act.

(3) If any person wilfully delays or obstructs any persons empowered by the Central Government under sub-section (1) in the performance of his functions, he shall be guilty of an offence under this Act.

(4) The provisions of the Code of Criminal Procedure, 1973, or, in relation to the State of Jammu and Kashmir, or an area in which that Code is not in force, the provisions of any corresponding law in force in that State or area shall, so far as may be, apply to any search or seizures under this section as they apply to any search or seizure made under the authority of a warrant
issued under section 94 of the said Code or as the case may be, under the corresponding provision of the said law.

11. POWER TO TAKE SAMPLE AND PROCEDURE TO BE FOLLOWED IN CONNECTION THEREWITH

(1) The Central Government or any officer empowered by it in this behalf,[13] shall have power to take, for the purpose of analysis, samples of air, water, soil or other substance from any factory, premises or other place in such manner as may be prescribed.[14]

(2) The result of any analysis of a sample taken under sub-section (1) shall not be admissible in evidence in any legal proceeding unless the provisions of sub-sections (3) and (4) are complied with.

(3) Subject to the provisions of sub-section (4), the person taking the sample under sub-section (1) shall--

(a) serve on the occupier or his agent or person in charge of the place, a notice, then and there, in such form as may be prescribed, of his intention to have it so analysed;

(b) in the presence of the occupier of his agent or person, collect a sample for analysis;

(c) cause the sample to be placed in a container or containers which shall be marked and sealed and shall also be signed both by the person taking the sample and the occupier or his agent or person;

(d) send without delay, the container or the containers to the laboratory established or recognised by the Central Government under section 12.

(4) When a sample is taken for analysis under sub-section (1) and the person taking the sample serves on the occupier or his agent or person, a notice under clause (a) of sub-section (3), then,--

(a) in a case where the occupier, his agent or person wilfully absents himself, the person taking the sample shall collect the sample for analysis to be placed in a container or containers which shall be marked and sealed and shall also be signed by the person taking the sample, and

(b) in a case where the occupier or his agent or person present at the time of taking the sample refuses to sign the marked and sealed container or containers of the sample as required under clause (c) of sub-section (3), the marked and sealed container or containers shall be signed by the person taking the samples, and the container or containers shall be sent without delay by the person taking the sample for analysis to the laboratory established or recognised under section 12 and such person shall inform the Government Analyst appointed or recognised under section 12 in writing, about the wilfull absence of the occupier or his agent or person, or, as the case may be, his refusal to sign the container or containers.

12.ENVIRONMENTAL LABORATORIES

(1) The Central Government[15] may, by notification in the Official Gazette,--

(a) establish one or more environmental laboratories;

(b) recognise one or more laboratories or institutes as environmental laboratories to carry out the functions entrusted to an environmental laboratory under this Act.[16]

(2) The Central Government may, by notification in the Official Gazette, make rules specifying--

(a) the functions of the environmental laboratory;[17]

(b) the procedure for the submission to the said laboratory of samples of air, water, soil or other substance for analysis or tests, the form of the laboratory report thereon and the fees payable for such report;[18]

(c) such other matters as may be necessary or expedient to enable that laboratory to carry out its functions.

13. GOVERNMENT ANALYSTS

The Central Government may by notification in the Official Gazette, appoint or recognise such persons as it thinks fit and having the prescribed qualifications[19] to be Government Analysts for the purpose of analysis of samples of air, water, soil or other substance sent for analysis to any environmental laboratory established or recognised under sub-section (1) of section 12.

14. REPORTS OF GOVERNMENT ANALYSTS

Any document purporting to be a report signed by a Government analyst may be used as evidence of the facts stated therein in any proceeding under this Act.

15. PENALTY FOR CONTRAVENTION OF THE PROVISIONS OF THE ACT AND THE RULES, ORDERS AND DIRECTIONS

(1) Whoever fails to comply with or contravenes any of the provisions of this Act, or the rules made or orders or directions issued thereunder, shall, in respect of each such failure or contravention, be punishable with imprisonment for a term which may extend to five years with fine which may extend to one lakh rupees, or with both, and in case the failure or contravention continues, with additional fine which may extend to five thousand rupees for every day during which such failure or contravention continues after the conviction for the first such failure or contravention.

(2) If the failure or contravention referred to in sub-section (1) continues beyond a period of one year after the date of conviction, the offender shall be punishable with imprisonment for a term which may extend to seven years.

16. OFFENCES BY COMPANIES

(1) Where any offence under this Act has been committed by a company, every person who, at the time the offence was committed, was directly in charge of, and was

responsible to, the company for the conduct of the business of the company, as well as the company, shall be deemed to be guilty of the offence and shall be liable to be proceeded against and punished accordingly:

Provided that nothing contained in this sub-section shall render any such person liable to any punishment provided in this Act, if he proves that the offence was committed without his knowledge or that he exercised all due diligence to prevent the commission of such offence.

(2) Notwithstanding anything contained in sub-section (1), where an offence under this Act has been committed by a company and it is proved that the offence has been committed with the consent or connivance of, or is attributable to any neglect on the part of, any director, manager, secretary or other officer of the company, such director, manager, secretary or other officer shall also deemed to be guilty of that offence and shall be liable to be proceeded against and punished accordingly.

Explanation--For the purpose of this section,--

(a) "company" means any body corporate and includes a firm or other association of individuals;

(b) "director", in relation to a firm, means a partner in the firm.

17. OFFENCES BY GOVERNMENT DEPARTMENTS

(1) Where an offence under this Act has been committed by any Department of Government, the Head of the Department shall be deemed to be guilty of the offence and shall be liable to be proceeded against and punished accordingly.

Provided that nothing contained in this section shall render such Head of the Department liable to any punishment if he proves that the offence was committed without his knowledge or that he exercise all due diligence to prevent the commission of such offence.

(2) Notwithstanding anything contained in sub-section (1), where an offence under this Act has been committed by a Department of Government and it is proved that the offence has been committed with the consent or connivance of, or is attributable to any neglect on the part of, any officer, other than the Head of the Department, such officer shall also be deemed to be guilty of that offence and shall be liable to be proceeded against and punished accordingly.

CHAPTER IV

MISCELLANEOUS

18. PROTECTION OF ACTION TAKEN IN GOOD FAITH

No suit, prosecution or other legal proceeding shall lie against the Government or any officer or other employee of the Government or any authority constituted under this Act or any member, officer or other employee of such authority in respect of anything which is done or intended to be done in good faith in pursuance of this Act or the rules made or orders or directions issued thereunder.

19. COGNIZANCE OF OFFENCES

No court shall take cognizance of any offence under this Act except on a complaint made by--

(a) the Central Government or any authority or officer authorised in this behalf by that Government,[20] or

(b) any person who has given notice of not less than sixty days, in the manner prescribed, of the alleged offence and of his intention to make a complaint, to the Central Government or the authority or officer
authorised as aforesaid.

20. INFORMATION, REPORTS OR RETURNS

The Central Government may, in relation to its function under this Act, from time to time, require any person, officer, State Government or other authority to furnish to it or any prescribed authority or officer any reports, returns, statistics, accounts and other information and such person, officer, State Government or other authority shall be bound to do so.

21. MEMBERS, OFFICERS AND EMPLOYEES OF THE AUTHORITY CONSTITUTED UNDER SECTION 3 TO BE PUBLIC SERVANTS

All the members of the authority, constituted, if any, under section 3 and all officers and other employees of such authority when acting or purporting to act in pursuance of any provisions of this Act or the rules made or orders or directions issued thereunder shall be deemed to be public servants within the meaning of section 21 of the Indian Penal Code (45 of 1860).

22. BAR OF JURISDICTION

No civil court shall have jurisdiction to entertain any suit or proceeding in respect of anything done, action taken or order or direction issued by the Central Government or any other authority or officer in pursuance of any power conferred by or in relation to its or his functions under this Act.

23. POWERS TO DELEGATE

Without prejudice to the provisions of sub-section (3) of section 3, the Central Government may, by notification in the Official Gazette, delegate, subject to such conditions and limitations as may be specified in the notifications, such of its powers and functions under this Act [except the powers to constitute an authority under sub-section

(3) of section 3 and to make rules under section 25] as it may deem necessary or expedient, to any officer, State Government or other authority.

24. EFFECT OF OTHER LAWS

(1) Subject to the provisions of sub-section (2), the provisions of this Act and the rules or orders made therein shall have effect notwithstanding anything inconsistent therewith contained in any enactment other than this Act.

(2) Where any act or omission constitutes an offence punishable under this Act and also under any other Act then the offender found guilty of such offence shall be liable to be punished under the other Act and not under this Act.

25. POWER TO MAKE RULES

(1) The Central Government may, by notification in the Official Gazette, make rules for carrying out the purposes of this Act.

(2) In particular, and without prejudice to the generality of the foregoing power, such rules may provide for all or any of the following matters, namely--

(a) the standards in excess of which environmental pollutants shall not be discharged or emitted under section 7;[21]

(b) the procedure in accordance with and the safeguards in compliance with which hazardous substances shall be handled or caused to be handled under section 8;[22]

(c) the authorities or agencies to which intimation of the fact of occurrence or apprehension of occurrence of the discharge of any environmental pollutant in excess of the prescribed standards shall be given and to whom all assistance shall be bound to be rendered under sub-section (1) of section 9;[23]

(d) the manner in which samples of air, water, soil or other substance for the purpose of analysis shall be taken under sub-section (1) of section 11;[24]

(e) the form in which notice of intention to have a sample analysed shall be served under clause (a) of sub section (3) of section 11;[25]

(f) the functions of the environmental laboratories,[26] the procedure for the submission to such laboratories of samples of air, water, soil and other substances for analysis or test;[27] the form of laboratory report; the fees payable for such report and other matters to enable such laboratories to carry out their functions under sub-section (2) of section 12;

(g) the qualifications of Government Analyst appointed or recognised for the purpose of analysis of samples of air, water, soil or other substances under section 13;[28]

(h) the manner in which notice of the offence and of the intention to make a complaint to the Central Government shall be given under clause (b) of section 19;[29]

(i) the authority of officer to whom any reports, returns, statistics, accounts and other information shall be furnished under section 20;

(j) any other matter which is required to be, or may be,prescribed.

26. RULES MADE UNDER THIS ACT TO BE LAID BEFORE PARLIAMENT

Every rule made under this Act shall be laid, as soon as may be after it is made, before each Hose of Parliament, while it is in session, for a total period of thirty days which may be comprised in one session or in two or more successive sessions, and if, before the expiry of the session immediately following the session or the successive sessions aforesaid, both Houses agree in making any modification in the rule or both Houses agree that the rule should not be made, the rule shall thereafter have effect only in such modified form or be of no effect, as the case may be; so, however, that any such modification or annulment shall be without prejudice to the validity of anything previously done under that rule.

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[1] It came into force in the whole of India on 19th November, 1986 vide Notification No. G.S.R. 1198(E) dated 12-11-86 published in the Gazette of India No. 525 dated 12-11-86.

[2] The Central Government has delegated the powers vested m it under section 5 of the - Act to the State Governments of Andhra Pradesh, Assam, Bihar, Gujarat, Haryana, Himachal Pradesh, Karnatalca, Kerala, Madhya Predesh, Mizoram, Orissa, Rajasthan, Sikkim and Tamil Nadu subject to the condition that the Central Government may revoke such delegation of Powers in respect of all or any one or more of the State Governments or may itself invoke the provisions of section 5 of the Act, if in the opinion of the Central Government such a course of action is necessary in public interest, (Notification No, S.O. 152 (E) dated 10-2-88 published in Gazette No. 54 of the same date). These Powers have been delegated to the following State Governments also on the same terms:

Meghalaya, Punjab and Uttar Pradesh vide Notification No. S.0.389 (E) dated 14-4-88 published in the Gazette No. 205 dated 144-88;

Maharashtra vide Notification No. S.O. 488(E) dated 17-5-88 published in the Gazette No. 255 dated 17-5-88;

Goa and Jammu & Kashmir vide Notification No. S.O. 881 (E~ dated 22-9-88; published in the Gazette No. 749 dated 2.9.88.

West Bengal Manipur vide Notificadon N. S.O. 408 (E) dated 6-6-89; published in the Gazette No. 319 dated 6-6-89;

Tripura vide Notification No. S.O. 479 (E) dated 25-7-91 published in thc Gazene No. 414 dated 25-7-91.

[3] For issuing directions see r.4 of Enviromnent (Protection) Rules, 1986.

[4] See r. 3 of Environment (Protection) Rules, 1986 and Schedules thereto.

i. Schedule I lists the standards for emission or discharge of environmental pollutants from the industries, processes or operations and their maximum allowable limits of concentration;

ii. Schedule II lists general standards for discharge of effluents and their maximum limits of concentration allowable;

iii. Schedule III lists ambient air quality standards in respect of noise and its maximum allowable limits; and

iv. Schedule IV lists standards for emission of smoke, vapour etc. from motor vehicles and maximum allowable limits of their emission.

[5] See r. 13 of Environment (Protection) Rules, 1986, and

i. Hazardous Wastes (Management and Handling) Rules, 1989;

ii. Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989; and

iii. Rules for the Manufacture, Use, Import, Export and Storage of Hazardous Micro organisms, Genetically-engineered organisms or Cells.

[6] Rule 13 SUPRA.

[7] See r. 5 of Environment (Protection) Rules, 1986.

[8] See r. 12 of Environment (Protection) Rules and Schedule 11, and relevant provisions of Hazardous Wastes (Management and Handling) Rules, Manufacture, Storage and Import of Hazardous Chemicals Rules and Rules for the Manufacture, Use, Import Export and Storage of hazardous Micro-organisms, Genetically Engineered Organisms or Cells.

[9] See r. 3 of Environment (Protection) Rules, 1486 and Schedule I.

[10] See r. 13 of Environment (Protection) Rules, 1986 and

i. Hazardous Wastes (Management and Handling) Rules, 1989;

ii. Manufacture, Storage and h7lporl of Hazardous Chemicals Rules, 1989; and

iii. Rules for the Manufacture, Use Import, Export and Storage of Hazardous Micro organisms, Genetically Engineered organisms or Cells.

[11] For authorities or agencies see r. 12 of Environment (Protection) Rules, 1986 and Schedule

[12] The Central Govt. has empowered 60 persons listed in the Table (p. 251) vide S.O. 83 (E) published in the Gazette of India No. 66 dated 16-2-87 and S.O. 63 (E) published in the Gazette of India No. 42 dated 18-1-88.

[13] In excercise of powers conferred under sub-section (i) of section 11 the Central Government has empowered 60 officers listed in the Table (p. 254) vide S.O. 84. (E) published in the Gazette No. 66 dated 16-2-87 and S.O. 62(E) published in the Gazette No. 42 dated 18-l-88.

[14] For procedure for taking samples see r. 6 of Environment (Protection) Rules, 1986, also.

[15] The Central Government has delegated its powers under clause (b) of sub-section (i) of section 12 and section 13 of the Act to the Central Pollution Control Board vide Notification No. S.O. 145 (E) dated 21-2-91 published in the Gazette No. 128 dated 27-2-91.

[16] The list of laboratories/institutes recognised as environmental laboratories: and the persons recognised as Govt. Analysts is given in the table (p. 223).

[17] See r. 9 of Environment (Protection) Rules, 1986.

[18] See r. 8 of Environment (Protection) Rules, 1986.

[19] For qualifications of Govt. Analyst see r. 10 of Environment (Protection) Rules, 1986.

[20] In exercise of powers conferred under clause (a)of section l9, the Central-Government has authorised the officers and authorities listed in the Table (p. 238) vide S.O. 394 (E) published in the Gazette No. 185 dated 164-87, S.O. 237(E) published in the Gazette No. 171 dated 29-3-89 and S.O. 656(E) dated 21-8-89 published in the Gazette No. 519 dated 21-8-89.

[21] See footnote 2 on Page 213.

[22] See footnote 3 on Page 213.

[23] See footnote I on Page 214.

[24] See r.6 of Environment (Protection) Rules, 1986.

[25] See r. 7 of Environment (Protection) Rules, 1986.

[26] See r. 9 of Environment (Protection) Rules, 1986.

[27] For the procedure for submission of samples to laboratories and the form of laboratory report see r. 8 of Environment (Protection) Rules, 1986.

[28] See r. 10 of Environment (Protection) Rules, 1986.

[29] See r. 11 of Environment (protection) Rules, 1986.

TECHNICAL ASSISTANCE COMPLETION REPORT

Division: SESS

TA No. and Name		Amount Approved: $790,000	
TA 3761-INO: Regulatory Framework for Private and Public Water Supply and Wastewater Enterprises		Revised Amount:	
Executing Agency:	**Source of Funding:**	**TA Amount Undisbursed**	**TA Amount Utilized**
Ministry of Settlements and Regional Infrastructure	ACCSF	$32,798	$757,202

Date			Completion Date	
Approval	**Signing**	**Fielding of Consultants**	**Original**	**Actual**
6 Nov. 2001	5 Feb. 2002	3 April 2002	31 March 2003	31 December 2003
			Closing Date	
			Original	**Actual**
			31 March 2003	31 March 2004

Description

Service provision of Indonesia's regional water supply enterprises (PDAMs) has increasingly deteriorated over the last few years due to the economic crisis, weak internal management, and a lack of support from regional legislative councils for needed tariff increases that makes rehabilitation and expansion of assets very difficult. At present, most of Indonesia's PDAMs are technically bankrupt, with operations continuing at a bare minimum of maintenance. Wastewater management has so far been separately handled by local governments on a non-cost recovery basis, but PDAMs are increasingly expected to assume greater responsibility for the wastewater subsector.

The situation of PDAMs has been aggravated further with the introduction of decentralization through laws 22 and 25 of 1999 and full implementation of the related administrative reform since January 2001 that devolved the responsibility for regional infrastructure provision to regional governments while at the same time significantly reducing direct central Government funding for regional infrastructure. Regional governments are acting as owner, operator, and regulator of these activities, which is creating an obvious conflict of interest. Efficient sector regulation to balance the interests of operators and consumers is increasingly seen as necessary, particularly as the sector is trying to attract more private sector investment, which requires transparent regulation, a level playing field, and a sound legal base for investment contracts.

Objectives and Scope

The objectives of the technical assistance (TA) were to (i) help develop and implement a regulatory framework, and (ii) establish a regulatory structure to facilitate credible, independent, autonomous, accountable, and transparent regulation for water supply and wastewater enterprises in Indonesia. The long-term goal of the TA was to promote good governance in the water supply and wastewater sector and to create enabling conditions for private sector participation (PSP).

The TA comprised three components: (i) analysis and development of a Water Supply Sector Policy Statement for Economic Regulation, (ii) selection of institutional options for regulation and preparation for implementation, and (iii) implementation of the regulatory framework and establishment of a regulatory body(ies). Component 1 involved an in-depth review and analysis of existing and draft laws, regulations, decrees, and policies related to the sector and present responsibilities for and effectiveness of regulation, and a review of international good practice in water sector regulation. Under component 2, institutional options for regulations were to be prepared based on stakeholder consultations to identify a preferred institutional option. Component 3 was to cover the preparation of guidelines for the establishment and operation of the regulator(s) and their duties, responsibilities, powers, and authorities. The design of the TA is generally rated as adequate.

Evaluation of Inputs

The TA provided for 39 person-months (pm) of consulting services, including 19 pm of international consultants and 20 pm of domestic consultants. Actual consultant input was 40.8 pm, including 19.8 pm of international consultants and 21 pm of domestic consultants, and was considered adequate. Overall, the consultant's performance is rated satisfactory, concurrent with the rating stated in the performance evaluation of the consulting firm.

The TA was to be executed by two directorates within the Ministry of Settlement and Regional Infrastructure (since October 2004: Ministry of Public Works), the Agency for Construction and Investment Development represented by the Center for Infrastructure Investment Development (CIID), and the Directorate General for Urban and Regional Development (DGURD). While CIID provided outstanding support and its performance was highly satisfactory, DGURD's performance was only partly satisfactory. CIID supported the TA team in terms of qualified counterpart staff and timely submission of documents and reviews, and liaised effectively with other ministries and legislative stakeholders to set up a regulatory framework for the sector. ADB's supervision of the TA consisted of one inception and three review missions with corresponding tri-partite meetings, and included participation in several stakeholder workshops and comprehensive reviews of reports produced by the TA. ADB's performance is rated satisfactory.

Evaluation of Outputs

The consultants prepared an inception report and an interim report on the Design of a Regulatory and Institutional Strategy under the first component, a Regulatory Framework Report and draft Regulatory Policy for Water Supply and Wastewater Services for the second component, a report on Organizational Functions and Structure of the National Regulatory Body for the third component, and a Final Summary Report. The quality of reports was generally very good, based on thorough analysis of best practices and extensive stakeholder involvement. Comments were readily addressed in revised versions of the reports.

Drawing on international experience and based on the work of the first component, five options for the establishment of a regulatory framework were identified and analyzed in the interim report. Analysis and extensive stakeholder consultations led to a two-tier option combining a national regulatory body and local regulatory functions, which was agreed upon with the Government as the best option to pursue. It recognizes the primary role of local governments in the provision and regulation of water services while establishing an overarching national regulatory framework to promote a consistent approach to transparent regulation throughout the country. Regulatory functions at the national and regional level were defined and discussed in detail with stakeholders to create a broad consensus.

It was decided after the interim workshops that the Water Resources Law (which was under consideration in the Parliament at the time of the TA and has since been passed as Law No.7/2004) was the best near-term option to establish a national regulatory body for the water supply sector as the law was expected to provide the best option to anchor the regulator body at the highest possible level. Details on the regulatory framework would then be set out in an implementing regulation (Government Regulation or 'PP', using its Indonesian acronym) and/or ministerial decree based on the law. CIID and the consultants spent considerable time with policy makers and key parliamentarians to successfully promote a better understanding of water-related regulatory issues, which materialized in terms of a clause on a national regulatory body in the new Water Resources Law. However, DGURD successfully lobbied for the body to be under the control of the Ministry, rather than reporting directly to the President as proposed by the TA. The related PP has not yet been drafted.

Overall Assessment and Rating

Overall, the TA is rated 'successful'. The TA was 'highly relevant' in terms of the topical relevance and the chosen approach to resolve prevailing issues. The TA was 'efficacious' in terms of its use of resources, allowing for slightly more person-months of consulting services than anticipated and producing a significant quantity of high quality outputs. The TA is considered 'partly effective' in terms of its impact on the EA, and 'partly sustainable' due to the last-minute deviation from the agreed-upon set up for the national regulatory body, which will impact on its ability to act independently from the line ministry. Interaction between the TA team and Government counterparts was fully satisfactory, with several ministries (the EA, BAPPENAS, and the Coordinating Ministry for Economic Affairs) indicating that they saw the TA approach—intensive and broad-based stakeholder involvement to clarify issues and strategies from the very beginning to the end—and resulting progress as a model for future TAs, in particular for those dealing with new policy issues.

Major Lessons Learned

While the TA design was adequate in terms of its sequencing, it was overambitious in trying to establish the regulatory framework and regulatory bodies within a period of 14 months. Water supply regulation is a new policy area in a sector mired with difficulties. Developing the legal framework, in particular the implementing regulation, will take some time and will require continuous awareness building activities. Misunderstanding the role of the regulator is widespread among policy makers and the general public. While international experiences provide a useful reference for how other countries have developed their regulatory structures, the approach adopted in a specific country must be tailored to its particular legal and political context. Further, lessons from Indonesia and from other countries (i.e., Sri Lanka) show that a champion is necessary to advance the agenda, both technically and politically and that the removal of such a champion can jeopardize the outcomes achieved.

Recommendations and Follow-Up Actions

Recommendations, reports, and materials produced by the TA are relevant and can be used by ADB and other development partners as cornerstones for a regulatory framework in the water sector. The draft policy and regulations developed under the TA are highly practical and offer up-to-date value. Additional TA would be required to undertake follow-up actions such as the implementation of the action plan as outlined in the Final Summary Report. Any follow-up would be conditional to a clear government commitment to follow through with the agenda as demonstrated by the preparation and approval of the relevant PP and/or ministerial decree.

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An Introduction to Chemically Enhanced Primary Treatment

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Introduction

Chemically Enhanced Primary Treatment (CEPT) is the process by which chemicals — typically metal salts — are added to primary sedimentation basins. The chemicals cause the suspended particles to clump together via the processes of coagulation and flocculation. The particle aggregates, or flocs, settle faster thereby enhancing treatment efficiency, measured as removal of solids, organic matter and nutrients from the wastewater. The chemicals utilized in CEPT are the same ones commonly added in potable water treatment (e. g. ferric chloride, aluminum sulfate), and there are practically no residual metals in the supernatant [Harleman and Murcott, 1992].

CEPT may be implemented using a dedicated "CEPT tank" (i. e. a settling tank specially designed for CEPT), or by retrofitting a conventional primary treatment facility, or stabilization ponds [Ødegaard *et al.*, 1987; Hanaeus, 1991a,b,c]. The later two incarnations of CEPT are relevant when upgrading overloaded or underdesigned existing systems [Harleman and Murcott, 1992]. CEPT has many important advantages over conventional treatment. It offers a cheaper, simpler and more efficient alternative to conventional primary treatment, as is discussed in the following sections. Most importantly, it is the least expensive wastewater treatment process in which the effluent can be effectively disinfected.

Financial Benefits of CEPT

CEPT allows the sedimentation basins to operate at twice the overflow rate of conventional primary treatment, while still maintaining a high removal rates of total suspended solids (TSS) and biochemical oxygen demand (BOD). Because of the removal of colloidal BOD, the increase in BOD removal by CEPT is usually larger than that of suspended solids. The treatment infrastructure can thus be smaller, and this directly reduces capital costs.

Additionally, CEPT provides the opportunity for either reducing the size of subsequent biological treatment units, or increasing the capacity of existing conventional treatment plants, such as activated sludge basins. The addition of metal salts will only require tanks for the chemicals and injection equipment. Table 1 presents data comparing the costs of primary treatment, secondary biological treatment, and chemically enhanced primary treatment.

Table 1: Treatment Cost Comparison

	Construction Costs[†] (US$M per m^3/s)	O&M Costs[‡] (US$M per year per m^3/s)
Primary Treatment (no disinfection)	1.5	0.2
CEPT & Disinfection	1.3	0.5
Primary & Activated Sludge & Disinfection	5.0	1.0

[†] Construction costs are based on the maximum plant flow capacity.
[‡] Operation and maintenance costs are based on the average yearly flow (assumed to be 1/2 the max. plant capacity)

CEPT costs are only marginally superior to those of conventional primary treatment, and only about half as much as secondary treatment. Yet, the removal efficiencies show CEPTs superiority, as discussed in the next section.

Efficiency of CEPT

Table 2 illustrates how CEPT enhances the removal of TSS and its associated BOD, through chemical coagulation and flocculation, followed by settling of the floc. The data, based on a survey of 100 wastewater treatment plants in the United States, show CEPTs superior efficiencies over conventional primary treatment. Moreover, when combined with the cost analysis presented in Table 1, it can be said that CEPT is highly competitive with biological secondary treatment.

CEPT is ideal for a coastal city since the removal of TSS is very high and the decrease in BOD is sufficient so as to not impact oxygen concentrations in the ocean. This is the case in two of the largest operating CEPT facilities in the world (San Diego and Hong Kong). Hong Kong's Stone Cutter's Island plant also benefits from increased performance due to seawater addition [Harleman *et al.*, 1997]. CEPT is also appropriate for in-land wastewater facilities, and is utilized for phosphorus removal by a number of facilities discharging their

effluent into the Great Lakes [Harleman and Murcott, 1992]. Indeed, while biological secondary treatment removes TSS and BOD at a very high efficiency, it does not effectively remove phosphorus and produces nitrates [Harleman and Morrissey, 1992].

Finally, in developing countries, the primary objective of any sanitation system should be disinfection, due to the high levels of morbidity incurred by water-borne illnesses. CEPT is the least expensive method of treatment in which the effluent can be appropriately disinfected [Harleman and Murcott, 2001b,a].

Table 2: Comparison of Removal Efficiencies [National Research Council, 1992]

	TSS (%)	BOD (%)
Conventional Primary Treatment	55	35
Conventional Primary + Biological Secondary Treatment	91	85
Chemically Enhanced Primary Treatment	85	57

Ease of Implementation

A conventional primary treatment process consists of bar screens, a grit chamber, and a settling tank (or primary clarifier) (see Figure 1). To upgrade a conventional primary treatment facility to a CEPT facility, all that is needed is the addition of a chemical coagulant (and optionally a flocculent) as shown in Figure 1. With CEPTs high surface overflow rate, the sedimentation basins will not need to be large when compared to conventional primary sedimentation basins [Harleman *et al.*, 1997].

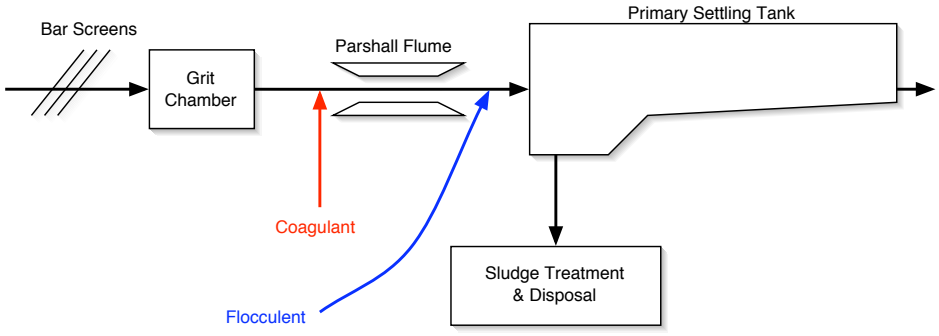

Figure 1: Schematic of Conventional Primary Treatment and CEPT (The addition of a flocculent in the form of organic polymers is optional.)

Conclusion

CEPT is an efficient, cost-effective and easily implemented wastewater treatment technology. The addition of chemical coagulants and/or polyelectrolytes allows for the increased removal of phosphorus, suspended solids and its associated biochemical oxygen demand. The increased removal efficiencies allow for the design of smaller basins and greater overflow rates.

CEPT has been used for over one hundred years, yet it is not as commonly found as would be expected upon analysis of its performance. The misconception is that CEPT dramatically increased sludge production. However, CEPT is used today with a minimal coagulant dosage (10 — 50 mg/L), and the chemicals themselves make only a slight contribution to the total sludge production. The greatest portion of the increase of sludge production is due to the increased solids removal in the settling tank. And that is precisely CEPT's goal.

CEPT treatment does not preclude secondary or tertiary treatment. It makes any subsequent treatment smaller and less costly due to the increased efficiency. CEPT is a relatively simple technology providing a low-cost and effective treatment, which is easily implemented over existing infrastructure [Harleman and Murcott, 1992, 2001b,a].

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Sustainable Technologies for on-site human waste and waste water management: Sulabh Experience

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Sanitation has become a yardstick of socio-cultural development of a nation. Improved sanitation results in improvement of health, reduced child mortality/morbidity, improved water quality, environment and economic growth of a country. Continued urban migration, congregation of urban poor in slums without safe water supply and sanitation facilities and increasing resource constraints have all led to rapid deterioration in quality of life and community health in many developing countries which are likely to become further aggravated unless steps are initiated to improve sanitation through inter- sectoral co-ordination, people's participation, innovative and appropriate technology for safe management of human wastes and waste water treatment. Epidemiological evidence suggests that sanitation is at least if not more as effective in preventing disease as improved water supply.

Sanitation coverage in South Asian countries is far below levels of satisfaction[1-2]. Most of the uncovered people are from lower socio-economic groups and are not aware of the health and environmental benefits of sanitation. It is still not seen as a high priority, resulting in absence of people's participation. Sanitation is regarded as a matter of individual initiative and not as a collective obligation of the community.

The grossly inadequate progress in the sanitation sector is primarily due to the following factors:

i. Lack of political will and administrative support for the sanitation programmes.
ii. Insufficient awareness/ motivation among the people, particularly those in the rural areas, about the need of sanitation and its health consequences.
iii. Lack of affordable sanitation technology
iv. Health sector's least involvement and lack of adequate advocacy on its part.
v. Failure to develop a demand-driven approach with adequate participation of the people at the grassroots level.
vi. Lack of professional marketing strategy.

For decades, the sanitation programme in developing countries has been conceptualized as supply-driven, government promoted and government controlled programme. It needs to be converted into a demand-driven, people-centered, and community-led programme.

In promoting hygiene and sanitation, one is often confronted with the apparent contradictions of the situation. It is often observed in India that the health issues related to sanitation are not appreciated by the community adequately. As a result, sanitation is not a felt-need of the community. It is often observed among the rural community, that a person with financial resources often buys a T.V. set, rather than building a latrine. This misplaced priority is primarily due to our failure to communicate the health message effectively and convincingly. If a mother could be made aware and convinced of the risks to her children associated with unsanitary disposal of human excreta, the family would certainly provide higher priority to having a sanitary latrine.

It is most important to create political will for the sanitation agenda in any country. A well-informed and educated community would create the necessary environment for the same.

Sulabh is implementing two technologies on sanitation - one for household waste disposal through two pit pour flush toilets and another for public places and slums through public toilets linked with a biogas plant & effluent treatment system for the complete recycling and reuse of human wastes. These technologies with their social and financial aspects are described below.

1. Two pit pour flush toilet

The Two pit pour flush toilet, popularly known in India as Sulabh Toilet, is technically appropriate, socio-culturally acceptable and economically affordable technology for house hold waste disposal. The toilet can easily be constructed by local labourers and materials. It requires only 1.5 to 2 liters of water for flushing and thus conserves water and does not need the services of scavengers to clean the pits. There are two pits which are alternately used. The capacity of each pit is kept generally for 3 years. Both the pits are alternately used. When one pit is full, excreta is diverted to the second pit. In about two years rest period, the sludge in the first pit gets digested and is almost dry, and pathogen free, that can easily be dug out by the beneficiaries and used as manure. The technology has been highlighted by the UNDP[3].

Based on this technology, Sulabh launched a progamme of converting dry latrines (cleaned by scavengers) into Sulabh toilets and construction of new toilets where they did not exist earlier. Over1.2 million such toilets have been implemented by the organization so far in different states of India. Owing to this technology, Sulabh has been able to liberate over sixty thousands of scavengers[*].

Cost of Sulabh flush toilet: The cost of a Sulabh flush composting toilet varies widely to suit people of every economic stratum. It ranges from US$ 25 to US$ 1000 per unit depending upon materials for construction of pits and seat as well as of superstructure. The pit can be constructed with bricks or any locally available material like stones, wood logs, burnt clay rings, or even used coal tar drums. Similarly, the quality of superstructure also ranges from simple gunny bag sheet or thatch to brick walls with tiles and R.C.C. roof, doors, etc. Cost varies also due to size and capacity of each pit that vary from 3 years to 20 years capacity. Keeping the basic design the same, Sulabh has demonstrated a number of such toilet models.

Vocational Training to Liberated scavengers: Sulabh is providing vocational training in different trades like tailoring, dress designing, computer, audio-visual, motor driving, electrician, beautician etc., to liberated scavengers[4]. The courses are approved by the Government Body. The aim of such programme is to make them self sustaining and check their reverting to the old practices.

Social Marketing and Delivery: Sulabh workers make house-to-house contact to educate and motivate the householders and disseminate information about the technology and programme contents. Once they agree, Sulabh undertakes the responsibility to construct the toilets to the entire satisfaction of the householders involving them fully in the process. Sulabh has set up a special cell to monitor the quality and satisfaction of the latrine adopters.

Women's Participation: Much of the demand for latrines comes from women as they are the worst sufferers due to non-availability of these facilities. Women have by far the most important influence in determining household hygiene practices and in forming habits of their children. So Sulabh plans the facilities with full awareness of their perceptions and needs.

Training: Although low-cost technology is easy to implement, yet it requires all the ingenuity and expertise for precision in construction and competence in supervision to guard against

[*] Scavengers are a class of people of lowest socio-economic status who manually clean human wastes from bucket privies of others for livelihood. There are still over 800,000 such persons in different states of India.

faulty construction and pollution of ground water. It, therefore, calls for mounting a well-planned training programme for the personnel involved in the implementation of sanitation projects.

2. Sulabh Public Toilet Complexes

Provision of public toilet complexes at public places and in slums on "pay & use" basis is an important activity of Sulabh in the field of community health & hygiene and environmental sanitation. Our experience revealed that when facilities for bathing are also provided with the community toilets, and above all they are kept clean, people have no hesitation in paying for the use. For washing hands, soap powder is provided to users. User charge is Rs. one (2 US Cent) per use. Children are exempted from such charge.

Sulabh has constructed so far over 6000 such public toilet complexes in different parts of the country, where maintenance is provided round the clock. These complexes are located at public places like bus stands, hospitals, markets etc. and in the slums. For the construction, operation, and maintenance of these complexes, the organization plays the role of a catalyst and a partner between the official agencies and the users of the toilet complexes.

The system of operation and maintenance of community toilets evolved by Sulabh has proved a boon for the local bodies in their endeavour to keep the towns clean and improve the environment. This is a unique example of partnership of local authorities, non-governmental organization, and the community.

Public Toilet Complexes in Delhi - a case study: In Delhi, Sulabh is maintaining 220 public toilet complexes since early 90s. There are additionally 1743 public toilets maintained either by the Delhi Municipal Corporation (MCD) or other NGOs of whom several toilet complexes were closed due to their bad shape or other reasons. Maintenance of rest of the toilet complexes were also far from satisfaction. Taking into consideration the maintenance quality of Sulabh Public Toilets, the MCD recently decided to hand over all the public toilet complexes to Sulabh for their maintenance. So far 960 such complexes have already been handed over and rest is in process.

Public Private Partnership in quality service delivery: The sustainable and affordable technologies developed by the organization have attracted various agencies towards management of human wastes. The 'pay & use' basis of maintaining a public toilet is saving annually a lot of money to the local bodies in maintaining the toilet complexes. Now, it is one time investment by the local government because maintenance of the toilet is being carried out by the user's contribution. As Sulabh is taking maintenance guarantee of the toilet complexes built by it for not less than 30 years, local governments as well as people have faith in the quality service by the Sulabh.

Financial viability of the projects: Since human excreta were considered a hated object, it was difficult for any one to consider financial viability of a project related to its disposal. However, Sulabh made it financially viable. The cost of construction is met by the local body. The maintenance of toilet blocks and day-to-day expenses is met from the user's charges. Sulabh does not depend on external agencies for finances and meets all the financial obligations through internal resources. All the toilet complexes are not self-sustaining particularly those located in slums and less developed areas. The maintenance of such toilet complexes is cross-subsidized from the income generated from toilet complexes in busy and developed areas.

Elimination of social stigma and psychological taboos: Earlier there was social stigma and psychological taboo attached to handling of human excreta. It was also due to the fact that only people of lowest economic strata were supposed to be associated with this job. Due to financial

viability now, people from higher social status are also engaged in the construction and maintenance of toilets.

Employment opportunity: Altogether there are 50,000 volunteers working with Sulabh who include technocrats, managerial, scientists, engineers, social scientists, doctors, architects, planners, masons and other non-revenue staff. Since Sulabh takes 30 years maintenance guarantee for the toilet complexes constructed by it, all the social workers associated with this work get almost regular employment. Besides, workers associated with construction job also get almost full employment.

2.1 Community Toilets Linked with Biogas Plants

Safe disposal of human excreta from public toilets is a major challenge particularly in unsewered areas. Normally septic tank system is attached with public toilets. The effluent from such tanks containing high Biochemical Oxygen Demand (BOD) and pathogen contents are discharged in nearby open/covered drains that finally lead to low land area/ nearby river causing severe water pollution and health hazards.

To overcome the problems Sulabh developed an efficient design of biogas plant linked with public toilets[5] under a project funded by the Ministry of Non-Conventional Energy Sources, Government of India that approved the design for implementation under its Central Financial Scheme[6]. Under the system only human excreta with flush water is allowed to flow into biogas plant for anaerobic digestion. Bathing and cloth washing water is collected separately that is reused after sand filtration or discharged in drain after settlements. For biogas generation no manual handling of excreta at any stage is required. Hydraulic Retention Time (HRT) of feed material is maintained for 30 days. One cubic foot (cft) of biogas is produced from the human excreta of one person per day. Human excreta based biogas contains 65-66% methane, 32-34% carbon oxide about 1% hydrogen sulphide and trace amounts of nitrogen oxide and ammonia. Biogas is stored inside plant through liquid displacement chamber. Biogas plant is made up of Reinforcement Concrete Cement (R.C.C.); therefore, no recurring expenditure is required for its maintenance.

Produced biogas is used for cooking, lighting though mantle lamps, and electricity generation. Cooking is the most convenient use of biogas. Biogas burner at reasonable price is available in the market that consumes about 25 cft of biogas per hour. Mantle consumes 2-3 cft biogas per hour that gives illumination equivalent to 40 watt bulb at 220 volt. Electricity generation is through dual fuel engine coupled with alternator that runs on 80% biogas and 20% diesel. Consumption of biogas is 15cft/BHP/hr. Based on `Sulabh Model' design, 140 number of biogas plants of 35 to 60 cum per day gas production capacity have been constructed by Sulabh in different states of the country so far.

2.2 BET (Biogas plant Effluent Treatment) System for reuse of effluent

During biogas generation there is remarkable reduction (up to 85%) of BOD of effluent of biogas plant in comparison to its affluent value. In absolute term the BOD of effluent is around 125 mg/l. Similarly, pathogen count is still higher than the permissible limit of discharge in any water body. Such effluent contains good percentage of nitrogen, potash, phosphate and other micronutrients for plants, but its aesthetically bad odour, yellowish colour, high BOD and pathogen contents limit its reuse for agriculture/horticulture or safe discharge in water body.

In a public toilet linked with biogas plant, used by 1000 users per day, maximum 5000 lts of waste water is generated per day. For a continuous flow from the treatment system a flow rate of 5-6 LPM (Liter Per Minute) will solve the purpose.

After a series of experiments under a R&D project[7] funded by the MNES, the author has developed a simple and convenient technology named as BET (Biogas plant Effluent Treatment) to treat such effluent. The technology is based on sedimentation and filtration of effluent through sand and activated charcoal followed by ultraviolet rays. The system consists of an overhead sedimentation tank of 2000 lts capacity with bottom conical shape fitted with valve. Effluent from outlet chamber of biogas plant is lifted to this tank and left for one and half hours to settle. It is passed through the sand filter column through Liquid Flow Meter at the rate of 6 LPM. From sand column it flows upward through an activated carbon column where carbon contact time is maintained for 5-6 minutes. Sand and carbon columns are made up of mild steel. From carbon column effluent passes through a U-V channel where retention time is kept for 30 seconds that helps eliminate bacteria and other pathogens. The treated effluent is colourless, odourless, pathogen free having BOD less than 10mg/l-quite safe for aquaculture, agriculture/horticulture purposes or discharge into any water body without causing pollution. It can also be used for floor cleaning of public toilets in water scarcity areas.

Recurring expenditure: The system requires 1 H.P. of electric motor to lift effluent to the overhead tank for maximum 3 hours a day i.e., 2.5 units of power a day is required. For operation of 3 nos. of UV (15 watts each) about one unit of power will be consumed per day. Such low consumption of electricity can easily be obtained through biogas. Expenditure incurred on the periodical replacement of activated carbon is very low that can easily out of the user's charges of the toilet complex.

One such system is under operation with a Sulabh public toilet complex with 13 WCs. (8 for gents and 5 for ladies) at Mahavir Enclave, New Delhi which is being used by around 600 users per day. Produced biogas is being used for cooking in a kitchen, lighting mantle lamps inside toilet complex and electricity generation. Treated effluent is being used for irrigating the lawn and horticulture.
Based on this new technology 3 Nos. of plants have been implemented in Ranchi – the capital town of Jharkhand State where there is no sewer system and disposal of waste from public toilets is a major challenge. One such toilet complex at Birsa Chowk with 20 WCs (12 for gents and 8 for ladies) is used by over 700 users a day. Produced biogas is being used for cooking, lighting, and electricity generation. A part of the treated effluent from public toilet linked biogas plant is being used for cleaning of floors of public toilet. Rest of it is discharged in the drain. 35 Nos. of public toilets are being implemented in the State with BET technology.

Implementation of two public toilets with such system in Kabul, Afghanistan is under way, on the invitation of the Government of Afghanistan and with the financial support from the Government of India (official communication). Since the area is completely unsewered with severe water scarcity and people use water for ablution, such technology will help a lot in conservation of water and maintaining good sanitation and public toilets clean.

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Problems of Drinking Water Quality in Kyrgyzstan: Ecological and Legal Aspects

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Kyrgyzstan has significant resources of above ground and undergroundwater. The large stocks are in the rivers (the number of rivers is more than 3,5 thousand), eternal glaciers and snow massives. The most big river in Kyrgyzstan is Naryn. Another big rivers are Karadarya, Chu, Talas, Sary-Jaz and Kyzyl-Suu.
The main stocks of Syrdarya and Amudarya rivers which fall into the Aral Sea are formed in the territory of Kyrgyzstan.

The major water basins in Kyrgyzstan are Amudarya, Syrdarya, Chu, Talas and Sary-Jaz.
The rivers of Kyrgyzstan provide water to 5 countries: Uzbekistan (Naryn, Karadarya), Kazakhstan (Chu, Talas), Tadjikistan (Kyzyl-Suu), Turkmenistan (Kyzyl-Suu) and China (Sary-Jaz, Ak-Sai).

According to agreement between Central Asia countries Kyrgyzstan can use 24% of water from the whole volume of river stocks. The Republic uses only 12-17% from these available stocks. The main volume of water is used for irrigation and the significant part (about 23%) of taken away water is lost at use. The rest of the river water flows out of the Republic.

1. Problem of Drinking Water Quality

1.1. Pollution of ground and underground waters

At present, water resources of Kyrgyzstan are in a critical condition. Ecosystems, people and economic development, which directly depend on these resources, may face a worsening situation in the future. The open water reservoirs and groundwater in the territory of Kyrgyzstan were polluted as a result of unsatisfactory storage, processing, utilization of industrial and household wastes, low culture of agricultural manufacture.

According to the data of the Ministry of Ecology and Emergency Situations of the Kyrgyz Republic, the water basins Chu and Syrdaria are the most polluted.

The chemical structure of water in these rivers influenced by the polluted wastewater of industry and agriculture, water from fields sated with disintegrating mineral fertilizers and poisons and economic activity of the population. The rivers have markedly increased contents of nitrogen, copper, zinc, petroleum, organic and other harmful substances, as well as residual quantities of poisonous matter. Similar pollution is found in the basin of Issyk Kul Lake.

Serious dangers exist in numerous dams and waste tailings of the mining enterprises, which store radioactive substances, heavy metals and cyanides. They are located, as a rule, in intermountain hollows and basins of the rivers. With activization recently of the technogenic catastrophic phenomena connected with floods, earthquakes, landslides and erosion, the threat of pollution of above ground and undergroundwater grows. Another problem is infiltration into water sources of organic wastes, salts of heavy metals, petroleum, phenols and other harmful substances.

More than 90% of wastewater is dumped directly in streams, open ditches, rivers, lakes and coastal waters of reservoirs without preliminary cleaning. In the rivers of Asia, there

are 50 times more bacteria than in the rivers of industrial and advanced countries. The pollution of water by organic substances and solid particles is the most serious problem in Central Asia.

As a result of nitrogen pollution of groundwater of Ala-Archa reservoir that is used for water supply for Bishkek city, the city had to cease using the groundwater for drinking purposes up to depth of 100-150 meters in an area of about 25 km^2 in the central, western and southwest parts of capital.

1.2. Drinking Water Supply

In Kyrgyzstan almost 90% of all drinking water, and also the most part of water for industrial use, is provided with groundwater. Nevertheless, in a number of regions of the Kyrgyz Republic, the problem of drinking water supply is in crisis.

Average consumption of drinking water from the centralized systems is 60-150 liters per day for 1 person.

More than one half of village populations, which compose 63% of the population of the Republic, consume contaminated water. Among the 1012 existing waterpipes: 217 (21.4 %) – do not have a zone of sanitary protection, 35 – do not have a necessary complex of cleaning. Disinfection is not done on 121 waterpipes of drinking water and 40% require overhaul.

Now, 83.7% of the population of the Republic is provided with drinking water from the centralized systems, including 76.8 % of the inhabitants of villages. About 786,000 people, which live in 608 villages, do not have access to clean sources of drinking water and use water from a network of irrigation channels and rivers.

To change this situation, the Asian Development Bank has provided the credit of US$ 36 million for restoration and construction of waterpipes in 730 villages and 7 cities of Chui, Osh, Jalalabat and Batken areas for 2002-2007.

The project «Village water supply and sanitation», at a total cost US$ 24.5 million under the credit of the World Bank for the period of 2002-2007 years, also has the basic purpose of restoring and constructing village waterpipes in 270 villages of Issyk Kul, Naryn and Talas areas.

1.3. Influence of drinking water quality on health of the population

A significant number of research projects have confirmed the influence of drinking water quality on health. The use of non-quality water has increased the number of diseases in different areas of Kyrgyzstan.

The infectious pathology is widely distributed among the population of Kyrgyz Republic. The annual index of this pathology is 23-35% from the number of general diseases of the population. The conditions of the transition period beginning after the disorganization of the USSR and difficult social and economic situation complicate the challenges in reducing the level of infectious diseases. About 227,682 infectious diseases were registered in 2002 in the Republic. These diseases result in death at the rate of 5-10% among infected adults and 30% among children of an early age.

The Kyrgyz Republic is especially concerned about the virus of hepatitis and typhoid fever in endemic territories. For the period 1997-2002, the Republic experienced 1611 cases of typhoid fever connected with the use of contaminated water. According to the estimations,

the republic annually loses value of abpotu US $125 million as a result of treatment of illnesses that are connected with use of contaminated water.

Kyrgyzstan is known in the world as one of the iodine deficit regions. The geographical position corresponds to the greatest risk of lack of iodine in biosphere - 90% of territories occupy mountains that are considerably distant from the seas and oceans. Iodine insufficiency is stable and is characterized by its low natural contents in soil and water and accordingly in foodstuff. For the last 10 years, diseases caused by iodine deficiency have increased 40 times, especial among children. the Repubnlic had developed the law "About preventive maintenance iodine deficit diseases" (2000) and developed programs to reduce these diseases.

2. Legal Regulation of Drinking Water Quality

2.1. Legislative base on drinking water

The state authorities in Kyrgyzstan are not give due attention to problems of water regulation which is connected with some objective reasons. The effective decision of water problems, certainly, should based on good normative legal base.

With acceptance of sovereignty in Kyrgyzstan, the process of forming national laws has begun, which at the present stage is directed on construction of a lawful state. The adaptation to new conditions requires conformity with the international norms.

On July 27, 1996, the government of Kyrgyz Republic accepted the Decision № 338 "About urgent measures on improvement of water supply of the village population of Kyrgyz Republic by qualitative drinking water". This decision had practically no force. As we found out, a new extended legal basis on drinking water as a whole was necessary.
There is a certain national strategy on water resources, but it is laregely ignores the state, regional and local levels.

In 1997, the Government of Kyrgyz Republic organized an interbranch technical committee, МТК-509 "Quality superficial, underground, waste water", to develop a new law about drinking water.

2.2. Law of Kyrgyz Republic “About drinking water ".

In 1999, the legislative assembly of the Parliament of Kyrgyz Republic accepted the new law "About drinking water". This law stipulates the basic concepts about water, the functional duties of all departments participating in its preparation, competence of all bodies of authority and allocates responsibility for offences.

However, questions of perfecting the control of drinking water quality according to the requirements of the standards, sanitary norms and rules are practically not mentioned in this law. In addition, many sections in clauses are “addressless”, i.e., it is not clear who is responsible for execution and the mechanisms of execution of the laws is not registered. Clauses on certification and offence are addressed by the general legislation of Kyrgyzstan.

2.3. Normative Requirementsfor Drinking Water Quality

Now, in many regions, the problem of drinking water supply of the population of Kyrgyzstan in many regions has a catastrophic character. The situation is aggravated not only by consumption of unsafe drinking water by the population, but also by its insufficient

quantity, in spite of the fact that Kyrgyzstan has huge resources of ground and surface waters.

Systematic study, research and monitoring of groundwater resources were carried out earlier by 800 observation posts but now only 75% of them work. The situation was created by centralized maintenance of drinking water facilities and is appreciably aggravated by the economic crisis in Kyrgyzstan.

With the purposes of improvement of supplying the population with quality drinking water, the Government of Kyrgyz Republic accepted the Decision № 338 in July 24, 1996: "About urgent measures on improvement of water supply of the village population of Kyrgyz Republic by qualitative drinking water". According to this Decision, the State Committee for Metrology and Standardization and other authorized bodies were entrusted to develop the National Program "Drinking water".

The establishment of the normative requirements is carried out now on international and national levels. The main international documents that influence the development ofo urlawas are "Management on quality surveillance of drinking water", developed by the World Health Organization and "Instruction on drinking water" of the European Community № 80/778/EC.

In Kyrgyzstan, drinking water quality stanbdards cover hygienic requirements, control of quality, sources of the centralized irrigation and drinking water supply, hygienic and technical requirements, sanitary rules and protection of groundwater from pollution.

Now the relations in the field of irrigation, drinking water supply and maintenance of quality of drinking water are based on the appropriate rules of the Constitution and laws of the Kyrgyz Republic "About water", "About drinking water", "About protection of the rights of the consumers", "About standardization", "About certification of production and services", "About maintenance of unity of measurements ".

2.4. Normative acts and requirements of the standards

The works on standardization, metrology and certification are based now on a strong legal basis. The State Committee for Metrology and Standardization is mainly responsible for creation of the legal, economic, organizational and maintenance mechanisms. 84 standards have been developed for managing the documents of state systems, standardization, metrology and certification. These have also been harmonized with the international standards.

The tasks of the State Committee for Metrology and Standardization concern improvement of drinking water supply and quality in accordance with world practice. These tasks cover not only preparation of necessary legislation and metrological maintenance, but also creation of an effective system of certification in the sphere of drinking water supply. The system of certification provides the all-round control of performance requirements guaranteeing safety of drinking water and its conformity to the sanitary, hygienic specifications.

The basic contaminants of drinking water of the centralized systems of water supply are metals, products of corrosion, salt structure, viruses, activators of parasitic diseases, combinations formed during water treatment by chlorine, etc. As a whole it is necessary to carry out about 70 measurements of various parameters to guarantee safety of drinking water under the European standards.

For example, the Ministry of Ecology and Emergency Situations of Kyrgyz Republic, which is responsible for quality of groundwater, carries out regular measurements only in the 4 largest cities (Bishkek, Osh, Jalalabat, Karakol) on 20-25 parameters. The measurements of water quality will be carried out only on 20 parameters, i.e. actually only a third of the European parameters.

The Department of Sanitary Control of the Ministry of Public Health of the Kyrgyz Republic regularly carries out control of drinking water quality in all regional centres of Republic. This control of water is carried out on 20-25 of parameters for groundwater sources, open reservoirs, waterpipe network and other drinking water sources.

Thus, as already noted above, in Kyrgyzstan only a third of the European parameters of drinking water quality are used.

3. On a problem on perfection of the water legislation

The existing legislative base in the water sector insufficiently supports protection of waters, both surface and groundwater.

The basic law in the field of the water relations is the Law "About water". The exact definitions of the purposes and tasks concerning quality of water in the law are absent. The law "About drinking water" does not contain the concrete purposes and tasks connected with norms of quantity and quality of water. The laws do not provide for protection of grou wates from pollution.

The Law "About water" provides for protection of water bodies, but it does not define the concrete responsibility for quality of water. It does not provide for compensation of damages to water resources.

Imperfection in the basic legislation in the water sector means that it is vitally necessary to develop supplementary laws. The basic legislative reforms needed are:

a.) *The ratification of the new legislation,* that automatically will change old supplementary law acts and conduct to develop new ones;
b.) *The unification of the normative acts*, that accordingly means the reduction of their number);
c.) Reconsideration of the requirements for licensing and sanctions.

4. Recommendations for water sector

For decision problems in water sector it is necessary to realize a complex measures to reduce dumping of polluted waste water in water bodies is. It is necessary to strictly regulate water protection zones, coastal strips and drainage waters. It is also necessary to decrease specific water use in agriculture by reconstructing irrigation systems, introducing progressive technologies (a half-willow and turnaround water supply), and also automating control systems of managenemt of water resources.

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Municipal Solid Waste Management in India: Present Practices and Future Challenge

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1.0 Introduction

Urbanization is now becoming a global phenomenon, but its ramifications are more pronounced in developing countries. Natural growth of population, reclassifications of habitation and migration trends are important in urban population in India. The population of urban India was 285 million as per 2001 census, which accounts for 27 per percent of the total population. Global experience shows that when a country's urban population reaches almost 25% of the overall population (as in the case of India), the pace of urbanization accelerates (Kumar and Gaikwad, 2004).

Due to rapid urbanization and uncontrolled growth rate of population, SWM has become acute in India. SWM services are rendered by municipal bodies in India. Though, it is an essential service, it is not attaining proper priority, which it deserves and services are poor. NEERI has provided extensive services to municipal bodies in India to improve their MSWM system.

The present paper aims to outline the existing situation of SWMS, problems associated with the system and also highlights some best practices and lessons learnt by NEERI's experience along with EXNORA's Zero Waste Management in two South Indian cities. An approach for design of sustainable SWMS compatible to Indian situations is also detailed.

2.0 Situation Analysis

MSWM is a part of public health and sanitation, and is entrusted to the municipal government for execution. Presently, the systems are assuming larger importance due to population explosion in municipal areas, legal intervention, emergence of newer technologies and rising public awareness towards cleanliness (Kumar *et al.*, 2004).

Except in the metropolitan cities, SWM is the responsibility of a health officer who is assisted by the engineering department in the transportation work. The activity is mostly labour intensive, and 2-3 workers are provided per 1000 residents served. The municipal agencies spend 5-25% of their budget on SWM, which is Rs. 75-250 per capita per year (Kumar and Gaikwad, 2004)**.** Normally a city of 1 million populations spends around Rs. 10 crores for this activity. In spite of this huge expenditure, services are not provided to the desired level.

Quantity and characteristics are two major factors, which are considered as the basis for the design of efficient, cost effective and environmentally compatible waste management system. The municipal corporation often depends on the vehicle trips record to estimate the waste quantity. This does not give the actual picture of waste generation. NEERI has conducted extensive studies on quantum of waste generation in various cities. Studies have revealed that quantum of waste generation varies between 0.2-0.4 kg/capita/day in the urban centers and it goes up to 0.5 kg/capita/day in metropolitan

cities. Per capita waste quantity for various cities with different population is presented in Table 1.The physico-chemical characteristics of MSW in Indian Cities are presented in Table 2.

Characterization studies carried out by NEERI (1996) indicate that MSW contains large organic fraction (30-40%), ash and fine earth (30-40%), paper (3-6%) along with plastic glass and metal (each less than 1%), calorific value of refuse ranges between 800-1000 kcal/kg and C/N ratio ranges between 20 and 30. Presently, NEERI has again been retained by Central Pollution Control Board (CPCB), New Delhi in quantification and characterization of MSW in metro, class I & class II cities and towns to know the actual quantities as well as characteristics of solid wastes in designing MSWM system. The study would be completed in October 2005. Community bin collection system is usually practiced in India.

The collection bin and implements used in various cities are not properly designed. It has been observed that community bins have not been installed at proper location. This has resulted in poor collection efficiency. Lack of public awareness has made the situation worse. Various types of vehicles are used for transportation of waste to the disposal site. However, these vehicles are not designed as per requirement. In many urban centers, proper garages are not provided for the vehicles for protection from heat and rain. Preventive maintenance system is not adopted and as a result the life of the vehicle is reduced. Many of the vehicles used for transportation of waste have outlived their normal life.

Manual composting is carried out in smaller urban centres. Although in 1980's mechanical composting plants were set up in 10 cities, presently, only one plant out of them continues to be in operation. Over the years, a few more plants have been set up. Incineration has not been successful due to the low calorific value of the solid waste. Waste is disposed of in low-lying areas without taking any precautions and without any operational control. Solid waste workers handle the waste without any protective equipment and are prone to infection.

3.0 Future Scenario

The urban population of 285 million is concentrated in a few large cities and 32 metropolitan cities are accounting for 34.5 percent of the urban population that is expected to reach 341 million by 2010 (census of India, 2001). The waste quantities are estimated to increase from 46 million tonnes in 2001 to 65 million tonnes in 2010 (Kumar and Gaikwad, 2004).

The waste characteristics are expected to change due to urbanization, increased commercialization and standard of living. The present trend indicates that the paper and plastics content will increase while the organic content will decrease. The ash and earth content is also expected to decrease mainly due to an increase in the paved surface. Although, the organic content is expected to decrease, the material will still be amenable to biodegradation and the calorific value will continue to be unsuitable for incineration.

In keeping with the present practices and estimates of waste generation, around 90% of the generated wastes are landfilled requiring around 1200 hectare of land every year with an average depth of 3 m. Due to rapid urbanization, prevailing land use regulation and completing demands for available land, it is desirable that adequate land be earmarked at the planning stage itself for solid waste disposal. The larger quantities of solid waste and higher degree of urbanization will necessitate better management involving a higher level of expenditure on manpower and equipment.

4.0 Problems Associated with the System

SWM systems exist in most of the urban centres since last few decades. However, these systems have yet to emerge as a well-organized practice. Although, the solid waste characteristics in different

urban centers vary significantly, there is a meager effort to tailor the system configuration to the waste characteristics. The major deficiencies associated with the system are described in the following sections (Kumar and Gaikwad, 2004).

Rapidly Increasing Areas to be Served and Quantity of Waste

The solid waste quantities generated in urban centres are increasing due to rise in the population and increase in the per capita waste generation rate. The increasing solid waste quantities and the areas to be served strain the existing SWM system.

Inadequate Resources

While allocating resources including finance, SWM is assigned with a low priority resulting in inadequate provision of funds. Often there is a common budget for collection and treatment of sewage and SWM and the later receives a minor share of the funds. The inadequacy of human resource is mainly due to the absence of suitably trained staff.

Inappropriate Technology

The equipment and machinery presently used in the system are usually that which have been developed for general purpose or that which have been adopted from other industry. This results in underutilization of existing resources and lowering of the efficiency. A few attempts have been made to borrow the technology developed in other countries like highly mechanized compost plants, incinerator-cum-power plants, compactor vehicles *etc*. However, these attempts have met with little success, since, the solid waste characteristics and local conditions in India are much different from those for which the technology is developed.

Disproportionately High Cost of Manpower

Mostly out of the total expenditure, around 90% is accounted for manpower of which major portion is utilized for collection. Since citizens tend to throw the waste on the adjoining road and outside the bin, the work of the collection staff is increased. Hence, the cost of collection increases considerably.

Societal and Management Apathy

The operational efficiency of SWM depends on the active participation of both the municipal agency and the citizens. Since the social status of SWM is low, there is a strong apathy towards it, which can be seen from the uncollected waste in many areas and the deterioration of aesthetic and environmental quality at the uncontrolled disposal sites.

Low Efficiency of the System

The SWM system is unplanned and is operated in an unscientific way. Neither the work norms are specified nor the work of collection staff appropriately supervised. The vehicles are poorly maintained and no schedule is observed for preventive maintenance. Due to shortage of financial resources, the vehicles are often used beyond their economical life resulting in inefficient operation. Further, there is no co-ordination of activities between different components of the system. The cumulative effect of all these factors is an inefficient SWM system.

5.0 NEERI's Contribution towards MSWM in India

Since last three decades, at NEERI, SWM Division has been carrying research, development and expertise extension programme to improve the status of waste management in the country. In order to

perform practice-driven research, NEERI has been consistently working with the partnership of related organizations in the country.

The prominent best practices evolved during the last five years, are described below:

- Preparation of strategy paper on SWM in India;
- Long term planning of SWM;
- Biomethanation of vegetable market wastes;
- Greenhouse gas inventory estimation for waste sector, its uncertainty analysis and formulated measures to mitigate the same;
- Utilization of landfill site for construction of Rail Car Depot;
- Site selection criteria for sanitary landfills;
- Utilization of residue from destruction of soiled currency notes;

NEERI has successfully developed strategic long-term plans for a number of cities including metropolitan cities like Mumbai, Delhi and Islands like Lakshadweep and Port Blair, among which many municipalities adopted the plan. NEERI is also assisting in implementation of the long-term plans. NEERI has been actively engaged in various ecosystems like Island areas such as Lakshadweep, coastal areas such as Mumbai and others metropolitan cities and towns having different geographical, climatological and social environment in the country.

6.0 Lessons Learnt from NEERI`S contribution and EXNORA'S Zero's Waste Management Scheme

The involvement of NEERI in SWM activity emphasizes that the improvement of system needs to be developed addressing the following issues:

- Financial weakness of managing agency;
- Difficulties in changing the prevailing nature of infrastructure service;
- Low recycling potential of waste material;
- Non-availability of skilled labours;
- Societal and managerial apathy.

EXNORA, a local non-governmental organization (NGO) based on a 'zero waste management scheme' set up, run and financed by the residents themselves. EXNORA, which is an acronym for` Excellent Novel Radical `, has been driving the environmentalist movement for sustainable urban development In Chennai (INDIA) since 1989. It has been promoting community based projects in areas where the local government is unable to provide sufficient service. EXNORA believes that area-based project led by the local community is an ideal way to spread environmental, social &civic messages resulting in a more equal and responsible society (Colon and Fawcett, 2005).

EXNORA identified SWM as a medium to promote a new model of society based on participative democracy. It places SWM at the core of society: its moral values, its social structure, its lifestyle, its economics and politics. The model itself raises the fundamental issue of governance. It is an idealistic model because if it were to work as originally envisaged it suggests that citizens would no longer need local government for the provision of basic needs such as a clean environment. It stresses the need for local bodies to be more aware of people's concerns and for citizens to be more involved in civic affairs. This model has been implemented in two communities *viz.* Chennai and Hyderabad. Results from two Indian cities, indicate limited success of the schemes both in saving a significant fraction of the generated waste from dumping, and in rehabilitating the local poor. However, they show that motivated individuals can successfully set up and manage waste collection systems that lead to overall environmental improvements. The system advocated by EXNORA seems to require significant local resources, and political and technical support which are hard to find and sustain without strong local leaders. This is based on triangular contracts between the municipality, the residents and micro-

enterprises and may provide a good solution in dealing with the technical and commercial aspects which communities find difficult (Colon and Fawcett, 2005).

7.0 Design of Appropriate Waste Management System

An approach to design sustainable waste management system and operating guidelines is outlined below.

Quantity and Characteristics

Quantity and characteristics of the waste are the major factors, which decide magnitude of waste management problem. It is necessary to carry out weighment exercise regularly to assess the quantity of waste. Future per capita quantity can be estimated with the help of projected population and annual increase of per capita quantity. On the basis of the waste quantity, infrastructure requirement can be estimated. It is also necessary to carry out characterisation studies frequently in order to assess the changes in waste characteristics due to ever-changing scenario. This data will also serve as a basis for selection of disposal/treatment option.

Collection of Waste

Properly designed collection bins and implements should be used for collection and storage of waste. Wastes should be collected frequently in order to avoid accumulation, which leads to degradation of environmental and aesthetic quality. Suggested collection frequencies for cities with different population ranges have been presented in Table 3. Suggestion from the citizen as well as workers for improvement in the design of bins and implements will be useful. Spacing and location of the bins should be fixed on the basis of the waste load and public opinion. House to house collection system can be introduced gradually to ensure environment friendly collection practices.

Transportation of Waste

Selection of properly designed vehicles is important. Various factors like width of the road, transport volume, road conditions, *etc*. play important role in selection of vehicles. Proper garage should be provided to save the vehicles from wear and tear due to heat and rain. Preventing maintenance system should be introduced which is useful for longer life of the vehicles. Vehicle route should be properly planned for proper utilization of manpower, saving of fuel and reduction of time. Time and motion study should be conducted to reduce the non-productive idle time of the vehicles and increase productivity.

Disposal of Waste

Sanitary landfill technique should be adopted for disposal for waste. Compaction of waste should be carried out regularly preferably with bulldozer. A daily earth cover of 15 cm thickness and final cover of 60 cm thickness should be applied over the compacted waste. These practices will minimize migration of leachate through soil strata, suppress the foul odour and improve the aesthetic quality. Impervious clay liner/synthetic liner should be provided at the bottom of the landfill for protection of groundwater from environmental pollution. Perforate polyvinyl chloride (PVC) pipe can be provided for leachate collection. It is also desirable to install gas collection and flaring system to prevent continuous escape of methane in the surrounding atmosphere.

Treatment/Recycling of Waste

Composting is the process of decomposition and stabilization of organic matter under controlled condition. Since India is an agriculture-based country, there is a need for popularization of the product among the farmers and to exploit the manure value of the product. Waste minimization, through segregation of recyclable materials like plastics, glass, metals, *etc*. is another aspect, which needs

special attention. NGOs may come forward to promote the activity. Waste pickers may be trained so that the segregation of recyclable items can be done in a more systematic and organized way.

Financial Structure

A new tax scheme can be introduced to meet the expenditure for modernization of SWM system and to improve the financial status of municipal corporation. Additional charges can be collected from the individuals availing house-to-house collection facility.

Community Participation

Community participation is essential for smooth and efficient operation of SWM system. In every area, citizen forums should be formed. These forums should comprise citizen's representatives, social workers and municipal officers. Immediate action based on feedback from such forum will go a long way in improving the situation. Various programmes should be conducted for increasing public awareness.

8.0 Conclusion

SWM is a vital, ongoing and large public service system, which needs to be efficiently provided to the community to maintain aesthetic and public health standards. Municipal agencies will have to plan and execute the system in keeping with the increasing urban areas and population. There has to be a systematic effort in the improvement in various factors like institutional arrangement, financial provisions, appropriate technology, operations management, human resource development, public participation and awareness, and policy and legal framework for an integrated SWM system. To achieve Cleanliness, which is next to Godliness, it is necessary to design and operate an efficient SWM system. Public co-operation is essential for successful operation of such a system. Finally, there is a also a need do develop a methodology of research for developing interactive techniques for system's design and operational control as indicated in Figure 1.

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Table 1

Per Capita Quantity of Municipal Solid Waste in Indian Cities (NEERI, 1996)

Population Range (in million)	Average Per Capita Value kg/capita/per day
1.0 – 0.5	0.21
0.5 – 1.0	0.25
1.0 – 2.0	0.27
2.0 – 5.0	0.35
> 5.0	0.50

Table 2

Physico-chemical Characteristics of MSW in Indian Cities (NEERI, 1996)

Population range (in million)	Number of cities surveyed	Paper*	Rubber*, leather and synthetics	Glass*	Metals*	Total* compos-table matter	Inert* material	Nitrogen^{+} as Total Nitrogen	Phosphorous^{+} as P_2O_5	Potassium^{+} as K_2O	C/N ratio	Calorific value in Kcal/kg
0.1 to 0.5	12	2.91	0.78	0.56	0.33	44.57	43.59	0.71	0.63	0.83	30.94	1009.89
0.5 to 1.0	15	2.95	0.73	0.35	0.32	40.04	48.38	0.66	0.56	0.69	21.13	900.61
1.0 to 2.0	9	4.71	0.71	0.46	0.49	38.95	44.73	0.64	0.82	0.72	23.68	980.05
2.0 to 5.0	3	3.18	0.48	0.48	0.59	56.67	49.07	0.56	0.69	0.78	22.45	907.18
>5	4	6.43	0.28	0.94	0.80	30.84	53.90	0.56	0.52	0.52	30.11	800.70

* All values are in percent, and are calculated on wet weight basis

+ All values are in percent, and are calculated on dry weight basis

Table 3

Collection Frequency of Solid Waste (NEERI, 1996)

Types of Locality	Frequency	
	Class I Cities (> 1 lakh population)	**Class II Cities (< 1 lakh population)**
Residential Areas		
Area with high population density	Once or twice a day	Once a day
Area with medium population density	Once or twice a day	Once in two days
High income and VIP area	Once or twice a day	Once a day
Area with low population density	Once in two days	Once in three days
Markets	Once or twice a day	Once or twice a day
Commercial areas	Twice a day	Once a day
Industrial areas	Once a day	Once a day

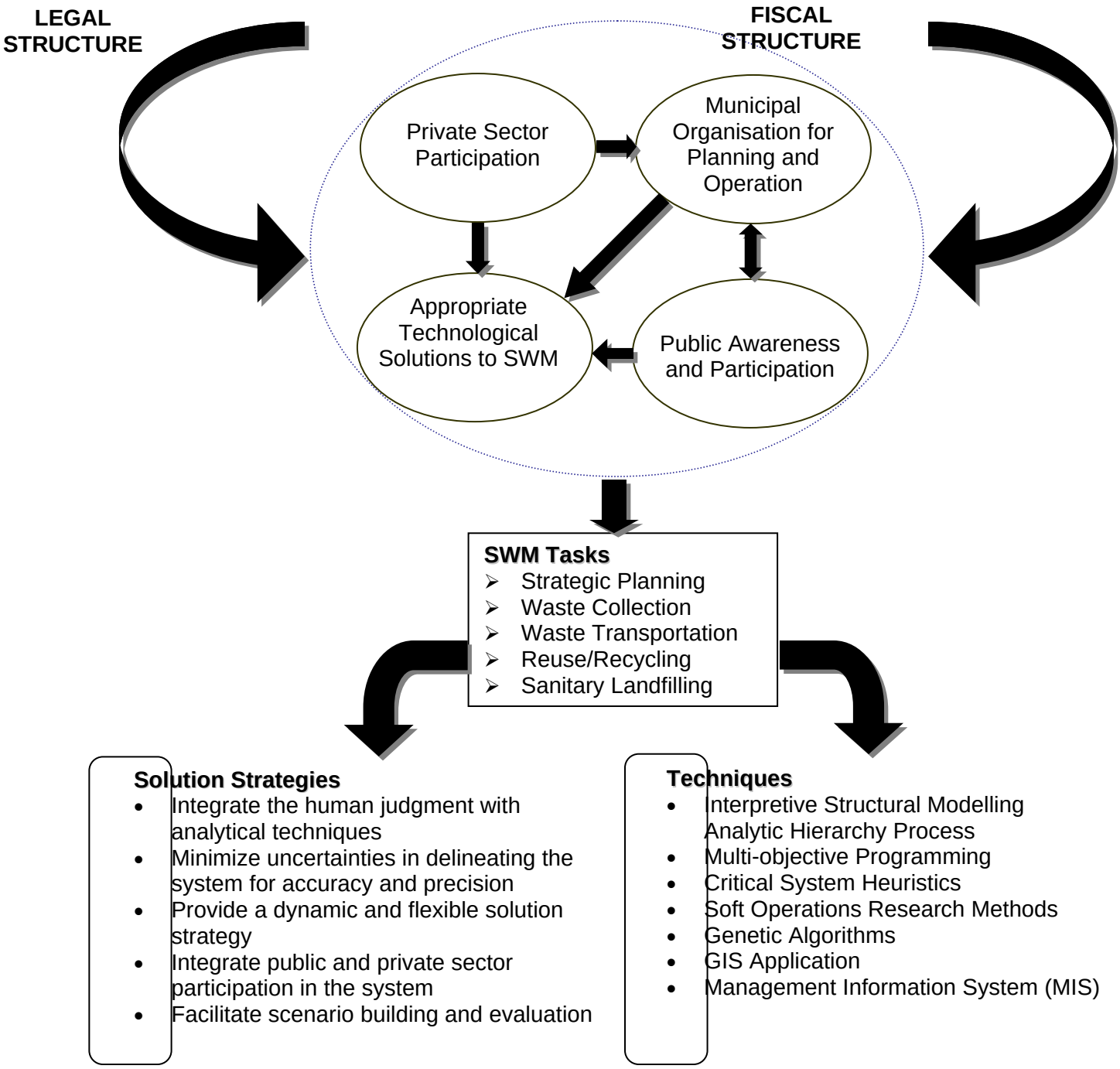

Figure 1
Methodology of Research for Developing Interactive Techniques for System's Design and Operational Control

Comprehensive approaches to develop and maintain drainage/sewerage systems in urban areas of Vietnam

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1. Introduction covering location and problem definition

Vietnam is a tropical country in the Southeast of Asia. It has an area of 320,000 km^2 and a population of 83 millions. Over the last decade, the Government has been pursuing the Reform Policy resulted in significant changes of its socio-economic status. The country has 65 cities and provinces and they are classified in according to administration levels which reflect differences in area, size of population, socio –economic condition and political status. There are five big cities are now under administrative function of the central government including Ha Noi, Hochiminh, Hai Phong, Hue, Da Nang, Can Tho. The rest of provinces are administrated by provincial governments. In each province, there will be a provincial town and/or several district towns with different extent of socio-economic development.

Looking back in to the reform process in the last 15 years, advancement of Viet Nam in socio-economic development is partly contributed by support and assistance of international donors such as World Bank, ADB, EU, Japan, etc. who had provided their official development assistance through a wide range of sector projects and programs with an aim to help the country to overcome poverty and achieve sustainable development. Among urgent issues of national agenda need to be solved, urban development is considered crucial to address rural-to-urban migration and the regional imbalance between the major cities and poor areas. External assistance to develop urban infrastructure systems of small and medium towns in Vietnam had given its emphasis on water supply rather than sanitation and drainage/wastewater management though there is a link between them. As a result of this, in recent years, when urban water supply has developed nearly to an extent of satisfaction, drainage/wastewater is posing urgent challenges to authorities of different levels when they are unable to accommodate the ongoing urbanization and economic development of urban areas. In provincial/district towns of Vietnam, the old, fragmented and deteriorated drainage/sewerage systems fail to be compatible with new and modern water supply systems. They trigger risks to environment and public health of urban communities, especially to the poor people. Shortage of resources including funding, technology, institutional arrangement/management capacity and public education/awareness are major causes for poor and insufficient drainage/sewerage systems in provincial/district towns.

In response to the Call for Papers of the Asian Development Bank, the Author, who has more than 30 years involved in water sector of Viet Nam as the water supply, drainage/sewerage engineer, would like to present in this Paper some individual views and proposals as comprehensive approaches to develop and maintain drainage/sewerage systems in urban areas of Vietnam. The scope of proposed ideas presented in this paper is applicable to urban areas but limited to small and medium towns[1].

[1] Small and medium scaled towns in this Paper refer to towns of provincial and district levels which are classified on the basis of administrative management level.

2. Situation Analysis

Urban areas in Vietnam are classified based on administrative management category. Accordingly, there are 5 central cities and 60 provinces. In each province there are one provincial towns/city and/or other district towns serving as economic and administrative centers for the surrounding areas. Population sizes of urban areas are therefore different to each other, ranging from 20,000 to 500,000 at provincial level and to millions at central level.

According to Statistic Book of Year 2003, depending on different level of urban areas and socio economic development, urban water supply coverage varies from 60-95%, access to piped water ranges from 60% to 90%, septic tank coverage is 55% - 70%, solid waste is collected from 65%-80% of households, and drainage coverage is 7-89m/ha. These statistic figures may be lower in district towns where economic development growth rate is rather low.

In general, drainage/sewerage and sanitation facilities in provincial/district towns of urban areas exist in the form of combined system which conveys both storm water and wastewater. They are open canals and box culverts, which are out of date, poor designed, fragmented and deteriorated due to lack of proper investment and maintenance. There are few separate sewerage systems developed recently for new towns or cities but small in scale and limited in hydraulic capacity to serve for particular purpose of economic or industrial activities. As a result of this, residents of provincial/district towns are facing environmental and public health problems resulted in disturbance to their economic and social activities especially those urban poor people living in less developed areas.

The National Orientation for Urban Drainage and Sewerage Development to 2020 interprets the Government's strategies to pursue ongoing improvement, extension of the existing combined drainage system; providing new water chamber and interceptor sewers to separate storm water and waste water; developing separate waste water system including sewers and waste water treatment facilities in industrial areas, newly developed city or urban areas and tourism complex. Also, the Construction Law requires septic tanks provided to all of newly building structures.

3. Description of problem

As mentioned above, provincial/district towns are serving as economic and administrative centers for the surrounding rural areas. They provide most of the non-agriculture employment in their provinces. In provincial/district towns, most of drainage/sewerage systems are in a very poor condition since they were constructed long time ago. They are unable to meet the increasing demand for urban services because of lack of investment, inadequate maintenance and weak institutional capacity. As a result of this, flooding and environmental risks trigger health problems to the urban residents, especially to poor people who usually reside in less developed areas where drainage system is limited or overloaded. The problem is also compounded by overflowing of river during rainy season, causing serious disturbance to those communities living near the river's bank. Flooding of houses, roads, footpaths and public

areas such as the town's school, market, bus station causes property damage and disrupts economic and social activities. Frequent overflows of polluted storm water mixed with wastewater pose health risks to communities. Water born diseases occur with high frequency and in large areas. Pools of stagnant water resulting from intense rainfall during the rainy season, and stagnant wastewater in open canals and drains during dry season provide breeding grounds for mosquitoes and other disease bearing insect vectors.

It is hard to find a significant modern wastewater treatment system in provincial/district towns rather than septic tanks. Septic tank coverage is rather low in small, poor and less developed towns. Most of industrial facilities, hospitals or health clinics do not have adequate waste water treatment or if so they are not functioned well enough to ensure no harmful waste water discharged to combined drains or sewers. Although septic tanks are the most common facilities of wastewater treatment for urban activities, there has been a lack of maintaining actions taken to ensure its designed treatment capacity. Therefore, problem of undersized and lack of frequently emptied septic tanks add to the causes of environmental problems. The consequence is solids spill over into drains causing blockages and environmental degradation and liquid effluent seeps into the soil, polluting near-surface aquifers. The lack of proper septic tanks constitutes a major health hazard during storms and flooding when fecal pollutants from human wastes are easily spread through contaminated floodwaters, covering public areas such as roads and footpaths and the ground floors of homes and other buildings. The lack of adequate on-site sanitation systems results in contaminated surface waters and related health risks. They are generally in need of improvement and greater coverage of septic tanks in the communities is necessary to reduce adverse environmental impacts and health risks.

Health and environmental problems in the towns become serious because uncollected household garbage is dumped into drains, waterways, beaches or vacant land, resulting in pollution, odors and drain blockages which exacerbate flooding. Disposal of solid waste to drains also increases maintenance costs. The reason is because existing solid waste management is inadequate due to limited collection and transport systems and leads to illegal disposal of solid waste to drains, waterways. Also, unsanitary landfills with poor design or simple leachate treatment discharge polluted and untreated leachate to nearby water course pose a great threat to the surrounding residential areas.

Together with the whole poor background of existing drainage/sewerage system, once again, institutional or management constrains are also hindering elements posing to local urban public authorities which require urgent and radical initiatives of reform. Public entity known as Urban Environmental Company (URENCO) or Urban Public Works Unit (UPWU) is responsible for managing, operating and maintaining urban public facilities including water supply, drainage, wastewater solid waste and other public services. It is an operating unit attached to the provincial/district people's committees (PPC/DPC) but it has little managerial autonomy, and very limited responsibility or accountability for budgeting or meeting service standards. They do not operate as a self-financing public service enterprise, but relies largely on budget allocations from the PPC/DPC for its operating budget and capital investment. Cost recovery from their urban services is very low. Although the URENCO/UPWU bills customers and collects revenue for water supply, tariffs are set by the PPC/DPC at levels that are insufficient for proper O&M and do not provide sufficient funds for capital investment. Actually the URENCO/UPWU undertakes little or no maintenance of these systems because of lack of fund for their technical and labor inputs. There is a fact that only some provincial towns charge

wastewater or drainage tariff through the water bill. Other smaller authorities of district towns may not make it effective. They rely entirely on budget allocations from the PPC/DPC for these services and thus cost recovery is ignorant. For solid waste management, URNENCO/UPWU provides a basic service for collection and disposal, which serves from 20% to 65% of households. Although households are charged for the solid waste service, bills are issued by another authority known as Tax Department belong to PPC and through this billing channel, revenues are transferred directly to the treasury rather than to URENCO/UPWU. In any case, the level of tariffs is too low to cover proper operation and maintenance costs.

Sanitation and environmental problems at the community and household level are severe. However, there is little opportunity for participation by the communities to make decisions on their development priorities and to participate in planning, implementation and maintenance of local infrastructure. There is generally a low understanding of environmental health issues at all levels from residents to town agencies and leaders. The community has low awareness of the links between water, sanitation, hygiene and health, and basic hygiene practices in the communities are poor. It is due to lack of awareness activities and printed health information material relating to water and sanitation for households. There is a need to increase community participation in improving sanitation and environmental conditions and to raise people's awareness of health sanitation issues

4. Preliminary Approaches

Taking into account National Orientation for Urban Drainage and Sewerage Development to 2020, it is urgent to take necessary and appropriate measures to improve existing drainage/sewerage/sanitation systems which will help to bring benefit of improving living conditions to people living in urban areas. The improvement of drainage and sewerage systems will contribute to poverty reduction, economic and social development, improved public health, and will have an overall positive social impact. The following suggestion may be useful to undertake in the developing background of Vietnam which are now facing many constraints of resources and policies.

First and foremost is to seek for available funding from both internal and external sources to invest in development of new urban infrastructure system and improving existing system to serve the increasing demand on water supply, drainage, sewerage and sanitation of urban residents. The Government should take this into consideration of its annual budgeting plans, setting a certain part of allocated fund available to provincial governments for developing urban infrastructure system. A part from that, at central level, policy reform to harmonize ODA procedures may build up more confidence of donors to our demanding environment of development and thus help Vietnam to absorb further official assistance for urban development strategies.

Efforts of institutional reform should be made to relevant authorities of all level, i.e. URENCOs/UPWUs who are now designated to take over maintenance and management of drainage/sewerage systems. The reforms will help to ensure their efficient capacity in handling urban services. The institutional reforms will cover various changes to enable URENCO/UPWC (i) to become efficient and autonomous public entities with focus on management, operation and maintenance of urban services including operation and maintenance responsibilities to urban public facilities; (ii) to

suggest, justify, and charge appropriate[2]service fees to their customers to ensure that fees cover at least operation, maintenance and equipment replacement costs in the short term and an increasing portion of capital investment costs in the medium term; (ii) to own equipment for O&M and keep in their accounts sufficient funds for the provision of depreciation of the equipment (iii) to impose penalties to people not paying the fees for the services received, or destroying urban infrastructure under their responsibility; (iv) to recommend service levels after consultation with customers; and (v) to make key management and operating decisions. These institutional arrangements recommended to URENCOs/UPWCs should be made through intensive training including on-the-job and formal training to their staff in urban services management, financial management, asset management, and customer relations. Besides, capacity strengthening to other relevant authorities at provincial and town levels[3] should be also made though training to improve their capacity on urban services management and urban planning, enable them to develop appropriate service levels for urban services in consultation with residents and businesses.

Initiatives of technology and technical options should be encouraged but they need to be in line both with the approved provincial master plans and the Orientation Plan for Urban Drainage and Environmental Sanitation to 2020 issued by the Government. These alignments can be interpreted as the followings:

- Design of drains, sewers and wastewater treatment works will follow the objectives and targets of Government's Orientation Plan for Urban Drainage to 2020, and Vietnamese technical standards which identify appropriate technology and design for existing and future development of urban infrastructure system.
- For existing developed areas in the provincial towns, a combined drainage system is proposed for improvement of which existing primary drains and open canals will be upgraded to convey storm water to discharge points at rivers, existing secondary drains will be rehabilitated and cleaned; extension network of primary, secondary and tertiary drains; rehabilitation and deepening existing regulation ponds to improve surface drainage capacity.
- For sewerage and sanitation, it is proposed that overflow chambers should be constructed at discharge points to convey wastewater through interceptor sewers to a future wastewater treatment facility and in the medium term, technology proposed for this work will be biological or oxidation ponds.
- For newly developed, tourism and industrial area, separate drainage and sewerage systems are proposed for conveying stormwater and wastewater; wastewater treatment facility in the medium term will be biological or oxidation ponds.

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[2] Tariff for drainage and wastewater services should be charged on a "user pays" basis that takes into account the special needs of poor households and their capacity to pay.

[3] Relevant authorities at provincial and town levels involved in urban works are construction departments under provincial people's committees or urban management division under district/town people's committees.

Finally, together with physical improvement, it is crucial to develop a scheme of community participation and education/information/public relation to link the responsibility of developing, protecting and maintaining urban infrastructure systems of concerned authorities with urban residents. Specifically, the education/information/public scheme aims to improve the communities' awareness of the relationships between water, sanitation, and health and the necessity of developing a good drainage/sewerage/sanitations system. Community will be able to participate in planning, operation and maintenance of urban facilities through various programs initiated and managed by local women's unions. They may appear in the form of community based sanitation program and sanitation credit program or revolving funds. A certain amount of fund will be sought and provided by provincial/district towns governments to local women's unions to provide seed funds to assist people living in narrow alleys and streets to construct tertiary drains connecting to larger drains. They may be encouraged to operate and maintain the drains by entering into service contracts with URENCOs/UPWCs. The septic tanks revolving funds can also provide some financial assistance to poor households to construct septic tanks or sanitary latrines. These activities usually conducted by local Women's Unions which has proven it success and efficiency under ADB funded provincial water supply projects. Women unions also need to be trained to carry out awareness campaigns to enhance awareness of the benefits of improved infrastructure, O&M requirements and the communities' responsibilities for the protection of public assets.

A. References

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3. Guidelines for management of sewerage facilities in developing countries by World Bank.
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B. Supporting Information

1. Vietnam Statistic Book 2003

Ecological Sanitation in the Philippines

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1. Introduction

The Programme involves introducing Ecosan in the Philippines and is being implemented by the Center for Advanced Philippine Studies (CAPS). It aims to:

a. Alleviate poverty and its effects through local initiatives in urban waste management and ecological sanitation;
b. Develop and build models in waste management and sanitation that consider the social environment (private and community sector participation) while recognizing local resources constraints; and
c. Direct or re-direct valuable resources to support livelihood opportunities among the poor and harness accumulated knowledge and experience to practical application.

The Programme has three components. The Ecosan Component focuses on the building of Ecosan Toilets in the City; the Waste Venture Component deals with developing livelihood and business opportunities related to Ecosan; and last but not least, the Knowledge Sharing Component conducts research and publication, capacity building, information and education campaigns.

The Ecosan Component of the Programme is primarily being implemented in San Fernando City, in the Province of La Union. As of the year 2000, the City of San Fernando had a population of 102,082 residents (National Statistics Office, May 2000) with an annual average growth rate of 2.265%. This number is expected to reach 114,178 persons by 2005, and 127,708 by 2010.

In terms of sanitation, San Fernando City is beset by three major interrelated problems, namely, lack of toilets among the poor residents, scarce water supply problem and contaminated ground water sources.

2. Situation Analysis

Although a large percentage of the population has access to water-sealed or flush type toilets, there are still those in the coastal and upland barangays who defecate in the open or make use of unsanitary open pit toilets. These types of toilets are potential sources of diseases and water pollution, especially since most are unlined and are not maintained or used properly because of lack of water. Water resources along the coastal and upland areas are inherently difficult.

The same can be said for the communal toilets in the three coastal barangays, the public toilets, and those sharing such facilities. Although some of them are of the water-sealed type, their improper use and poor maintenance, mainly due to lack of water for flushing, makes them potential sources of groundwater and/or surface water pollution. Most of these toilets are located very close to existing water wells for convenience, and/or because of lack of space due to population density. On the other hand, studies showed that there is excessive water extraction in coastal areas of the city. Excessive water

extraction can also cause contamination of the groundwater from domestic liquid wastes since the porous underlying formation in the area facilitates the movement of contaminants from nearby septic tanks or waste disposal pits. Thus, the Mines and Geosciences Bureau (DENR Region 1) study recommends that excessive pumping of groundwater should be avoided as much as possible. In addition, industrial development and population increase are exerting greater demand on the water resources of the city. And as San Fernando City grows, its neighbors are also growing. With most of the water sources of the MLUWD coming from San Fernando City's neighboring municipalities, water shortages will be much more pronounced than as is now being experienced by the city. Increased groundwater pumping is inevitable, increasing the likelihood of contamination especially in coastal areas. (ISWM Assessment, 2004)

3. Description of Intervention, Approaches or Projects

Technical/Engineering: Ecological sanitation, Ecosan for short, is a holistic and sustainable approach to sanitation. This approach is based on the principles of preventing pollution, sanitizing human excreta and using urine and feces as resources for agriculture. The basic approach is to separate the two fractions of human excreta, i.e., urine and feces. Urine is relative clean and rich in nitrogen, phosphorous and potassium (NKP). Through proper treatment and handling, feces can be turned into a valuable soil conditioner rich in carbon, providing good soil structure and good medium for essential soil micro-organisms (Ecosan Book, 2004).

In an Ecosan dry toilet, a urine-diverting bowl is used. The front side of the bowl has a funnel-like structure that collects urine that is diverted into a container below. The back side has a section where the feces drops and is caught by another container. Toilet paper can be disposed into the feces container. For anal washing, a different washbowl or bidet is used. When finished, a cup of ash is applied over the feces. The ash absorbs the moisture and raises the ph and temperature of the fecal matter below. This system of applying ash allows pathogen die-off and control of both odor and vectors. Lime, saw dust or soil can be used if ash is not available. Grey water from the bidet goes to an evapo-transpirator where it dries or gets absorb by the soil.

Legal/Institutional: The Project has four major Phases. These are the Inception Phase, the Pilot Project Phase, the Enabling Environment Phase and the Strategic Planning Phase. The Inception Phase includes the conduct of Baseline Studies and the formation of the Management Consortium, which was tasked to plan, manage and implement the Programme. The Pilot Project Phase mainly involves the putting up of the Ecosan Toilets in the two barangays including the capacity building at City and Barangay levels. The Enabling Environment Phase refers to the creation and enhancement of a favorable attitude and perception towards Ecosan at the City, Provincial and at the National level through policy advocacy, networking and education and information campaigns. Lastly, the Strategic Planning Phase aims to integrate Ecosan in the City and Provincial Development and Sanitation Plans and Programs.

Social/Poverty Alleviation: The Ecosan project aims to provide proper sanitation to those who do not have access to proper sanitation. These are the poorest of the poor who could not even afford to put up their own toilet. These are the people who either used their neighbor's toilet or defecate in the open fields or open water/sea.

Financial: The Programme is funded by the Dutch Government through WASTE, an NGO based in the Netherlands. In the Philippines, the funds are used to provide technical assistance in terms of capacity building, training, research and development, information and education under the Knowledge Sharing Component. It also provides a

facility for loans or credits to promote and enhance viable economic and livelihood related to Ecosan as part of the Waste Venture Component. The City is in charge of the construction of the toilet facility. The household cooperators provide construction labor, the roof, walls and two plastic drum containers for the urine and feces, as their counterpart.

Organization and Management: In terms of organizational set-up, the programme is being managed by a Consortium of five organizations. These are the City Government of San Fernando, La Union (CSFLU), the Center for Advanced Philippine Studies (CAPS) as Programme Coordinator, the Solid Waste Management Association of the Philippines (SWAPP), the Foundation for Sustainable Society, Inc. (FSSI), and the Institute for the Development of Ecological Alternatives (IDEAS). At the City level, a Technical Working Group (TWG) composed of Department Heads was formed to supervise day-to-day Ecosan activities. At the Barangay level, Barangay Ecosan Committee was formed to monitor the household beneficiaries on their use and maintenance of the toilets.

4. Results

Better sanitation and health conditions for the poor project communities. With introduction of Ecosan, the barangay leaders of one pilot community decided to pass an ordinance prohibiting defecating along the seashore and public places. This City is now in the process of formulating it 10-year Strategic Sanitation Plan.

Urban Agriculture: Majority of the households who now own an Ecosan toilet in the urban poor barangay are practicing urban agriculture, planting tomatoes, ampalaya, water melon, papaya, egg plant, and other vegetables.

Additional business for a ceramic toilet maker: The project contracted a small ceramic maker to develop (design and mould-making) a ceramic urine-diverting toilet at the cost of P255,000.00. An initial order of 500 units worth P300,000.00. For 2006, the projected number of units to be ordered is 2,000. This is again part of the Waste Venture Component to develop related businesses.

Ecosan in the Clean Water Act: Although it was not even mentioned in the CWA, Ecosan was accepted as a viable sanitation option in the Implementing Rules and Regulations. This was achieved through active networking under the Knowledge Sharing Component. Through this, a Philippine Ecosan Network (PEN) is now formed.

5. Lessons Learned

Social Preparation: The main challenge in terms of viability of Ecosan is its social acceptance by the target city stakeholders and partner-beneficiaries. In the case of San Fernando, this challenge was hurdled through effective social preparation, information and education campaigns. The concept of “dry sanitation” is a new and innovative approach, but Ecosan became viable because its benefits and advantages were successfully conveyed and concretely shown through knowledge sharing, capacity building and project piloting.

Capacity Building and Ownership of Programme and Projects: The programme conducts seminars, workshops, trainings and meeting with various sectors from the city level, to the barangay level, to the household level and now at the provincial level. This is to develop a more positive attitude among all stakeholders, especially at the household level, about the concept of ecological sanitation. The successful

implementation of the pilot projects in the two barangays has served a powerful tool in educating the people at large.

After several months of piloting from January to June 2005, Ecosan has gained tremendous acceptance not only from the City but also from the Provincial Government and other municipalities. CAPS is now processing several request for Ecosan project implementation from several local government units.

Political Will: It was the Mayor of San Fernando, Hon. Mary Jane C. Ortega, who first saw the applicability, advantages and benefits of Ecosan for her city. She was and still is the key factor in the pushing through and implementing in the City and now in the whole province of La Union.

6. Proposed Best Practices

Ecosan as an alternative to conventional sanitation: Ecosan is the most viable solution to the problems cause by conventional sanitation. Conventional sanitation, like flush toilets, consumes huge amounts of clean drinking water and consequently generates huge amounts of waste water. On a global scale, only 5 percent of domestic waste water is properly treated. The rest is discharged to water bodies untreated or partially treated resulting in massive water and soil pollution. Ecosan system separates urine and feces and treats them as resources. With dry Ecosan system, wastewater generation is avoided and therefore preventing water and soil pollution. In addition, food security is enhanced because Ecosan provides for the reuse of the urine and feces as fertilizer and soil conditioner. Ecosan follows the principle of closing the nutrient loop between sanitation and agriculture.

Stakeholders' Participation and Ownership of the Project: The programme is being implemented with deep involvement of the city and barangay officials in terms of planning and execution of programme components and activities and legislative support from the local council. There is a high level of ownership and capacity building being develop at the local level. The withdrawal of CAPS in 2007 is not seen to cause any disruption in service delivery.

References:

CAPS, Integrated Sustainable Waste Management Assessment in San Fernando City, La Union, May 11, 2004. Other studies and progress reports are available upon request.

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How ADB Can Improve Its Technology Transfer Operations

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1. This paper is based on my experience as a senior environmental engineering expert consultant with some 60 years total experience, focusing on design/evaluation of environmental engineering infrastructure projects (mostly in urban water supply and waste management), about 30 years on how to do this properly in the affluent industrialized countries (ICs) like the USA, the other half (since circa 1973) on how to do the best you can in the relatively very poor developing countries (DCs) where you have to tackle the same problems but with only a fraction of the budget levels used in the ICs.
2. My consulting practice in the last 3 decades in the DCs, which I have done from my office headquarters in Bangkok, has involved key participation (as the environmental expert) in some 100 infrastructure projects sponsored by the various International Assistance Agencies (IAAs) including the World Bank (ADB), ADB, and other MDBs, the various U.N. agencies (UNDP, WHO, UNEP, et al), and numerous bilaterals including USAID, CIDA, Danida, et al. This includes some 30 ADB projects.
3. In doing these many projects in the DCs, which have involved many projects sponsored by ADB (and other IAAs), I have learned many lessons on how the ADB operates, how the ADB despite its great number of projects intended to control environmental degradation in the DCs, has failed to give the assistance needed by the DCs, and specifically what the ADB should do to change the existing syndrome so that environmental system investments in the DCs will change from gross inadequacies/wastage to a system where the investment projects actually do their intended jobs. If ADB and the other IAAs continue to operate along present practices, the IAAs will continue to fail in their efforts to help the DCs to control gross environmental degradation.
4. The time element is critical because, if degradation continues along present lines, by mid-Century 21 the DC world have lost the bulk of their precious natural resources including forests/wetlands, and the DCs will be plagued by huge new urban mega-city slums (to accommodate mass rural to urban migration). For example, the tropical rain forests of the world, mostly located in the DCs, will be mostly gone and with this massive loss of wildlife habitat, decrease in base river/stream flow volumes, and intensified massive flooding of villages by debris washed downhill during storms. On the social side, people living in massive urban slums will be without adequate water (both in quantity and safety), without management of excreta and other human and industrial wastes, and without decent housing and other facilities.
5. To illustrate this problem, in Thailand, for example, there are some 50 urban sewage treatment plant projects, all of which are malfunctioning, and some 20 or 30 water supply treatment plants (rapid sand filters) which, excepting only those at Bangkok, are malfunctioning. This story is the same in all of the DCs of Asia (I have worked in all of them excepting the Central Asian Republics). Why is this so? Why has the assistance furnished by the IAAs et al not corrected this syndrome?
6. An important point here is that environmental engineering infrastructure projects generally use up money but don't earn money, especially for control of pollution discharges to environment (liquid/solid/gaseous). And in urban water supply the systems generally focus on delivery of the needed quantity of water (which earns money) but generally ignore water quality (including safety for drinking) which, while

greatly valuable for public health protection, does not result in visible cash return recognized in national accounting systems. Other sector investment projects (highways, ports, airports, etc.) are money-earning so these do get ample attention (except for their environmental degradation aspects which are often ignored). The problem for environmental infrastructure is how to reorient IAA practices so this sector gets the needed attention.

7. Here is my list of recommended revisions in IAA practices so that these investments will be much less wasteful and much more meaningful:
   (a) Require post-construction monitoring of performance of the systems which are built. This is basic standard engineering practice and such performance monitoring is routine in the ICs, to determine how effective the investment is, and what needs to be done to improve planning/design practices so the systems will become more effective. Despite this fundamental fact, ADB et al have persistently refused to require performance monitoring, hence the ADB staff have not found out how to improve their practices in planning/design. Such monitoring will reveal deficiencies in design and in provisions for O&M (See Annex I-5).
   (b) For each type of sector investment (water supply, sewerage, air pollution control, etc.), cease common ADB practice of designing systems which follow IC design criteria and matching environmental standards, and figure out for each sector for the particular DC what the appropriate/affordable environmental standards and matching design criteria should be, in recognition that the monies available will be only a fraction of that spent in the DCs for managing the same problem. This recommendation is illustrated in Annex I-1 attached. This is crucial but cannot be done by "Environmental Generalists" or "Engineer Generalists" but can be done by skilled sanitary engineers knowledgeable both in IC practices and how to modify these to suit DC conditions. Most of the ADB project staff with whom I have worked have not had the needed skills in appropriate IC vs DC practices.
   (c) Ensure that the recommended system is realistic with respect to the O&M limitations in the DCs. Most IAA projects have not done this but have pretended to do it. The Feasibility Study reports commonly include a chapter on O&M which simulates IC practices - even though the writers know the DCs cannot/will not implement it. This practice is not only counterproductive but is grossly unprofessional. The reason for the malfunctioning mentioned in Item 6 above sometimes is poor design, but even with good design the system often will not function effectively due to lack of adequate O&M. Usually the DC government (and the IAA sponsors) are not aware of this became of the lack of performance monitoring. Sometimes the DC officials involved may insist on including components in the project which shouldn't be there (such as a highly mechanized sewage treatment plant). Never mind, their "money need" must be accommodated, but they take only a part of the total project budget. The goal is to see to it that the remaining money isn't frittered away but will produce a useful project. The existing syndrome is that "corruption" takes a sizeable slice, but the DC can live with that. The need is not to let the rest of the money get frittered away.
   (d) The IAA investments have done a very poor job in technology transfer to DC personnel. The best/cheapest way to achieve effective TT (technology transfer) is to utilize the actual project for this purpose. But the way ADB et al structure the budget, when the overall project team includes both expat experts and DC participants, the project budget has no funds for enabling the expat experts to use the project for TT purposes. So the expats use the DC-ers to do tasks without explanation of the "why" of the tasks. The IAAs assume the TT will "rub off" on the DC participates in the project implementation process, but this doesn't happen—It's not that easy. The need is to increase the project

budget for the expats by about 10% to enable the expat experts to have the time to utilize the project for training purposes.

(e) ADB should recognize that Environmental Technology has been developed primarily in the ICs, but in the DCs, because of the non-money making nature of most environmental/sanitary infrastructures, the DC governments/ universities are generally not knowledgeable on appropriate sanitary engineering design technology. Often the practitioners and university professors have only academic backgrounds in affluent IC practices and are not at all capable of doing the thinking shown in Annex I-1. This applies also to most IAA staff. Annex I-2 shows that most DC (and many IAA) staff have not had the needed apprenticeship. The result is the poor design noted in Items (b) and (c) above. How to correct this very basic problem? Several approaches are feasible:

(e.1) Incorporate TT into the investment project program as noted in Item (d) above.

(e.2) Prepare textbook or manuals on appropriate DC design criteria (and matching environmental standards), which can guide DC/IAA designers to produce a project which works, such as I have just done for the Municipal Sewerage Sector as explained in Annex I-3. To my knowledge this is the only environmental engineering design textbook yet produced which is appropriate for DC application. As noted in the Preface (Annex I-3), this Sewerage textbook is "just for starters", to illustrate this approach. Similar textbooks are needed for all sectors (municipal water supply, highways, ports, etc.) so that projects in all sectors will be economically cum environmentally sound.

(e.3) Established graduate training programs on IC versus DC design practices for all types of investment, to ensure appropriate design practices (and matching environmental standards) for all types of environmentally-sensitive projects, as explained in Annex I-4, leading to university graduate degrees on Economic-cum-Environmental (E-c-E) Development in the DCs, to be attended by both DC and IAA personnel. This approach is the most basic—to give attention to the need for E1-cum-E2 project design for all sector projects as part of the graduate education program. ADB should take the lead to establish at least one such university program, somewhere in a qualified university.

(e.4) Promote establishment of an Environmental Engineering Journal, i.e., a professional magazine in which each issue will feature projects which discuss specific examples or case studies of illustrative DC projects which explain how IC practices were modified to suit DC conditions

(e.5) Furnish copies of selected IC textbooks/manuals which, despite their IC origins, nevertheless can be very useful to DC practitioners (who with rare exceptions cannot afford to buy them), translated into the local DC language. One example is the American text, "Standard Methods for Analysis of Water and Wastewaters", which is a virtual "bible" on this subject which is useful per se in both ICs and DCs. If done this should greatly improve water and wastewater management technology in China, hence remarkably high benefits at low cost.

(e.6) Send DC staff for <u>training</u> not "observing" with USA/IC organizations. Most MDB-sponsored projects of this type amount to what I call "observation junkets". What is needed (and I have used this repeatedly) is to assign the DC individual to be an additional working team member in an organization doing what he wants to learn to do. For example, if the DC-er wants to learn about regulatory permit systems for WPC (water pollution control), assign him to be a temporary extra member of the WPC permit section staff of one of the California

State Regional Water Quality Control Boards. This not only achieves real world training but doesn't require the organization to which the individual is assigned to make any special preparations. The best agencies for this purpose in my view in the environmental engineering field are the California Regional Boards for regulation procedures, and the Los Angeles County Sanitation Districts for management of liquid and solid wastes.

(e.7) Plan Technology Transfer projects, not in the usual way as a single event operation, but spread this over a period of training series with enough time between to permit the student to absorb the lessons from each session. The IAAs like the single-event approach because it "saves" travel costs, without realizing that their approach is not effective. Might as well cancel the project and save all of its cost.

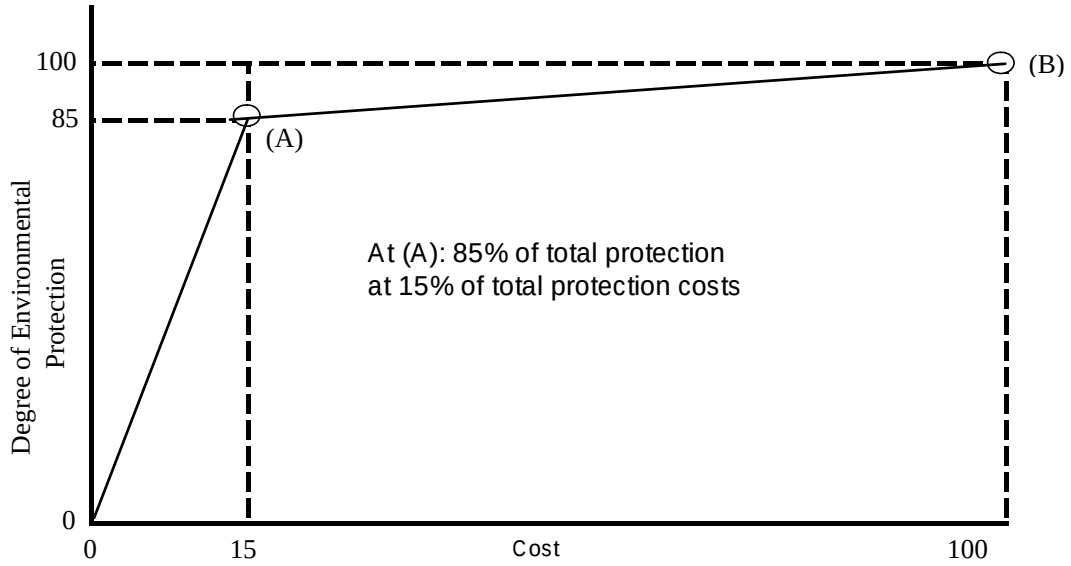
(e.8) Use retired expat experts to give hands-on training, where a single expert, say in community water supply systems, visits each of say 10 systems every month. The big advantage of this approach is that the expert catches the DC-er at the moments when he has a serious problem, hence listens carefully to the expert's advice. This is far superior to use of academic classroom textures.

8. I hope that my remarks may be useful to ADB. Thank you for this opportunity to present my views and recommendations.

Annexes

(I) Illustrative information:
- (I-1) DC versus IC practices
- (I-2) Developing expertise:
  - (I-2.1) Role of apprenticeship
  - (I-2.2) Doctorate-sans-apprenticeship syndrome
- (I-3) Textbook on municipal sewerage:
  - (I-3.1) Textbook of appropriate sewerage technology for developing countries
  - (I-3.2) Preface for sewerage textbook
- (I-4) DC versus IC graduate training
- (I-5) Performance monitoring

ANNEX I-1



Where (B) represents today's USA practices and standards (very expensive). Point (A) represents 1946 practices and standards which are recommended for use in DCs. (These correspond to USA standards circa 1940).

APPROPRIATE PROJECT DESIGN CRITERIA FOR DCs

ANNEX I-2.1

HFL/Dec. 2000

STEPS IN GAINING EXPERTISE

NOTES:

BC = Apprenticeship, meaning not the time put in, but the time spend working under the critical supervision of experts. Most DC environmental "experts" are not experts at all because they have never had the opportunity to work under real EIA experts.

The Doctorate - Sans - Apprenticeship Syndrome: A Major Problem in Environmental Technology Transfer in Developing Countries

A major problem in environmental agencies in many developing countries (DCs) is the lack of or inadequate professional capabilities to deal with and make correct judgments on environmental issues, ranging from simple to complex tasks. Analysis of this problem shows invariably that most developing country professionals (DCPs) have not undergone an appropriate apprenticeship as shown in Fig. 1. This "Doctorate-sans-Apprenticeship" syndrome is due in part to the overemphasis placed on academic credentials as the primary if not the sole criterion for expertise.

The main lesson derived from the experience of the past several decades is that the apprenticeship gap must be filled, that filling it means an input of hard work or sweat by the DCP over a prolonged period of time, and that there is no shortcut to achieving expertise. Indeed, DCPs often tend to define an Outside Adviser (OA) as one who can teach the DCP to achieve expertise without the sweat, as one who can reduce all complex questions to simple terms. It must also be recognized that the answer is not in sponsoring more academic training, more workshops/seminars/conferences, and more observation tours.

Several approaches are indicated for solving the apprenticeship problem. These include (1) replacing observation tours in the industrialized countries (ICs) with apprenticeship assignments, (2) using outside advisers for this purpose in the DCs, and (3) changing the nature of training activities to suit this purpose.

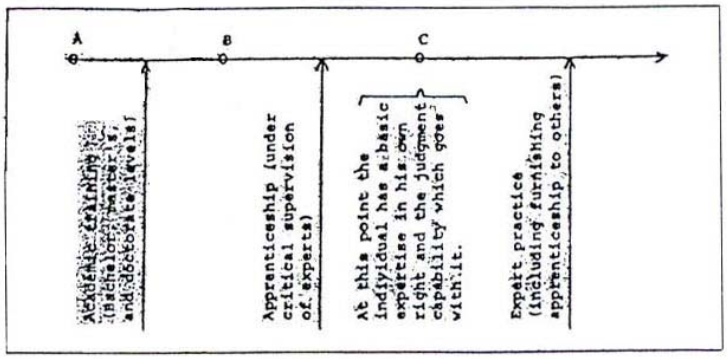


Fig. 1. Role of Apprenticeship in Development of Expertise

1. Assignment to IC Agency

Regarding the typical observation tours sponsored by funding agencies, the salient problem is the "no sweat no learn" principle, and "observing" does not fill this need. The author's approach has been, instead of using an observation tour, to assign the individual to be a working member of a team in an IC agency which is doing the kind of work of interest. The important feature is that the DCP understands that he is to serve essentially as a regular employee of the agency where he is assigned, as an "extra hand" with a team doing the kind of specialized work of interest to him. In this way the desired technology transfer takes place quite effectively, with few if any special training arrangements made for accommodating the trainee. No special training is arranged, rather the DCP is simply assigned to be a working member of the appropriate team. The main advantage of this system, in addition to its effectiveness for technology transfer, is its simplicity and low cost to the cooperating agency. While the technology utilized will often be advanced and not applicable to the DC, nevertheless the trainee will get a good picture of the objective of the program and of the steps involved, which he can subsequently modify and adapt to suit his DC conditions.

2. Use of Outside Advisers in the DCs

Training As Part of Trainee's Routine Work

Another approach is to assign an Outside Adviser to do training by working directly with the DCPs in a given unit of the DC agency where he will have responsibility for working directly with each DCP. The OA's work involves, for each DCP in his group, making use of the DCP's regular assignments for training purposes. For each DCP in the unit, the OA prepares regular assignments in writing, grades and critiques the responses and discusses them with the individual, and in addition conducts periodic seminars for the group of DCPs involved. This procedure not only achieves the feedback needed for training but because it enhances the DCP's work, the role of the Unit Chief is facilitated. Hence the Unit Chief will be sympathetic to the training program, rather than to regard it as impeding the regular work of his unit (as has sometimes been the case). Moreover the OA is in a position to furnish the Unit Chief and his superiors with specific information on the capabilities, interests, and potentials of the DCP personnel in the unit.

Training As Part of Special Projects

Excellent training opportunities are presented by virtually all major development projects funded by the IAAs (International Assistance Agencies) on the environmental aspects of the projects including EIAs. While most such projects have included training components, they have not been generally successful because (i) the trainee, to learn, must be assigned to be a working assistant to the Expert of the Project Consultant's team, rather than for the trainee to consider his role as "observing" and "monitoring" the counterpart's work (as has often been the case), and (ii) the Project Consultant's

budget must include an extra allowance to pay for the extra time needed by the counterpart for explaining the work to the trainee including periodic discussions specifically for this purpose. The lesson learned is that the IAA and the DC agency managing the project must do careful planning and budgeting to establish a training component which will succeed.

3. Improved Seminars and Workshops

To make the workshops and seminars effective for training purposes a markedly different approach is needed, involving:

(a) Selection of DCPs to be limited to those ready, willing, and able to make real work inputs, and management of the activity to require such inputs including regular homework assignments and examinations. These aspects can hardly be objected to provided both the sponsor and the DC involved are really interested in training as the primary purpose of the activity. As it has been up to now, the participant can, if he wishes, "sleep" through the activity and still receive a certificate of successful completion.

(b) Selection of the Activity Leader to be limited to an OA knowledgeable about the difference between the technologies appropriate for IC and DC situations, and with knowledge in both. Such individuals are not easy to find, that is, they are relatively expensive because they are invariably busy and in demand. The result often has been selection of an individual who is readily available and who will work for less, often an IC professor. Often this individual lacks the essential qualifications, hence the entire project tends to become counter-productive.

Harvey F. Ludwig, Dr. Eng.
Adviser to the National
Environment Board of Thailand
Bangkok, Thailand
ASEP Life Member

ANNEX I-3.1

TEXTBOOK OF APPROPRIATE SEWERAGE TECHNOLOGY FOR DEVELOPING COUNTRIES

Harvey F. Ludwig, Herbert Fennerty, K.L. Sow and Kumar Mohit

Practically all existing textbooks on planning/design of sewerage systems (MSSs) are written by Westerners and tend to emulate the environmental standards and matching design criteria utilized in the affluent industrialized countries (ICs), and because these same standards and design criteria have been used for planning/design of MSSs in the developing countries (DCs), most of the MSSs built in the DCs have been dysfunctional and have not achieved their intended objectives. This new textbook is believed to be the first which is written to be appropriate for DC use, featuring use of simple rather than sophisticated approaches, thus greatly simplifying problems of O&M. The textbook covers all aspects of MSSs systems including institutional, economic, financing, and environmental as well as technical engineering aspects for both sanitary and industrial wastewaters. It covers all components of MSSs including the collection component – collecting sewers, interceptors, and pumping – to collect and deliver the sewage to the treatment plants, plus treatment and disposal. Dr. Harvey F. Ludwig of Bangkok is the Chief Author, assisted by the three co-authors. Their combined experience in MSS technology is estimated 60 man-years, about one-third in IC and two-thirds in DC systems.

ISBN 81–7003–292–X	404 pp.	2005	hbk/Rs.895.00
ISBN 81–7003–298–9	404 pp.	2005	pbk/Rs.395.00

Dr. Harvey F. Ludwig is an American engineer recognized for world leadership in preparing and using project design criteria (and matching environmental standards) for application in affluent Industrialized Countries (ICs) and modifying these to be realistic, affordable, meaningful, and appropriate for Developing Countries (DCs). The present textbook incorporates his recommendations for DC sewerage projects.

Mr. Herbert Fennerty (Cambridge University, M.A. in Civil Engineering) is one of the rare Western engineers with in-depth experience in designing urban sanitary engineering systems, mainly in water supply and sewerage, suitable for both IC and DC conditions. This includes numerous projects in Canada, the Caribbean, South America, Africa, and Middle East as well as Asia.

Mr. K. L. Sow, a Malaysian citizen, received his M.S./Environmental Engineering from the Asian Institute of Technology. He has a remarkable record in planning and designing more than 100 sewerage projects in Southeast Asia, especially in Malaysia, Thailand, and Brunei. His expertise has focused on modifying conventional IC design criteria to be appropriate and practicable for DC use.

Mr. Kumar Mohit, an Indian citizen, received M.S. in Environmental Engineering from the Asian Institute of Technology, has 14 years of experience with Seatec International Consulting Engineers in design of environmental engineering systems in Asian DCs, including assisting on many projects managed by Dr. Ludwig and Mr Sow.

SOUTH ASIAN PUBLISHERS PVT LTD
50 Sidharth Enclave, PO Jangpura, New Delhi 110014, India

ANNEX I-3.2

HFL/22 May 05

PREFACE FOR SEWERAGE TEXTBOOK

1. When Dr. Harvey F. Ludwig retired as President of Engineering-Science, Inc., a major American environmental engineering consulting firm which he established following World War II, which focused on projects in the USA and the Western hemisphere, he decided to begin a new career in (and learn about) the Asian part of the world. Selections of Bangkok to be his operating headquarters was easy—His wife (Vanida) is a Bangkok Thai. Dr. Ludwig's first assignment in Thailand, beginning in 1972, funded by USAID, under the aegis of the National Research Council, was to evaluate the need for the Thai government to establish a national environmental protection agency—This was recommended and was duly established in 1975 as the National Environment Board,. It was during this initial project in Thailand that Ludwig saw the potentials for putting his environmental engineering expertise to work in the developing countries (DCs) of Asia where the concept of protecting precious environmental resources as an essential aspect of sustainable economic development was just beginning to be understood.
2. In 1973 Ludwig established his new company, Seatec International (SI) with headquarters at Bangkok with a staff comprising both expatriate and Asian personnel. Over the subsequent 31 year period SI, under Ludwig's management, has carried out some 200 projects in Asia (including practically all of the developing countries (DCs) of Asia. These have focused on environmental engineering projects including (i) design of sanitary engineering systems (urban water supply and environmental pollution control using environmental standards and matching infrastructure design criteria appropriate for use in DCs), (ii) development and use of environmental impact assessment (EIA) guideline manuals appropriate for evaluating environmental performance of infrastructure investments in DCs, and (iii) development of mechanics for modifying conventional methodology for economic development planning in DCs to incorporate the environmental parameter, to be integrated with the economic parameter and thus result in economic-cum-environmental sustainable development.
3. This work by Ludwig/SI is described in some 170 professional publications discussing the "lessons learned" in the work noted above. Unfortunately most sanitary engineering infrastructure projects built in the DCs, designed by both local and expatriate engineers under the guidance of the International Assistance Agencies (IAAs), are quite dysfunctional because the standards and design criteria utilized are emulations of how it is done in the affluent in industrialized countries which utilize sophisticated technologies requiring O&M skills and cost not practical for DC use. The present textbook, "Appropriate Municipal Sewerage Systems for Developing Countries" is intended to furnish the needed guidance for one important type of sanitary engineering infrastructure, for use by engineers of the DCs, of the IAAs, and of western IC consultants preparing designs for DC use. Unlike practically all existing textbooks, which emulate IC practices, the present textbook emphasizes the use of appropriate standards and matching design criteria, hence the use of the simplest types of equipment requiring the least levels of O&M skills. It emphasizes

also the need for a national sewerage/water pollution control agency in every DC with responsibility for promulgating use of the appropriate designs best suited to the particular country, for evaluating the total need for municipal sewerage systems in the country and prioritizing these to give attention to the most urgent needs, for establishing a meaningful system for periodic monitoring of system performance, and urges the DC governments to seek technical assistance grants form the IAAs to finance projects for preparing the best plan for establishing such national agencies in the DC. Similar textbooks are needed for virtually all types of investments in DC infrastructure, including municipal water supply, municipal solid waste management, DC road and highway design, etc. The present textbook is an intended to be an illustrative "starter".

4. While Dr. Ludwig is the senior author of the present textbook, its preparation has incorporated invalued collaborative inputs from three co-authors, namely Bert Fennerty, Sow Kim Leng, and Kumar Mohit. The combined experience of the 4 authors in sewerage engineering technology per se is estimated to total some 60 man-years (720 man-months), comprising about 20 and 40 years in IC and DC systems respectively. Detailed information on all 4 authors is given in Chapter 1 of the textbook.
5. Dr. Ludwig is a member of USA's National Academy of Engineering—one of the few Academy members with residence in the DCs.

ANNEX I-4

ASEP Newsletter, December 1988

NEW APPROACH FOR ENVIRONMENTAL TECHNOLOGY GRADUATE STUDY FOR DEVELOPING COUTNRIES

Based on some 15 years experience in living and working in developing countries (DCs) on numerous problems of environmental technology, some definitive conclusions may be drawn on the major constraints which inhibit progress in environmental protection and development in the DCs, and what can be done to assist the DCs in solving these problems. One of the most basic needs is for a marked reorientation in the nature of graduate academic training in Environmental Technology, so that the lessons learned will be much more appropriate for meaningful application in the DCS.

Environmental Technology is literally a brand new field, having emerged form its beginnings with the advent of the Environmental Movement in the USA in the 1960s. this in turn led to the UN Stockholm Conference of 1972, following which most DCs established their own National Environmental Protection Agency. Unfortunately, because the U.S. Environmental Protection Agency (USEPA) had pioneered in this field, many counterpart agencies in developing countries tended to try to emulate the USEPA, without realizing that the situation in an industrialized country (IC) like the USA is vastly different, in terms of environmental protection, from that of most DCs. The USEPA has, from its beginning, been blessed with very ample funds and very strong enforcement powers, hence its actions and programs have not had to be much concerned with costs to the national establishment, and effects on its economy; indeed the value of the imposed correction actions for protecting environment has often been simply assumed to equal the cost.

From the DC point of view, economics is and will continue to be a controlling factor over the foreseeable future; hence environmentalism must be sold as a cost-effective part of an overall plan for achieving desirable economic-cum-environmental development, both on a project basis and on a regional planning basis. This means that the DC environmentalist, while depending on the reservoir of Environmental Technology developed in the ICs, must be careful to adjust this to obtain guidelines which fit the local situation.

The critical need is for understanding of the problem, of the need to adapt IC technology to DC conditions, and to implement effective means to enable DCs to do this. Up to now, virtually all Environmental Technologies have had academic study limited essentially to IC technology, simply because this is what is taught by universities everywhere in both ICs and DCs. Hence the developing country environmental "Think Tanks", namely the universities and other research centers, tend to think in terms of using IC technology which is often inappropriate and counterproductive. For example, indiscriminate adoption of IC approaches in planning and conducting Environmental Impact Assessments and in devising and promulgating environmental standards has been prevalent in many DCs.

Clearly, there is a need for a new approach to graduate academic training for DC Environmental Technologists (and also for IC and international assistance agency staff engaged in DC operations). The suggested approach is to reorient the present masters/doctorate programs to make them balanced ("50-50") as far as IC and DC environmental technologies are concerned, so that the student will have a clear understanding of the great difference between the two. When the DC student returns home, with this understanding in hand, he will then be able to contribute to devising and using technology which is appropriate for use in his country.

A trial effort of such a 50-50 graduate course was made by the Environmental/Civil Engineering group of the University of Texas (Austin) as a special summer course in 1986, under the leadership of Dr. E. F. Gloyna who was Dean of Engineering at the time. Most of the students were from Latin America. The results were quire promising and encouraging. Hopefully this initial effort will help to get to-level attention of the international assistance agencies focused on implementing such 50-50 graduate study on a sizeable basis, sufficient to meet the needs of the many DCs faced with very difficult environmental problems.

Dr. Harvey Ludwig
Consulting Engineer/Chairman
SEATEC International Consulting Engineers
P.O. Box 8-101, Bangkok 10800
(ASEP Life Member)

Environmental Protection Action versus Enforcement

(1) Environmental Protection Action (EPA) = Laws/Regulations (L/Rs) x Enforcement (E)

(2) Enforcement (E) = Effective Monitoring (EM) x Stiff Penalities (SPs)

(3) Effective Monitoring (EM)

(3.1) Review of project feasibility study, to ensure inclusion of EIA constraints including use of appropriate environmental standards AESs).
(3.2) Review of project's final design, to ensure inclusion of EIA constraints including environmental controls to be followed by construction contractor.
(3.3) Monitoring of construction contractor's operations to ensure compilance with environmental controls.
(3.4) Inspection of final construction to ensure compilance with environmental construction (before releasing contractor).
(3.5) Periodc monitoring of project operations to ensure implementation of prescribed EPMs, including sampling and analyses, to evaluate project's actual environmental impacts, with follow-up to obtain needed corrections.

NOTES

(i) Symbol X means multipled by.
(ii) In USA and other industrialized countries, L/R, EM and SP are adequate, hence EPA is real.
(iii) In DCs, while many have adequate L/Rs, practically none as yet practice meaningful systematic monitoring or enforcement of meaningful penalties.
(iv) Effective monitoring is technically complex, because the data must be statistically sufficient to prove non-compilance. The saying in California is "No monitoring, no compliance action".
(v) Even with good monitoring there wil be little compilance unless penaltis are stiff enough to be "painful".

ANNEX I-5

ADB

Project Completion Report

PCR: FSM 27465

Water Supply and Sanitation Project (Loan 1459-FSM) in the Federated States of Micronesia

March 2005

Asian Development Bank

CURRENCY EQUIVALENTS

The currency unit of the Federated States of Micronesia is the US dollar.

ABBREVIATIONS

ADB	–	Asian Development Bank
BME	–	benefit monitoring and evaluation
CPUC	–	Chuuk Power Utilities Corporation
DSCR	–	debt-service coverage ratio
DTCI	–	Department of Transport Communication and Infrastructure
EA	–	Executing Agency
EIRR	–	economic internal rate of return
EOCC	–	economic opportunity cost of capital
IDC	–	interest during construction
FIRR	–	financial internal rate of return
FSM	–	Federated States of Micronesia
O&M	–	operation and maintenance
PCR	–	project completion report
PIA	–	project implementation agency
PMU	–	project management unit
PPTA	–	project preparatory technical assistance
PUC	–	Pohnpei Utilities Corporation
SOE	–	statement of expenditure
TA	–	technical assistance
UC	–	utility corporation
WACC	–	weighted average cost of capital
YSPSC	–	Yap State Public Service Corporation

WEIGHTS AND MEASURES

m^3	–	cubic meter
m^3/day	–	cubic meter per day
km	–	kilometer
km^2	–	square kilometers
gpm	–	galloon per minute
ha	–	hectare
mgd	–	million galloon per day
mg/l	–	milligram per liter
ml/day	–	megaliters per day

NOTES

(i) The fiscal year (FY) of the Government and its agencies ends on 30 September. FY before a calendar year denotes the year in which the fiscal year ends, e.g., FY2002 ends on 30 September 2002.

(ii) In this report, "$" refers to US dollars.

CONTENTS

BASIC DATA

A.	**Loan Identification**		
	1.	Country	Federated States of Micronesia
	2.	Loan Number	1459-FSM(SF)
	3.	Project Title	Water Supply and Sanitation Project
	4.	Borrower	Federated States of Micronesia
	5.	Executing Agency	Department of Transportation, Communications and Infrastructure (DTCI)[1]
	6.	Amount of Loan	SDR7,233,000
	7.	Project Completion Report Number	PCR:FSM 846
B.	**Loan Data**		
	1.	Appraisal	
		– Date Started	20 May 1996
		– Date Completed	11 June 1996
	2.	Loan Negotiations	
		– Date Started	12 August 1996
		– Date Completed	14 August 1996
	3.	Date of Board Approval	19 September 1996
	4.	Date of Loan Agreement	10 January 1997
	5.	Date of Loan Effectiveness	
		– In Loan Agreement	10 April 1997
		– Actual	10 October 1997
		– Number of Extensions	2
	6.	Closing Date	
		– In Loan Agreement	31 October 2000
		– Actual	4 February 2004
		– Number of Extensions	4
	7.	Terms of Loan	
		– Interest Rate	Service charge of 1% per annum
		– Maturity	40 years
		– Grace Period	10 years
	8.	Terms of Relending (if any)	National Government to the State Governments
		– Interest Rate	Service charge of 1% per annum
		– Maturity	25 years
		– Grace Period	5 years
		– Second-Step Borrower	The state governments to their respective utility companies at Asian Development Bank's interest rate for US dollar loans from its ordinary capital resources (6.82% per annum), an amortization period of 25 years, including a grace period of 5 years. A portion of the loan proceeds was held in the National Government to finance consulting services.

[1] The Executing Agency for the project at appraisal was the Office of Planning and Statistics.

9. Disbursements

a. Dates

Initial Disbursement	Final Disbursement	Time Interval
12 December 1997	5 August 2003	67.9 months
Effective Date	**Original Closing Date**	**Time Interval**
10 October 1997	31 October 2001	48.36 months

b. Amount ($)

Category	Original Allocation	Last Revised Allocation	Net Amount Available	Amount Disbursed	Undisbursed Balance[a]
01 Civil Works					
01A-Chuuk	1,612,056	2,446,561	2,446,561	2,453,139	(6,578)
01B-Kosrae	1,207,576	0	0	0	0
01C-Pohnpei	1,206,111	948,293	948,293	856,050	92,243
01D-Yap	1,411,282	2,377,432	2,377,432	2,244,920	132,512
02 Equipment					
02A-Chuuk	449,910	661,732	661,732	581,610	80,122
02B-Kosrae	65,948	0	0	0	0
02C-Pohnpei	29,310	200,224	200,224	248,901	(48,677)
02D-Yap	240,343	126,661	126,661	25,917	100,744
03 Materials					
03A-Chuuk	174,395	438,587	438,587	426,985	11,602
3B-Kosrae	212,498	0	0	0	0
03C-Pohnpei	293,101	885,080	885,080	1,013,818	(128,738)
03D-Yap	240,343	129,749	129,749	0	129,749
04 Consulting Services	1,486,022	1,031,421	1,031,421	1,029,750	1,671
05 Service Charge	124,568	229,501	229,501	227,428	2,073
06 Unallocated	1,846,537	92,381	92,381	0	92,381
99 Imprest Account	0	0	0	0	0
Total	**10,600,000**	**9,567,622**	**9,567,622**	**9,108,518**	**459,104**

[a] Undisbursed amount was cancelled on 4 February 2004.
Source: Asian Development Bank.

c. TA Amount ($)

Category	Allocation	Commitment	Disbursed	Undisbursed
Consultants	414,000	410,236	389,812	24,188
Materials and Equipment	80,000	114,500	105,036	(25,036)
Workshops, Training, and Seminars	9,000	21,400	21,400	(12,400)
Studies, Surveys, and Reports	5,000	18,000	18,000	(13,000)
Miscellaneous Administration	2,000	9,750	9,750	(7,750)
Contingencies	73,000	4,114	0	73,000
Government Observer	4,000	4,695	4,695	(695)
Total	**587,000**	**582,695**	**548,693**	**38,307**

Source: Asian Development Bank.

10. Local Costs (Financed)
    - Amount ($) $0.91 million
    - Percent of Local Costs 34
    - Percent of Total Cost 8

C. Project Data

1. Project Cost ($ million)

	Appraisal Estimate			Actual		
	ADB	FSM	Total	ADB	FSM	Total
Foreign Exchange Cost	9.20	0.00	9.20	8.20	0.00	8.20
Local Currency Cost	1.40	2.70	4.10	0.91	1.74	2.65
Total Cost	**10.60**	**2.70**	**13.30**	**9.11**	**1.74**	**10.85**

ADB = Asian Development Bank, FSM = Federated States of Micronesia.
Source: Asian Development Bank.

2. Financing Plan ($ million)

		Appraisal			Actual		
	Source	Foreign	Local	Total	Foreign	Local	Total
A	Implementation Costs						
	National and State Governments	0.00	2.70	2.70	0.00	1.74	1.74
	ADB Financed	9.00	1.40	10.40	7.98	0.91	8.89
	Total A	**9.00**	**4.10**	**13.10**	**7.98**	**2.65**	**10.63**
B	Service Charge						
	Borrower Financed	0.00	0.00	0.00	0.00	0.00	0.00
	ADB Financed	0.20	0.00	0.20	0.23	0.00	0.23
	Total B	**0.20**	**0.00**	**0.20**	**0.23**	**0.00**	**0.23**
	Total A and B	**9.20**	**4.10**	**13.30**	**8.20**	**2.65**	**10.85**

ADB = Asian Development Bank.
Source: Asian Development Bank.

3. Cost Breakdown by Project Component

	Appraisal			Actual		
Component	**ADB**	**FSM**	**Total**	**ADB**	**FSM**	**Total**
Civil Works	6.36	0.71	7.07	7.00	0.78	7.77
Equipment	0.79	0.09	0.88	0.86	0.10	0.96
Consulting Services	1.49	0.20	1.69	1.03	0.06	1.09
Project Management Office	0.00	1.17	1.17	0.00	0.80	0.80
Contingencies	1.85	0.53	2.38	0.00	0.00	0.00
Service Charge	0.13	0.00	0.13	0.23	0.00	0.23
Total	**10.60**	**2.70**	**13.30**	**9.11**	**1.74**	**10.85**

ADB = Asian Development Bank, IDC = interest during construction.
Source: Asian Development Bank.

4. Project Schedule

Item	**Appraisal Estimate**	**Actual**
Date of Contract with Consultants[a]		
1. Parsons Engineering Science	October 1996	29 August 1997
2. Sinclair Knight Merz		March 2001
3. Professor Keyan Zheng		March 2001
4. Mahabub K. Chowdhury		February 2002
5. Pipeline Network Analysis		September 2002
Chuuk State:		
Completion of Engineering Designs	November 1997	September 1999
Civil Works Contracts:		
CWC-01: Well Drilling		
Award of Contract	November 1996	May 1998
Completion of Work	June1997	December 1999
CWC-02: Rehabilitation of Weno Water Supply		
Award of Contract	March 1998	March 2000
Completion of Work	April 1999	March 2001
CWC-03: Installation of Power Supplies		
Award of Contract	March 1998	February 2001
Completion of Work	April 1999	June 2002
CWC-05: Installation of Water Meters		
Award of Contract	March 1998	September 2002
Completion of Work	April 1999	October 2002
Equipment and Materials		
Dates:		
First Procurement	October 1997	December 1997
Last Procurement	March 1998	December 2000
Completion of Equipment Installation	April 2000	December 2001
Start of Operations		
Completion of Tests and Commissioning	April 2000	March 2001
Pohnpei State:		
Completion of Engineering Designs	January 1999	June 2001
Civil Works Contracts:		
CWP-01: Pipeline Construction		
Award of Contract	January 1998	March 2000

Item	Appraisal Estimate	Actual
Completion of Work	February 1999	September 2001
CWP-02: Well Drilling		
Award of Contract	June 2001	March 2002
Completion of Work	December 2001	October 2002
Equipment and Materials		
Dates:		
First Procurement	November 1997	December 1999
Last Procurement	March 1998	October 2002
Completion of Equipment Installation	April 2000	October 2002
Start of Operations		
Completion of Tests and Commissioning	April 2000	October 2002
Yap State:		
Completion of Engineering Designs	November 1997	August 2000
Civil Works Contract		
CWY-01: Well Drilling		
Award of Contract	November 1997	February 1999
Completion of Work	June1998	October 1999
CWY-02: Transmission Line		
Award of Contract	March 1998	February 1999
Completion of Work	April 1999	September 2001
CWY-03RS: Development of Wellfield		
Award of Contract	March 1998	February 2000
Completion of Work	April 1999	June 2002
Equipment and Supplies		
Dates:		
First Procurement	May 1997	August 2001
Last Procurement	November 1998	August 2001
Completion of Equipment Installation		
Start of Operations		
Completion of Tests and Commissioning	January 1999	October 2001

5. Project Performance Report Ratings

	Ratings	
Implementation Period	**Development Objectives**	**Implementation Progress**
30 November 1998 to 31 December 1998	S	U
31 January 1999 to 31 May 1999	S	U
30 June 1999 to 31 December 1999	S	S
31 January 2000 to 31 March 2000	S	S
30 April 2000 to 31 August 2003	S	S

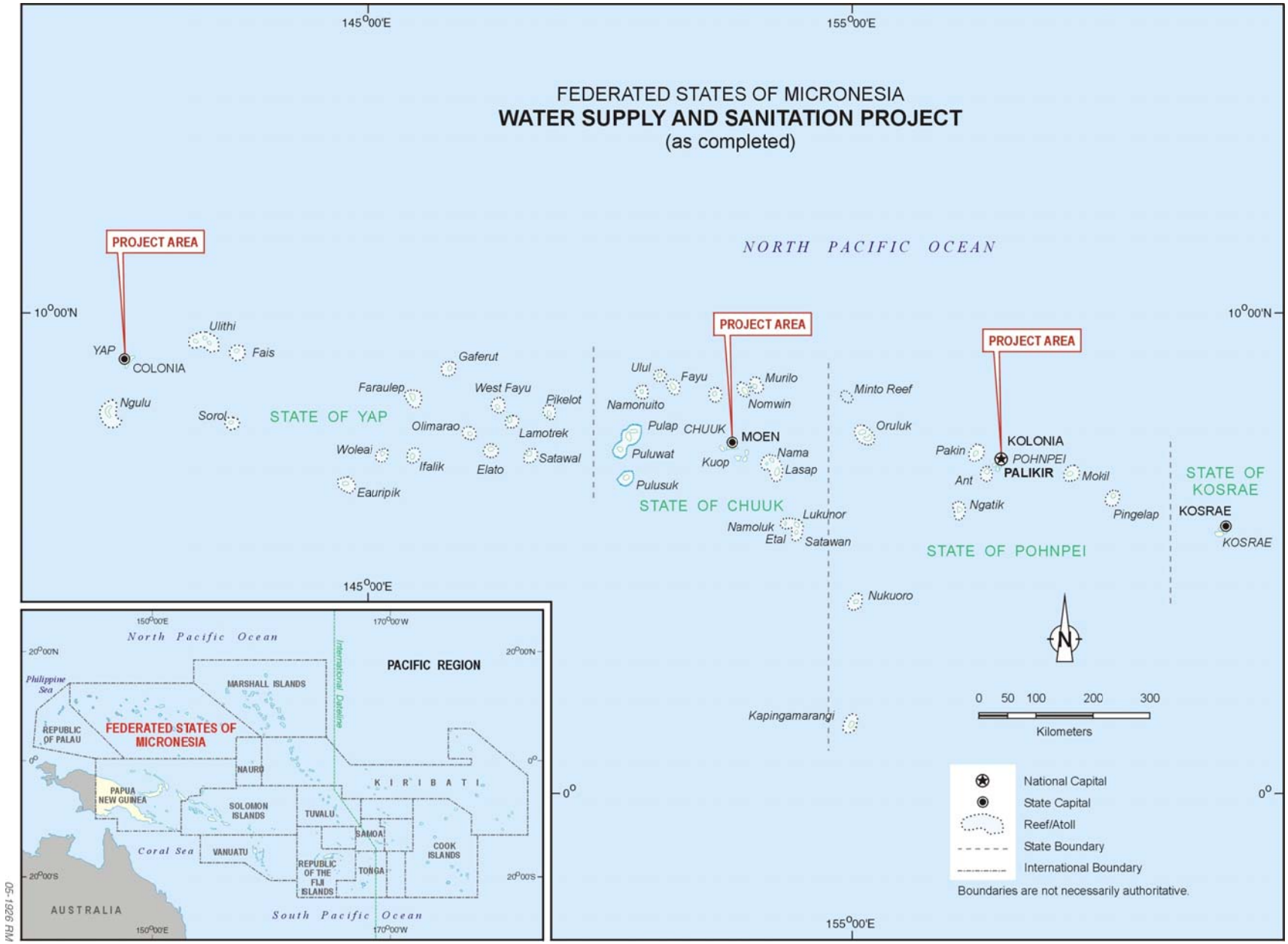
D. Data on Asian Development Bank Missions

Name of Mission	Date	No. of Persons	No. of Person-Days	Specialization of Members[a]
Fact-Finding	5–23 February 1996			a
Consultation	April 1996			a
Appraisal	20 May to 11 June 1996	4		a, b, c, d
Inception	17 February to 4 March 1997	2	32	a, h
Special Project Review 1	6 to 9 May 1997	3	9	e, f, h
Review 1	25 November to 6 December 1997	2	22	a, h
Review 2	10 to 14 May 1998	1	5	a
Special Project Review 2	11 to 13 November 1998	1	3	f
Review 3	17 to 23 May 1999	2	12	g, h
Midterm Review	17 to 28 September 2000	2	22	g, h
Total		**17**	**105**	
Project Completion Review[b]	31 August to 13 September 2003	3	42	g, h, i

[a] a – project engineer, b – economist/financial analyst, c – water supply engineer, d – assistant general counsel, e - project administration specialist, f- project administration unit head, g – project implementation specialist, h- senior assistant/assistant project administration analyst, i – staff consultant/financial specialist.

[b] The Project Completion Report was prepared by Amarnath Hinduja, Senior Project Specialist, Antonietta Salvador, Assistant Project Administration Analyst, and Teresa Villareal, Staff Consultant.

Source: Asian Development Bank.


FEDERATED STATES OF MICRONESIA
WATER SUPPLY AND SANITATION PROJECT
(as completed)
145°00'E
155°00'E
10°00'N
0°
NORTH PACIFIC OCEAN
PROJECT AREA
YAP
COLONIA
Ulithi
Fais
Gaferut
Faraulep
West Fayu
Pikelot
Ngulu
Sorol
STATE OF YAP
Olimarao
Lamotrek
Woleai
Ifalik
Elato
Satawal
Eauripik
PROJECT AREA
Ulul
Fayu
Murilo
Namonuito
Nomwin
Minto Reef
Pulap
CHUUK
MOEN
Oruluk
Puluwat
Kuop
Nama
Lasap
Pulusuk
STATE OF CHUUK
Lukunor
Namoluk
Etal
Satawan
PROJECT AREA
KOLONIA
Pakin
POHNPEI
PALIKIR
Ant
Mokil
STATE OF KOSRAE
Ngatik
Pingelap
KOSRAE
KOSRAE
STATE OF POHNPEI
Nukuoro
Kapingamarangi
N
0 50 100 200 300
Kilometers
National Capital
State Capital
Reef/Atoll
State Boundary
International Boundary
Boundaries are not necessarily authoritative.
PACIFIC REGION
North Pacific Ocean
International Dateline
Philippine Sea
MARSHALL ISLANDS
REPUBLIC OF PALAU
FEDERATED STATES OF MICRONESIA
NAURU
KIRIBATI
PAPUA NEW GUINEA
SOLOMON ISLANDS
TUVALU
SAMOA
Coral Sea
VANUATU
COOK ISLANDS
REPUBLIC OF THE FIJI ISLANDS
TONGA
AUSTRALIA
South Pacific Ocean
05-1926 RM

I. PROJECT DESCRIPTION

1. An analysis of the rain patterns in the Federated States of Micronesia (FSM) showed that all four states (Chuuk, Kosrae, Pohnpei, and Yap) receive ample but uneven annual rainfall. During the El Nino phenomenon in the early 1990s, all the islands suffered from severe droughts. Yap, in particular, has endured a series of relatively harsh droughts, which occur every 3–5 years and last for several months. This situation has been aggravated by the generally old and disparate water supply systems on the islands, which need repair, maintenance, and supervision. In addition, no new water sources have been developed to address the seasonal shortages. Health indicators have shown a high incidence of water-related diseases, such as diarrhea and typhoid, which can be attributed directly to poor water supply, sanitation, and hygiene. This reflected the status of the services before the FSM Water Supply and Sanitation Project (the Project).[1]

2. The main objective of the Project was to continue the Asian Development Bank's (ADB) support for the Government's efforts to improve water supply and sanitation services in the four island states. Chuuk, Kosrae, Pohnpei, and Yap include more than 600 islands scattered over 2.6 million square kilometers (km^2) of the western Pacific Ocean. The land area of Micronesia is about 700 km^2, while the country's population at project appraisal was about 105,000. By 2000, nearly 6 years after appraisal, the population had increased to 107,000.[2]

3. The Project focused on policy reforms in the water supply sector, particularly in the areas of demand management and cost recovery.[3]

4. The project scope and anticipated outputs at appraisal consisted of Part A, Water Supply Facilities Improvements; and Part B, Project Implementation Support. (Hereafter, the states are listed in order of their population, from largest to smallest.)

Part A: Water Supply Facilities Improvement:

(i) Chuuk: Construction of 30 water wells, refurbishment of a water treatment plant and three water tanks, construction of a new water transmission pipeline, and installation of chlorinating facilities;

(ii) Pohnpei: Construction of four water distribution pipelines to extend the coverage of the service areas;

(iii) Yap: Construction of seven water wells and deepening of another well, construction of transmission and distribution pipelines and a pumping station, refurbishment of a water treatment plant, and installation of chlorinating facilities and a water tank;

(iv) Kosrae: Construction of four water treatment plants and water transmission and distribution pipelines, and refurbishment of one intake; and

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[1] The most striking examples of the effect of poor water and sanitation conditions were outbreaks of cholera in Chuuk between 1980 and 1982, and again in 1990. In all states, outbreaks of leptospirosis have been associated with contamination by rats of rainwater collected from roofs and stored in household rainwater tanks.

[2] The population based on the 2000 census: Chuuk, 53,595; Kosrae, 7,678; Pohnpei, 34,486; and Yap, 11,241.

[3] The Government has encouraged the states to undertake the institution-building reforms necessary to establish autonomous, self-governing utility companies (UCs). But reforms between the states reflect the small size of the systems and intersystem differences, and the socioeconomic difference between the states.

(v) Connections to new households and installation of consumer water meters in all states.

Part B: Project Implementation Support: This covered consulting services for project management and project implementation support.

5. The Project also had associated technical assistance (TA),[4] which aimed to improve (i) operation and maintenance (O&M) procedures, (ii) billing, (iii) accounting, and (iv) management information systems. It also covered the development of utility companies' (UCs) abilities in public education and participation. Outputs of the TA were to include capacity building activities including training manuals and equipment. The manuals focused on reinforcing the capacity building activities at each UC in an attempt to improve its economic and technical efficiencies, which would enable them to consistently attract the necessary investments to the sector.

II. EVALUATION OF DESIGN AND IMPLEMENTATION

A. Relevance of Design and Formulation

6. With the urban population in the FSM rising as people from different parts of the country—including those from the outer islands—migrated to the state capitals in search of employment, the timing of the Project was especially relevant. The deterioration of the health made the development of water supply and sanitation facilities necessary. The Project Completion Report (PCR) Review Mission concluded that the project objectives generally had been achieved. Pohnpei and Yap produced more successful results, while the successes were limited in Chuuk. In Kosrae, while the Project remains highly relevant, its objectives were not achieved due to the state's withdrawal from the Project. The communities in Pohnpei and Yap significantly benefited from the project through improvements in the quantity and quality of the water supply. In Chuuk, the implementation of the physical works was completed successfully. However, the Project did not establish a sustainable institutional structure to maintain the infrastructure and associated benefits.

7. The Mission also found that the proposed design and formulation, as conceived at the time of appraisal, was highly relevant to the strategies and objectives of both ADB and the Government. However, the Mission noted that the project proposal and implementation plan failed to take into account the difficulties of working effectively with five governments (national and four states). A precondition for project effectivity was that two states and their UCs must enter into a tripartite financing agreement satisfactory to ADB. The national Government's reluctance to sign the loan agreements until it was reasonably sure that the states would comply with the conditions of loan disbursement delayed project implementation for more than a year. Land acquisition also delayed implementation. While land ownership issues are not uncommon in most Pacific island countries, the Project failed to take into account the particularly difficult situation in FSM.[5] The sustainability of the project in Chuuk already is in question, partly due to the land issues faced during implementation. Although there were implementation problems, nevertheless, the project design is considered relevant at completion.

[4] ADB. 1996. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan and Technical Assistance to the Federated States of Micronesia for the Water Supply and Sanitation Project*. Manila.

[5] Due to the cross-migration among the four states that are separated by vast distances and tribal cultures, land ownership is a particularly sensitive issue.

8. The Project was generally well formulated through the Project Preparatory TA (PPTA).[6] It included relevant support for project management and implementation components for the UCs. However, the PPTA could have designed the project monitoring system for better implementation. The original project objectives and project elements did not change throughout implementation. However, some appropriate and relevant design changes in the Yap component, such as replacing the booster-fed system with a gravity-based system, were made to lower the operating cost of the system. Overall, the quality of the PPTA was satisfactory.

9. The attached TA[7] included measures that assisted the development of the UCs as viable and sustainable institutions by ensuring their autonomy from the states. Appropriate cost-recovery policies and mechanisms have been put in place to eliminate subsidies to UCs within 5 years of project completion. Full cost recovery[8] was expected within 10 years of project completion. Such measures were in line with ongoing reforms in the sector. The Government planned to initiate legislative reforms aimed at providing autonomy and accountability for the financial and operational performance of the enterprises. The advisory TA support was relevant to the Project.

B. Project Outputs and Implementation

10. A brief summary of outputs anticipated at appraisal for the four states is listed in para. 4. Apart from some necessary changes, the outputs were achieved in Pohnpei and Yap. In Chuuk, the achievement was partly satisfactory. With the cancellation of the project in Kosrae, none of the outputs were achieved. A brief summary of the issues faced in each state is provided in paras. 11−17. The details of achievements are in Appendix 1.

1. Chuuk

11. Chuuk was the first state to comply fully with the conditions of loan effectiveness. However, the Project faced difficulties from the outset. Procurement of a drilling rig for use in Chuuk was part of the advance action approved under the Project. Due to delays in project implementation, this procurement was deferred. Later when the procurement was initiated, the actual cost of the rig was considerably higher than projections.

12. The Project remains highly relevant in Chuuk, but it failed to achieve the immediate objective of providing improved water supply services to targeted beneficiaries. These were due to (i) fewer households than expected were connected, and (ii) the quantity and quality of the water provided varied. The Chuuk Public Utilities Corporation (CPUC) is in severe financial difficulty due to less than 50% collection rate and poor management. This has resulted in poor maintenance and inefficient service, which have left only five of 16 ADB-sponsored wells in operation. Due to the lack of administrative direction and excessive dependence on the board of directors and the Government for most administrative decisions, major changes in the administrative structure of the UC would be necessary before it could provide the level of services expected.

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[6] ADB. 1994. *Technical Assistance to the Federated States of Micronesia for Water Supply and Sewerage*. Manila. (TA No.2137-FSM, approved on 18 August 1994).

[7] ADB. 1996. *Capacity Building for Management and Operation of Water Supply and Sanitation System.* Manila.

[8] In the loan covenant, each UC was expected to formulate the appropriate tariff structures and levels, and develop programs for the implementation of these tariffs, and determine the degree of cross-subsidization between user groups to ensure that a basic quantity of water is available at an affordable price to lower-income consumers.

2. Pohnpei

13. Pohnpei was the last of the three states to comply with the disbursement conditions, which significantly delayed the start of implementation. While the scope of activities to be undertaken by the Pohnpei Utilities Corporation (PUC) was limited mainly to construction of four new water distribution pipelines to extend the coverage of the service area, PUC management was extremely proactive and completed the work well within the prescribed schedule. Seizing the opportunity created by the withdrawal of Kosrae, PUC requested assistance for a hydrogeological survey for new well sites, the procurement of the necessary equipment and material, and the drilling of 10 new wells that would help increase the source of water supply. PUC undertook the work soon after the increase in scope was approved, and completed it by the extended loan closing date.

14. During a site inspection, the PCR Mission confirmed that all activities were completed according to the agreed scope, and the facilities were being operated and maintained efficiently. The Project's objectives of providing safe and reliable water supply and better sanitation were addressed successfully.

3. Yap

15. Significant design changes were made to the Yap component of the Project. The change in scope covered additional work for the study, design, and construction of a water treatment plant to reduce the iron and manganese in the groundwater of Eyeb Well field. It also included further study of the Gitam treatment plant, which was not envisaged during project formulation. Yap's original design featured a booster-operated supply system, which was found to be inefficient and difficult to maintain. The system was redesigned into a gravity-fed system, which has been proven to be more suitable to local topography. The new system also is less expensive to maintain.

16. The PCR Mission confirmed that the essential infrastructure to support urban development was in place and operating efficiently. This has been instrumental in improving the living conditions of people in Yap.

4. Kosrae

17. The Kosrae component was cancelled in late 2000 due to the state's noncompliance with a disbursement condition that required the state legislature to authorize the governor to sign the financing agreement. The Mission concluded that the community in Kosrae generally agreed on the need for a safe water supply. However, Kosrae could not reach a consensus on the community paying for such services. This was the primary reason for the failure of the state legislature to pass the legislation, despite repeated attempts. After the cancellation of the Kosrae component, the loan proceeds were reallocated to the other three states to offset cost escalations and support approved changes in scope:

(i) Chuuk: To include the design and rehabilitation of the sewer treatment plant, in an attempt to prevent the dumping of raw sewage into the lagoon.

(ii) Pohnpei: To support an expected increase in the demand for water as a result of expansion in the distribution system, to conduct a hydrogeological survey for the

new well, and to assist in the procurement of equipment and materials for the well drilling program.

(iii) Yap: To support the financing shortfall due to necessary changes in the project design.

C. Project Costs

18. At appraisal, the project cost was estimated at $13.30 million.[9] The Government requested a loan of $10.60 million equivalent to cover $9.20 million in foreign exchange costs and $1.40 million in local currency costs. The approved loan for SDR7.23 million (or $10.60 million equivalent) from ADB's Special Fund resources covered 80% of the project cost.[10] The national Government and the state governments were to jointly meet the remaining local currency cost of $2.70 million. Due to depreciation of the SDR against the dollar, the amount available for the loan at closing was $9.57 million equivalent compared to $10.60 million at approval. While the available loan amount was reduced, following the cancellation of the Kosrae component, the cost and the scope of the Project increased in the three remaining states. To offset the shortfall and support the scope increases necessary to enhance the outputs in the three states, the loan funds originally for Kosrae were reallocated at the request of the Government. At project completion, the amount disbursed for the three states was $9.11 million.

19. The actual project cost of $10.85 million was lower than the appraisal estimate of $13.30 million due to the realignment of project coverage from four states to three states. The revised project costs resulted in lower financial internal rates of return (FIRRs) and economic internal rates of return (EIRRs) for the three states. The project EIRR was 12.9%, lower than the 16.2% estimated at appraisal.

20. Table 1 compares the actual costs for the project components with the appraisal estimates.

Table 1: Project Cost Comparison ($ million)

	Appraisal			Actual		
Component	**Foreign**	**Local**	**Total**	**Foreign**	**Local**	**Total**
Civil Works	5.11	1.96	7.07	6.24	1.56	7.80
Equipment	0.63	0.25	0.88	0.77	0.19	0.96
Consulting Services	1.49	0.20	1.69	0.97	0.12	1.09
Project Management Office	0.00	1.17	0.17	0.00	0.78	0.78
Contingencies	1.85	0.53	2.38	0.00	0.00	0.00
Service Charge	0.13	0.00	0.13	0.23	0.00	0.23
Total	**9.20**	**4.10**	**13.30**	**8.20**	**2.65**	**10.85**

Source: Asian Development Bank and Consultant's Report.

[9] Comprising $9.20 million in foreign currency, and $4.10 million in local currency.

[10] FSM's national and state governments, as the Borrowers, were to have allocated $2.70 million (20% of the project cost) as matching funds. This $2.70 million equity contribution comprised counterpart funds for land and contributions for taxes and duties.

D. Disbursements

21. Government approval procedures delayed loan effectiveness, which in turn delayed the start-up Project activities. Under the re-lending agreements between the Borrower and Chuuk, Yap, and Pohnpei, the states had to submit their withdrawal applications to the central PMU established by the Borrower. Soon after the Project became effective on 10 October 1997, an imprest account was established and an amount of $120,000 was deposited to the account with Bank of FSM.

22. Loan disbursements amounted to a total of $9.11 million (Appendix 2). The use of the imprest account and SOE procedures simplified the procedures for drawing advances and replenishments, and were extremely beneficial to Project implementation. However, replenishment of the imprest account was often delayed, mainly due to the lack of dedicated accounting staff to oversee the project accounts. The loan closing was delayed beyond the allowable winding-up period of 90 days. This undue delay was a result of delays on the part of the Borrower in reconciling and settling the unliquidated advances of the imprest account with ADB. A refund of $6,502.37 was finally received by ADB on 4 February 2004. Upon this final settlement, the loan was effectively closed as of 4 February 2004.

E. Project Schedule

23. The loan was approved on 19 September 1996, became effective on 10 October 1997, and had an original closing date of 31 October 2000. However, the Project was significantly delayed, mainly due to the states' late compliance with disbursement conditions. As explained in paras. 12, 14 and 22, appropriate dialogue during the design stage could have minimized the delays. Chuuk was the first state to comply with the conditions, nearly 13 months after approval. Yap and Pohnpei complied with the loan conditions 24 and 34 months after loan approval, respectively. By July 1999, three states had complied, and the withdrawal of Kosrae was confirmed. At around this time, disbursements picked up significantly, reflecting major contract awards for civil works. The reallocation of funds from the Kosrae component to the other three states supported significant scope changes that enhanced project objectives. However, this necessitated a loan extension. The Project finally closed on 4 February 2004, after five loan extensions. In light of the 34 months of delay, an implementation period of 70 months from effectivity—including the approved major increase in scope—was considered satisfactory (Appendix 3).

F. Implementation Arrangements

24. The original Executing Agency (EA) for the Project, the Office of Planning and Statistics, was changed to the Department of Transportation, Communications and Infrastructure (DTCI), which is the agency responsible for public utilities. The utility corporation in each state were the implementing agencies: CPUC, Yap State Public Service Corporation (YSPSC), and PUC. DTCI provided the overall coordination for the Project through the PMU, which was established in 1997. The PMU consisted of a project manager under UN funding, and a project supervision consultant, funded under the Project. DTCI, the Government, the consultants, and ADB coordinated closely. The PMU effectively managed the Project, despite the land acquisition problems, and the lack of materials and capable staff. However, after the departure of the project manager and the accountant, implementation slowed during the closing months of the Project. This led to problems in finalizing the liquidation of the imprest fund at loan closing (Appendix 4).

25. The Project's implementation arrangements were effective, and facilitated the transition from project implementation to operations and management of project facilities. Overall, the implementation, though delayed, was satisfactory.

G. Conditions and Covenants

26. Loan effectivity was conditional on the states' compliance with the disbursement conditions. This appeared to be a major hurdle, requiring almost 13 months for the first state to comply, while the other two complied within 24 and 34 months, respectively. No covenants were modified, suspended, or waived during implementation. A majority of the loan covenants were complied with (Appendix 5). Partial compliance was observed in relation to (i) financial management and project accounting due to the absence of full-time accounting staff in Chuuk and PMU; (ii) revenue generation and reduction of non-revenue water. Chuuk was the only utility that did not comply with the covenant. These conditions are not likely to be complied with in the short term due to the serious management problems at the Chuuk utility; and (iii) asset inventory and valuation covenant for development of a benefit monitoring and evaluation (BME) manual was not complied with. Neither the PMU nor the state utilities maintained a benefit monitoring system. In the future, the applicability and relevance of some of the covenants should be carefully considered before being included to ensure effective compliance.

H. Related Technical Assistance

27. The PPTA was evaluated as satisfactory. It formulated the Project clearly, defining all the components and assessing the needs of each state. The project design appropriately included an advisory TA[11] to provide capacity building and institutional strengthening to the UCs. Major TA activities included (i) training in operation and maintenance of water and sewage treatment plants for Yap, Chuuk, and Kosrae; (ii) capacity building in billing, accounting, and management information systems for the Chuuk and Kosrae UCs to bring them up to the standard of PUC and YSPSC; and (iii) capacity building in leakage prevention and detection, including the preparation of base plans of water distribution systems.

28. While the concept and coverage of the advisory TA were very appropriate, the implementation schedule was problematic. The TA consultants were mobilized in October 1997, before the Project began. Since the participation of the states and their utilities depended on their compliance with the disbursement conditions, the timing of the TA implementation should have been programmed to match the project implementation. Further, Kosrae's failure to participate in the Project made it impractical for that state to receive training on billing and accounting of water supply services, as the UC did not have a water supply system under its jurisdiction. In Chuuk, the sustainability of the TA's benefits was questionable, because the services of the personnel trained in billing and financial management and O&M of project facilities were terminated.[12] The CPUC lacks administrative direction. Overall, the benefits achieved from the TA have been limited.

29. The TA was designed to increase the UCs' capabilities in O&M, billing and financial management, and enhance the capabilities of the state Government departments in public education and participation in water supply and sanitation issues.[13] However, only YSPSC and

[11] ADB. 1996. *Technical Assistance to the Federated States of Micronesia for Capacity Building for Management and Operation of Water Supply and Sanitation System*. Manila.

[12] Since October 2002, no accountant was assigned, resulting in a lack of financial management and control.

[13] Even though the Kosrae component was cancelled, some basic training in financial management and operations was given to Kosrae Utilities Authority staff during a review mission in 1998.

PUC undertook more effective financial management, which enabled them to cover O&M costs, including salaries, repairs, maintenance, and supplies.[14] Despite having a small customer base, YSPSC was the most efficient in its water supply operations. PUC has not increased its tariff and reduced its non-revenue water, two steps needed for its operations to become self-sustaining.

30. CPUC suffered from inefficient management, an inability to provide a continuous supply of good quality water, and delays in the implementation of a tariff at any level. As a result, CPUC was unable to collect arrears from customers, and failed to charge appropriate water tariffs to recover its O&M costs. To improve the financial viability of its operations, drastic reforms in management, billing and collection, and operations are needed. This should be undertaken based on a comprehensive financial restructuring and performance audit by the national and state governments.

31. Management and operational training manuals on water supply production and treatment plants were prepared under the TA for the benefit of the new staff. These were used to orient the new staff. About 20 employees from the UCs and other government agencies benefited from the TA. The outputs of the TA were rated as partly satisfactory.

I. Consultant Recruitment and Procurement

32. Goods and services were procured from loan funds in accordance with ADB's *Guidelines for Procurement* and *Guidelines on the Use of Consultants*. Civil works, equipment, and materials were procured largely as appraised**.** All civil works contracts, equipment, and materials were procured through international competitive bidding. No major problems were encountered in packaging contracts, preparing bidding documents, or evaluating bids. Further, no disputes or contractual difficulties were encountered with any contracts. The recruitment of design and supervision consultants also complied fully with ADB guidelines.

J. Performance of Consultants, Contractors, and Suppliers

33. The overall performance of consultants, contractors and suppliers was generally satisfactory. Implementation could have been expedited if the consultants had been recruited, fielded and managed in a timely manner. The consultants' inputs were critical in the implementation of the project components, especially the civil works. The contractors and suppliers completed their contracts generally on time. The Project has helped to further enhance local small contractors and to undertake small contracts.

K. Performance of the Borrower and the Executing Agency

34. The performances of the Borrower and EA were generally satisfactory. They met their responsibilities and obligations during project implementation. The initial delays in project implementation cannot be attributed to their performance, as they were due to the political structure of four independent state governments and the national Government. However, CPUC's implementation suffered extensive delays due to the delayed release of adequate counterpart funds, and the UC's organizational and operational uncertainties. A change in its management structure should be a prerequisite for any future assistance to this utility. Future

[14] Starting in May 2002, Chuuk implemented a flat tariff of $5 per connection, regardless of water consumption. CPUC has been reluctant to impose consumption-based charges until the quality and reliability of its water supply significantly improves (May 1998). CPUC's failure to enforce effective user charges compromised its financial operations.

projects must ensure that a political consensus is secured during appraisal to avoid unnecessary delays.

L. Performance of the Asian Development Bank

35. Overall, ADB's assistance was satisfactory. ADB undertook six review missions to monitor the progress of the Project, and worked on the resolution of implementation issues. ADB review missions worked closely with the Government and the EA to overcome disruptions caused by land acquisition problems and design changes. However, during the appraisal and early stages of implementation, ADB should have given more attention to the Government's political structure. ADB also should have anticipated higher physical contingencies on some subcomponents, and should have focused on technical requirements and capacity building needs that could have facilitated project implementation. ADB was flexible and agreed to a number of minor changes to overcome problems and facilitate better implementation.

III. EVALUATION OF PERFORMANCE

A. Relevance

36. The Project was highly relevant in meeting the immediate and the long-term objectives of the Government and ADB's country strategy. The Project was formulated to improve the efficiency of water supply services and to enhance the commercial viability of the UCs by addressing their facilities and management. Measures included (i) cost-recovery mechanisms, such as establishing affordable tariff structures; (ii) a reduction in non-revenue water to sustain the financial viability of the UCs; and (iii) the introduction of a billing system.

37. The changes made in Yap water supply system to suit the local topography and to lower O&M costs enhanced Project objectives. Policy reforms to establish water treatment standards and increase tariffs to achieve full cost recovery, and institutional strengthening in water demand management were fully supported under the Project. Key elements of UCs' policies that are still in force include (i) the expansion of service areas of urban water supply, (ii) government funding of capital works, (iii) user tariffs, and (iv) greater autonomy and accountability on financial and operational performance. However, the project design failed to take into account the political structure of four individual state governments, which led to considerable delays in project effectivity and implementation. The PCR Mission, nevertheless, rated the project as relevant.

38. The advisory TA was provided to strengthen the UCs' operational and financial management capacities, focusing on (i) corporate planning and management, (ii) operational performance indicators, (iii) non-revenue water management, and (iv) design of water and sewerage tariffs. The TA scope and design were highly relevant. However, while the TA addressed the critical areas for institutional strengthening of the UCs, it could have been more effective with better timing. Therefore, it was rated as partly relevant.

B. Efficacy in Achievement of Purpose

39. At appraisal, the water supply in the three participating states was unreliable, requiring water rationing. The system had poor pressure and inconsistent water quality. The Project achieved its immediate objectives of providing its targeted beneficiaries—domestic, commercial, and industrial customers in Yap and Pohnpei—with a water supply service that is reliable, safe, and available 24 hours a day. The systems in these two states have the capacity to meet the

anticipated 2005 demand, and can be considered efficacious. However, the Project was rated as less efficacious in Chuuk.

40. **Chuuk.** The Project implemented the components as proposed, and achieved 0.8 million gallons per day (mgd) of additional output.[15] However, it did not ensure a sustainable supply of water that is better in quantity and quality. CPUC was unable to provide the necessary management support and understanding required to operate, monitor, and maintain the project outputs. Although the project TA instituted appropriate O&M manuals, and provided operator training, CPUC's O&M capabilities and implementation procedures were not satisfactory. CPUC is generally reactive, and lacks the financial resources to sustain O&M requirements. CPUC management recognized the shortfall of trained staff for O&M of electrical equipment. However, outsourcing and training of more staff to meet O&M staffing needs was not carried out, resulting in the deterioration of project facilities. Moreover, the required length of transmission and distribution pipeline was not completed due to land disputes. As of August 2003, CPUC had 960 connections, covering 65% of the 1,480 potential connections on Weno Island.

41. **Yap.** The Project in Yap provides reliable and safe water on a 24-hour basis. The system also has the capacity to meet the anticipated 2005 demand. As of August 2003, Yap had 778 connections, covering 91% of the 850 potential connections on Kolonia. This represented an increase of 238 connections over the 540 connections at appraisal. The increase in connections was the result of constructed capacity of 240 gallons per minute (gpm) water production and the expansion of distribution system by 28,500 feet (ft).

42. **Pohnpei.** The Project in Pohnpei provides reliable and safe water on a 24-hour basis in Awak, Meitik, and Sekere, servicing a combined population of about 3,500. The system also has the capacity to meet the anticipated 2005 demand of 6,180 cubic meters (m^3). As of August 2003, PUC had 3,387 connections, covering 89% of the 3,800 potential connections.[16] This represented an increase of 554 connections over the 2,833 connections at appraisal.

43. Considering the performance of the project in Chuuk, the project in Chuuk was rated as less efficacious. However, with improvements in living conditions and the socioeconomic impact in Yap and Pohnpei, the Project as a whole was considered relevant and efficacious.

C. Efficiency in Achievement of Outputs and Purpose

44. ADB's internal processing of the Project was efficient and satisfactory. The organization and management of the EA and the implementing agencies were effective in ensuring efficient project implementation, as well as timely. This contributed to the anticipated outputs being achieved on schedule in three states, despite startup delays.

45. As part of the policy reforms, the UCs increased water tariffs in stages to ensure financial viability. Physical investments under the Project included the design and installation of production and treatment facilities for Yap and Chuuk to address the short supply and poor quality of the water. The facilities were completed within a reasonable schedule, given the changes in design and additional scope of works. The facilities were fully operational, though Chuuk was unable to maximize its benefits. Twenty staff were trained directly under the Project, while many others received indirect training from consultants, contractors, and co-workers.

[15] CPUC had an additional ground water production of 860,000 gallons per day to augment its surface water source of 251,000 gallons.

[16] The 3,387 connections comprise 237 commercial, 2,533 residential, 69 state governments, 45 other governments, and 503 connections not billed.

1. Economic Internal Rate of Return

46. The EIRRs for the Chuuk, Yap, and Pohnpei components were recalculated and compared with the estimates at appraisal. In Chuuk, the EIRR was lower than at appraisal due to (i) an increase in project costs, (ii) the inability to provide a reliable and safe water supply, and (iii) fewer-than-expected connections after project completion. In Yap and Pohnpei, the EIRRs were higher due to their ability to provide safe and reliable water supply to a greater percentage of population, particularly during dry periods.

47. Overall, the EIRR was 12.7%, compared with 16.2% at appraisal. The EIRRs for individual states were 5.5% for Chuuk, compared with 19.9% at appraisal; 15.2% for Yap, compared with 14.9% at appraisal; and 20.9% for Pohnpei, compared with 14% at appraisal. Sensitivity analyses indicated that the EIRRs of the project components were relatively more susceptible to a reduction in project benefits than a reduction in costs, as anticipated during appraisal. Appendix 6 presents a more detailed analysis of the economic reevaluation.

2. Financial Internal Rate of Return

48. The FIRRs of the three states were recalculated based on actual project cost and data on financing and revenue, and compared with the weighted average cost of capital (WACC) of 3.3%. The FIRRs for Yap and Pohnpei were 7.3% and 5.9%, respectively, higher than the 6.7% and 4.6%, respectively, estimated at appraisal. The recalculated FIRR for Chuuk was 4.7%, lower than the 7.4% at appraisal. Overall, the FIRR was 5.1%, which was lower than the 7% estimate at appraisal. Sensitivity analyses indicated that the FIRRs of the three states were more vulnerable to decreases in revenues than increases in O&M costs, as expected during appraisal. The Project was rated partly efficient due to inability of CPUC to charge appropriate tariffs and increase its collection efficiency. Appendix 6 provides a detailed analysis of the financial assessment.

D. Preliminary Assessment of Sustainability

49. The sustainability of the Project was rated as likely in Yap and Pohnpei, as the physical outputs were technically sound and the personnel were trained to handle operational and technical problems. While financial sustainability was expected in Yap and Pohnpei, improvements are required in increasing connections and monitoring performance indicators. In Chuuk, the sustainability of the Project was rated as less likely. Significant improvements in managing the system need to be institutionalized. These include adopting proper O&M procedures and deploying staff with adequate technical and financial capabilities to manage, operate, and maintain the project facilities.

50. Overall, the sustainability of the Project was rated as likely. The Project is relevant, efficacious, efficient, and sustainable. Improvements in the living conditions and socioeconomic conditions were evident in Yap and Pohnpei, though not in Chuuk (Appendix 7).

E. Environmental, Sociocultural, and Other Impacts

1. Environmental Impact

51. As anticipated at appraisal, environmental impacts of the Project were minimal. During project implementation, the backwashing of the rapid sand filters and chlorination system testing in Chuuk raised some early environmental concerns. However, these were unfounded. No

environmental concerns related to the project components were raised in Yap and Pohnpei. Overall, the improvement in water quality and sanitation, along with the better management of the water supply, had a positive impact on the environment.

2. Social Impact

52. At appraisal, the Project was anticipated to benefit 13,100 people—7,520 people in Chuuk, 1,860 people in Yap, and 3,720 people in Pohnpei. At completion, based on the service area population of the water supply system, beneficiaries were estimated at 3,360 in Chuuk, 1,428 in Yap, and 2,042 people in Pohnpei. The project benefits have not been fully realized, and the process of adding new connections is ongoing. While Yap and Pohnpei are extremely active in expanding coverage, the process in Chuuk is slow and service connection capacity only has been partially achieved. The social impact, therefore, is moderate.

3. Other Impacts

53. The Project, in general, had a significant impact. It strengthened the UCs in Yap and Pohnpei, and assisted them in identifying opportunities to achieve its statutory mandate of providing a safe water supply and improved sanitation. The UCs are also providing advisory assistance to the government at various levels on developing urban water systems. One significant benefit of the Project in Pohnpei was an initiative that used the experience gained to provide training on the design and operation of water supply production and treatment facilities for community-based systems. Chuuk, on the other hand, is still struggling due to management and political problems.

IV. OVERALL ASSESSMENT AND RECOMMENDATIONS

A. Overall Assessment

54. The objectives of the Project and associated TA, while appropriate, were not fully achieved. However, the physical infrastructure generally met the targets set at appraisal. With the revised scope for the Yap component, it will meet the anticipated 2005 needs.

55. In terms of the scope of facilities, the Chuuk component facilities essentially were built as envisaged at appraisal. However, the completed facilities were not properly operated and maintained. As a result, the capacity of the system could not be fully utilized. O&M funding in their operating budget was insufficient. CPUC continues to depend heavily on subsidies that are irregular due to financial problems faced by the state government. Tariff increases have been difficult to implement, while the collection efficiency has been poor. The UC, therefore, has been unable to achieve the required cost recovery.

56. The Yap portion of the Project has performed well. With the substantial changes in the Yap component, including a switch from a booster-fed system to gravity-based system, the UC in Yap benefited from the resulting lower operating costs. The primary objectives of improving the water supply, enhancing living conditions, and supporting development in the main urban center of Kolonia have been fully met.

57. The Pohnpei component pipelines were built as envisaged at appraisal, and are properly operated and maintained. The funding allocation for O&M is sufficient. While the cost recovery is adequate to sustain the O&M costs, tariffs need to be increased to achieve the projected cost recovery. The PUC has good administrative structure, confirming the effectiveness of the

institutional strengthening program. The management continues to identify strategic planning needs, and addresses areas of operational improvements.

58. The Project has been successful in Yap and Pohnpei, generating significant improvements in living conditions and socioeconomic conditions. In other areas, the impacts have been moderate (Appendix 8). For improvements to be effective in Chuuk, significant administrative and structural changes are necessary. Political interference also must be minimized. Overall, the Project was rated as successful.

B. Lessons Learned

59. The PCR identified several lessons learned that should be applied to future water supply sector projects.

(i) In FSM, the readiness of essential legislative support and project cofinancing by the state and national governments should be confirmed at project appraisal or the loan negotiation stage to avoid implementation delays.

(ii) Land acquisition remains a difficult challenge in all states. Future projects must attempt to resolve such issues at appraisal to minimize land issues. Where land acquisition is necessary, the acquisition process should be established early at appraisal stage.

(iii) For works such as wells, reservoirs, water tanks, and other capital assets constructed on land belonging to third parties, such transactions should be properly documented with lease registers and approved minutes. These should be reflected in the annual financial statements of the UCs. The financial statements should clearly explain the procedure in dealing with leases to ensure fair valuation of the assets.

(iv) Necessary design changes and construction variations with major cost implications should be discussed and agreed with ADB early to avoid implementation delays.

(v) A full-time project accountant to manage project accounts should be fielded from the start of the project to prepare and monitor project expenditures.

(vi) Where a single UC is responsible for both water and power, the UC must maintain separate records for the water supply operations and power operations to assist in cost recovery.

(vii) A review of variations for the expansion of distribution systems should, in future, include the legal requirements for connection, particularly where the extension involves use of leased land.

(viii) Comprehensive connection programs should be developed to include targeted areas, businesses, compliance and enforcement, connection maintenance, and connection targets. Such programs are especially relevant in places such as Chuuk. An associated public education and awareness program should be developed to improve community understanding of the benefits of connection, availability of lifeline block supplies, and payment methods. Customer data and

performance indicators must be reported properly to the management in a timely manner to allow necessary adjustments in O&M, budgets, and connection programs; and to improve administration and customer relations.

(ix) Establishment of suitable and appropriate indicators is important to properly monitor and evaluate the effectiveness of the Project during implementation. These should include water quality baseline data to evaluate improvements in quality under the Project.

(x) Incidents of water-borne diseases should be reported in more detail by community to assist in identifying the problem areas that need more sanitation education.

(xi) Sufficient data on improvements in water supply and quality under the Project must be provided by technical staff in coordination with the financial and customer services staff.

C. Recommendations

60. Based on key lessons learned, the Mission noted that implementation of future projects in Chuuk would require special attention. Appendix 9 highlights some of the problems faced, and specific recommendations for future interventions in Chuuk. General recommendations for future ADB projects in the water supply sector include the following:

(i) The project design should give more emphasis to identifying specific physical infrastructure and improved living condition targets.[17]

(ii) ADB must ensure that, before the start of any technical assistance, the recipient agencies are demonstrably committed and the assistance is timed for maximum benefit.

(iii) ADB should undertake regular technical and financial review of projects throughout implementation to identify and respond quickly to potential changes in the scope or construction variations. Such review should include detailed updating of project component progress and financial reports, as this will facilitate PCRs.

(iv) More guidance should be provided to the PMU and implementing agencies in developing more meaningful and measurable project performance indicators early in project implementation. This should preferably be established during project inception stage.

(v) The Project readiness should be carefully assessed to avoid unnecessary delays in loan effectivity and project implementation.

[17] Time-bound targeted outputs are required for the project framework.

(vi) The establishment of a BME system to evaluate project benefits, such as health improvements and cost savings,[18] is valuable. However, its value for corporations should be carefully assessed before including them as covenants.

The project performance audit review could be undertaken in 2005 or 2006, when full operational data on project facilities in all UCs is available.

[18] A loan covenant required development and implementation of a BME program. The Midterm Review Mission advised the PMU to coordinate with each UC a detailed implementation plan for BME and submit to ADB by 30 March 2001. This was not complied with.

PURPOSE, TARGETS, AND ACHIEVEMENTS

Purpose/Scope	Targets	Outputs and Outcomes
A. Chuuk Water Supply		
1. Improve water supply capacity and reliability	Drilling of exploratory boreholes and development of 30 water wells to the depth of approximately 80–100 feet (ft).	Drilling of 16 water wells to the depth of approximately 80–100 ft. Field tests confirmed that the 16 wells provided sufficient output.
	Installation of submersible pumps, water discharge, and interconnection with water transmission lines.	Installation of submersible pumps, water discharge, and interconnection with water transmission lines.
	Installation of chlorinating systems at each well	Installation of chlorinating systems at each well.
	Refurbishment of Pou Water Treatment Plant, as follows:	Refurbishment of Pou Water Treatment Plant, as follows:
	(i) Installation of a 12-inch water production meter (ii) Installation of new chlorinating equipment (iii) Replacement of standby power generator (iv) Repairs of filter hardware and filter media, and reestablishment of backwash facilities (v) Development of water meter shop and storage facilities.	(i) Installed 12-inch production meter (ii) New chlorinating equipment installed (iii) Replaced standby power generator (iv) Repairs of filter hardware and filter media, and reestablishment of backwash facilities (v) Installation of raw water and clear water pumps (vi) Construction of waterworks building and storage facilities.
2. Reliably serve existing and 2005 demand	Installation of 9,840 ft. of 8-inch high density poly-ethylene (HDPE) looping main from Sapuk to Epinup.	Installation of 6,000 ft., or 1.13 miles, of 8-inch HDPE waterline from Sapuk to Epinup villages to distribute water to 40 households. Therefore, capacity achieved, but total available demand not served.
3. Improve Living Conditions	No specific targets.	Additional 240 people provided a piped water supply.[1]
4. Support Urban Development	No specific targets.	Supply exists to support urban development.

[1] As of September 2003, domestic connections served with piped water supply totaled 9,401 for Chuuk, 2,683 for Pohnpei, and 778 for Yap.

Purpose/Scope	Targets	Outputs and Outcomes
B. Yap Water Supply		
1. Improve water supply capacity and reliability, and extend distribution system	Drilling of 6 wells to a depth of approximately 250 ft. in the Eyeb Valley.	Drilling of 7 wells at the Eyeb Valley.
	Installation of submersible pumps and well discharge lines.	Installation of submersible pumps and well discharge line.
	Drilling of one new well and deepening of a second in the vicinity of the Gitam reservoir.	Installation of pumping main to Feereel Hill and installation of power lines.
	Construction of a 60,000 gallon balancing tank at Feereel Hill.	Modifications of the Feereel Hill water tank.
	Installation of 9,500 ft. of a 4-inch and 6-inch pumping main from Eyeb Valley well field to Feereel Hill tank and the new Gitam Wells.	Installation of 28,500 ft. of 10-inch HDPE waterline from Colonia to Feereel Hill Tank.
	Installation of 22,000 ft. of 6-inch HDPE transmission main from Feereel Hill to Colonia.	Installation of a 40 kilowatt-hour (kWh) backup generator at the Eyeb Valley well field.
	Installation of a new booster station in Colonia to pump water to the Nimar water tank.	Construction of a chlorinating plant adjacent to the water tank.
	Installation of 5,900 feet of pumping main from the booster station to the existing Nimar water tank.	
2. Improve Living Conditions	No specific targets.	Increase in population provided a piped water supply resulting in reduced water costs being spread across larger number of users with a net. Health indicators suggest a decline in waterborne diseases.[2]
3. Support Urban Development	No specific targets.	Supply exists to support urban development
C. Pohnpei Water Supply		
1. Improve water supply capacity and reliability, and extend distribution system	Awak Extension of 19,500 ft. of 8-inch HDPE.	Awak Extension of 16,500 ft. 8-inch HDPE and 1,800 ft. of 4-inch HDPE.
	Metik Loop Extension of 14,200 ft. of 6-inch HDPE waterline.	Metik Loop Extension of 14,800 ft. 6-inch HDPE and 700 ft. of 8-inch.
	Sekere Extension of 9,200 ft. 8-	Sekere Extension of 12,500 ft. of 8-

[2] See footnote 1.

Purpose/Scope	Targets	Outputs and Outcomes
	inch HDPE waterline. Likie Extension of 11,000 ft. 4-inch HDPE waterline.	inch HDPE.
2. Improve Living Conditions	No specific targets.	Likie Extension of 11,300 ft. of 4-inch HDPE.
3. Support Urban Development	No specific targets.	Increase in population provided a piped water supply resulting in reduced water costs being spread across larger number of users with a net. Health indicators suggest a decline in waterborne diseases.[3] Supply exists to support urban development.

HDPE = high density poly-ethylene.
Source: Asian Development Bank.

[3] See footnote 1.

DISBURSEMENTS AND REALLOCATIONS

Category	Original Allocation	Last Revised Allocation	Net Amount Available	Amount Disbursed	Undisbursed Balance[1]
01 Civil Works					
01A-Chuuk	1,612,056	2,446,561	2,446,561	2,453,139	(6,578)
01B-Kosrae	1,207,576	0	0	0	0
01C-Pohnpei	1,206,111	948,293	948,293	856,050	92,243
01D-Yap	1,411,282	2,377,432	2,377,432	2,244,920	132,512
02 Equipment					
02A-Chuuk	449,910	661,732	661,732	581,610	80,122
02B-Kosrae	65,948	0	0	0	0
02C-Pohnpei	29,310	200,224	200,224	248,901	(48,677)
02D-Yap	240,343	126,661	126,661	25,917	100,744
03 Materials					
03A-Chuuk	174,395	438,587	438,587	426,985	11,602
03B-Kosrae	212,498	0	0	0	0
03C-Pohnpei	293,101	885,080	885,080	1,013,818	(128,738)
03D-Yap	240,343	129,749	129,749	0	129,749
04 Consulting Services	1,486,022	1,031,421	1,031,421	1,029,750	1,671
05 Service Charge	124,568	229,501	229,501	227,428	2,073
06 Unallocated	1,846,537	92,381	92,381	0	92,381
99 Imprest Fund	0	0	0	0	0
Total	**10,600,000**	**9,567,622**	**9,567,622**	**9,108,518**	**459,104**

Source: Asian Development Bank.

[1] Undisbursed amount was cancelled at loan closing.

IMPLEMENTATION SCHEDULE

ACTIVITY COMPONENT	1996				1997				1998				1999				2000				2001				2002				2003			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Project Mgmt Component																																
Establish PMU																																
Recruit and Mobilize Consultants																																
Advance Period Activities[a]																																
(Design Report, Design & Specs)																																
Consulting Services																																
Cons. Services/PMU Assistance																																
(Procurement Issues)																																
Consulting Services/PMU Assistance																																
(Construction Period)																																
Procurement & Cons Services																																
Materials & Equip. Procurement-Chuuk/Pohnpei/Yap																																
Force Account Proc. Well Drilling-Chuuk/Yap																																
Const. & Commissioning–Pohnpei																																
Well Drilling – Pohnpei																																
General Contractor & Proc.																																
Const. & Commissioning–Chuuk/Yap																																
Maintenance Period																																

PMU = project management unit.

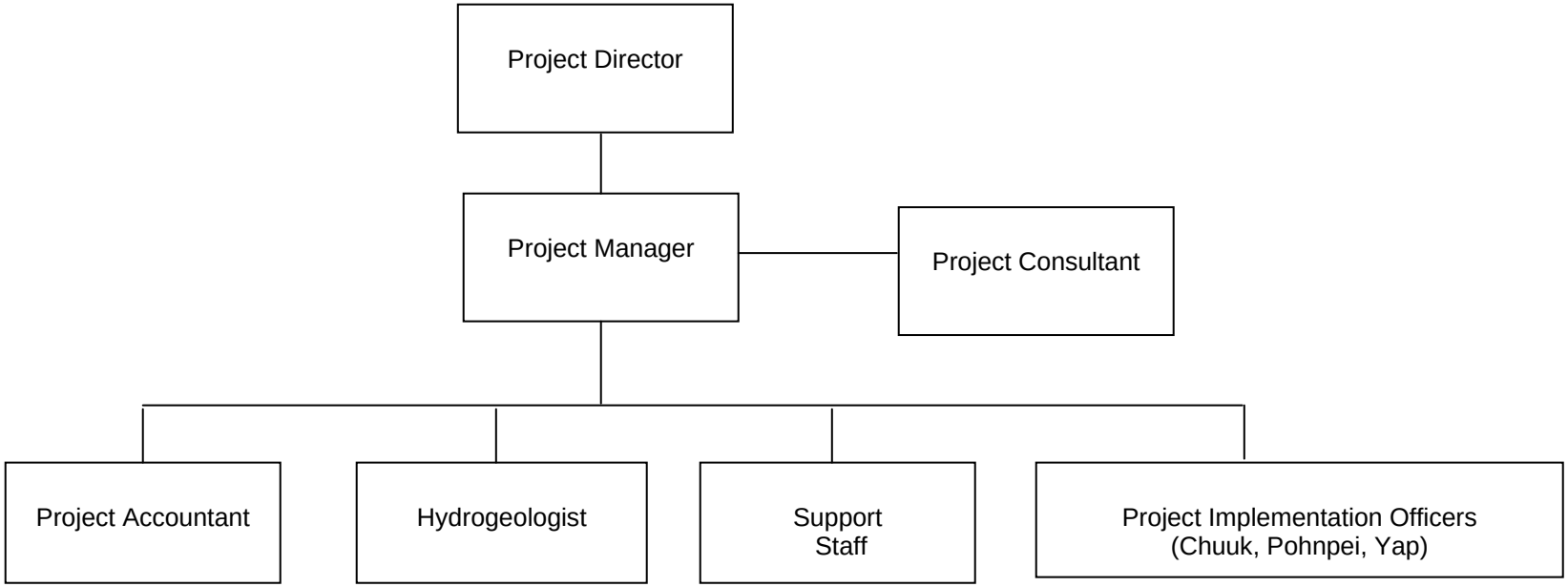
[a] The schedule covers activity before project commencement date. Design Report, Design and Specification and include land access arrangements.

Source: Asian Development Bank.

- original

- actual

PROJECT ORGANIZATION OF EXECUTING AGENCY AND UTILITIES CORPORATIONS



STATUS OF COMPLIANCE WITH LOAN COVENANTS

Covenant	Reference in Loan Agreement	Status of Compliance
The Borrower shall cause the Department of Transport Communication and Infrastructure (DTCI) to carry out the Project with due diligence and efficiency and in conformity with sound administrative, financial, engineering, environmental, and water supply and sanitation practices.	Article IV, Section 4.01 (a)	Complied with.
In carrying out the Project and operation of the Project facilities, the Borrower shall perform, or cause to be performed, all obligations set forth in Schedule 6 to this Loan Agreement.	Article IV, Section 4.01 (b)	Complied with.
The Borrower shall make, or cause to be made, available to DTCI and to each corporation, promptly as needed, the funds, facilities, services, land, and other resources which are required, in addition to the proceeds of the loan, for carrying out and implementing the Project.	Article IV, Section 4.02	Complied with.
The Borrower shall ensure that the activities of its departments and agencies, and of the corporations, with respect to carrying out and implementing the Project and operating the project facilities, are conducted and coordinated in accordance with sound administrative policies and procedures.	Article IV, Section 4.03	Complied with.
The Borrower shall furnish, or cause to be furnished, to the Asian Development Bank (ADB) all such reports and information as ADB shall reasonably request concerning (i) the loan, and the expenditure of the proceeds and maintenance of the service thereof; (ii) the goods and services and other items of expenditure financed out of the proceeds of the loan; (iii) the Project; (iv) the administration, operations and financial condition of the corporations and any other agencies of the Borrower responsible for carrying out and implementing the Project and operating the project facilities, or any part thereof; (v) financial and economic conditions in the territory of the Borrower and the international balance of payments position of the Borrower; and (vi) any other matters relating to the purposes of the loan.	Article IV Section 4.03	Complied with.

Covenant	Reference in Loan Agreement	Status of Compliance
Financial		
The Borrower shall (i) maintain separate accounts for Part B of the Project; (ii) have such accounts and related financial statements audited annually, in accordance with appropriate auditing standards consistently applied, by independent auditors whose qualifications, experience and terms of reference are acceptable to ADB; (iii) furnish to ADB, as soon as available but in any event not later than 12 months after the end of each related fiscal year, certified copies of such audited accounts and financial statements and the report of the auditors relating thereto (including the auditors' opinion on the use of the loan proceeds and compliance with the covenants of this Loan Agreement), all in the English language; and (iv) furnish to ADB such other information concerning such accounts and financial statements and the audit thereof as ADB shall from time to time reasonably request.	Article IV, Section 4.04 (b)	Not complied with. Separate accounts were maintained, but audit of project account needs to be included as part of the terms of reference of private government auditor.
The Borrower shall exercise its rights under each Financing Agreement in such a manner as to protect the interests of the Borrower and ADB and to accomplish the purposes of the loan.	Article IV, Section 4.07 (a)	Complied with.
No rights or obligations under any Financing Agreement shall be assigned, amended, abrogated, or waived without the prior concurrence of ADB.	Article IV, Section 4.07 (b)	Complied with.
It is the mutual intention of the Borrower and ADB that no other external debt owed a creditor other than ADB shall have any priority over the loan by way of a lien on the assets of the Borrower. To that end, the Borrower undertakes (i) that, except as ADB may otherwise agree, if any lien shall be created on any assets of the Borrower as security for any external debt, such lien will ipso facto equally and ratably secure the payment of the principal of, and service charge and any other charge on the loan; and (ii) that the Borrower, in creating or permitting the creation of any such lien, will make express provision to that effect.	Article IV, Section 4.08 (a)	Complied with.
The term "assets of the Borrower" as used in	Article IV,	

Covenant	Reference in Loan Agreement	Status of Compliance
paragraph (a) of this section includes assets of any political subdivision or any agency of the Borrower and assets of any agency of any such political subdivision, including any central bank which may be established by the Borrower and such terms includes assets held on behalf of the Borrower with any foreign or local commercial bank or institution for the time being performing the functions of a central bank for the Borrower; provided that if for any constitutional or other legal reason, such provision cannot be made with respect to any lien created on assets of any of its political subdivisions, the Borrower shall promptly and at no cost to ADB secure the principal of, and service charge on, the loan by an equivalent lien on other assets of the Borrower satisfactory to ADB.	Section 4.08 (c)	Complied with.
Implementation		
General As the Project's Executing Agency, DTCI shall be responsible for overseeing and coordinating project implementation. Chuuk Power Utilities Corporation (CPUC), Kosrae Utilities Authority (KUA), Pohnpei Utilities Corporation (PUC), and Yap State Public Service Corporation (YSPSC) shall be responsible for the implementation of Parts A.1, A.2, A.3 and A.4 of the Project, respectively. DTCI shall be responsible for the implementation of Part B of the Project.	Schedule 6 Para. 1	Complied with.
Project Management Unit The project management unit (PMU), established by the Borrower to assist DTCI in project implementation, shall be responsible for day-to-day management and coordination of all project activities. The director of DTCI, designated by the Borrower as project director, shall be supported by a project manager and necessary support staff.	Schedule 6 Para. 2	Complied with. PMU established. Project manager, accountant and water engineer appointed. However, project accounts have not been properly recorded and updated, particularly on counterpart funding and implementing agency contribution.
Project Implementation Officers Each corporation shall appoint a project implementation officer (PIO) from its staff. Each PIO shall be responsible for coordination with the PMU on project activities	Schedule 6 Para. 3	Complied with.

Covenant	Reference in Loan Agreement	Status of Compliance
to be implemented by the corporation. The duties of PIOs shall include (a) monitoring the progress of project implementation, (b) presentation of periodic project progress reports to the PMU, (c) ensuring that satisfactory plans and descriptions of project works within their relevant project area are prepared with the assistance of consultants, and (d) ensuring smooth project implementation and timely consideration of issues by the project implementation committee (PIC).		
Project Implementation Committee The PIC, established by the Borrower to provide overall coordination of project activities throughout the project area, shall have as members the general manager of each corporation, and one representative nominated by each state, and shall be chaired by the project director. The PIC shall meet at least semiannually and shall invite other representatives to attend, as necessary, to ensure satisfactory resolution of all project implementation issues. The PMU shall serve as the secretariat for the PIC.	Schedule 6 Para. 4	Complied with.
Operation and Maintenance The Borrower shall ensure, or cause the respective states to ensure, that structured O&M systems are developed by each corporation to develop and maintain appropriate service levels in a cost-effective manner.	Schedule 6 Para. 5	Being complied with by YSPSC and PUC. In the case of CPUC, proper and sufficient O&M is provided for the project facilities.
The Borrower shall ensure, or cause Chuuk to ensure, that, by 31 March 1997, CPUC has prepared and submitted an application for comprehensive assistance to the Operation and Maintenance Improvement Program (OMIP) of the US Department of the Interior, and shall have prepared and submitted, or caused to have been submitted, to the Chuuk legislature a formal request for the appropriation of state counterpart funds necessary for OMIP assistance.	Schedule 6 Para. 6	Complied with. OMIP application submitted in July 1997.
Public Education and Participation The Borrower shall ensure, or cause to ensure, that during project implementation,	Schedule 6 Para. 7	Complied with.

Covenant	Reference in Loan Agreement	Status of Compliance
each corporation undertakes public education programs, during the course of which public meetings are held to review and discuss project-related issues, including water conservation, health aspects of water use, rights of access to water resources, and water tariffs and their affordability. In such connection, the Borrower shall inform ADB annually of measures taken to improve community acceptance metered billings and willingness to pay.		
Land and Water Rights The Borrower shall ensure, or cause each state to ensure, that all land, right in land and water, including riparian rights, and other rights privileges required for construction of project facilities are promptly acquired or otherwise made available so as to ensue timely implementation of project construction activities.	Schedule 6 Para. 8	Complied with.
Benefit Monitoring and Evaluation The Borrower shall ensure that a benefit monitoring and evaluation (BME) program shall be developed and implemented. Such BME program shall be based on ADB's *Handbook for Benefit Monitoring and Evaluation*, and an evaluation exercise shall be undertaken after an extended period of operation of the project facilities.	Schedule 6 Para. 9	Not complied with. A BME program was not developed and implemented.
Midterm Review Within 18 months after the Effective Date, the Borrower shall undertake a comprehensive midterm review which shall, inter alia, evaluate project progress, implementation procedures, procurement, the BME program, and performance of the project consultants and the effectiveness of the Borrower's public education and community participation initiatives. Such midterm review shall be conducted in consultation with ADB and the project consultants and shall formulate, as necessary, recommendations for remedial action.	Schedule 6 Para. 10	Complied with. There was no BME program evaluated.

Covenant	Reference in Loan Agreement	Status of Compliance
Environmental Matters The Borrower shall ensure, or cause the respective states to ensure, that each corporation shall comply with ADB's environmental requirements and all applicable environmental laws and regulations of the Borrower, including all state and local laws and regulations.	Schedule 6 Para. 11	Being complied with.

CHUUK PUBLIC UTILITIES CORPORATION
STATUS OF COMPLIANCE WITH LOAN COVENANTS
OF PROJECT IMPLEMENTATION AGREEMENT

Covenant	Reference in Loan Agreement	Status of Compliance
The corporation shall furnish the Asian Development Bank (ADB), through the project management unit (PMU), quarterly reports on the execution of the Project and on the operation and management of facilities provided under the Project. Such report shall indicate progress made and problems encountered during the quarter under review, steps taken or proposed to be taken to remedy these problems, and the proposed program of activities and expected progress during the following quarter.	Project Implementation Agreement (PIA), Section 2.08(b)	Complied with.
The corporation shall: (i) maintain, or cause to be maintained, separate accounts for the Project; (ii) have such accounts and related financial statements (balance sheet, statement of income and expenses, and related statements) audited annually, in accordance with appropriate auditing standards consistently applied, by independent auditors acceptable to ADB; and (iii) furnish to ADB, promptly after their preparation, but in any event not later than 12 months after the close of the fiscal year to which they relate, certified copies of such audited accounts and financial statements and the report of the auditors relating thereto (including the auditor's opinion on the use of the loan proceeds and compliance with the covenants of the PIA, all in the English language).	PIA, Section 2.09(a)	Complied, but only from 1998–2001.
The corporation shall make best efforts to generate revenues to fund (i) operating expenses (and thus eliminate the need for subsidies) within 5 years of project completion; and (ii) all operation and maintenance (O&M) expenses, including depreciation and interest expenses, within 10 years of project completion.	PIA, Schedule (i)	Not complied with. In 2001 and 2002, water and sewerage revenues covered only 5.6% and 8.5% of O&M expenses, respectively.
The Corporation shall make best efforts to maintain a debt service ratio, within 5 years of project completion, of at least 1.0 and, within 10 years of project completion, of at least 1.2.	PIA, Schedule (ii)	Not yet due.
The corporation shall adopt measures to reduce non-revenue water (NRW) to 30% by the end of FY2005, including use of improved meter reading, computerized	PIA, Schedule (iii)	Not complied with. As of 2002, estimated NRW was 60% and O&M

Covenant	Reference in Loan Agreement	Status of Compliance
billing, operational procedures, construction standards, and leakage detection programs.		procedures were not being undertaken.
The corporation shall achieve the following accounts receivable targets expressed in terms of average number of days of water and sanitation services billings: (i) within 12 months from project completion, 110 days; (ii) within 24 months from project completion, 90 days; and (iii) within 36 months from project completion and thereafter, 70 days.	PIA, Schedule (iv)	Not complied with. About 50% of accounts receivables and arrears are more than 180 days.
The corporation shall submit annually to ADB prior to the start of each fiscal year during project implementation, through the PMU, a draft corporate plan for review and comment, which details the projected development and operation of the corporation on a 3-year rolling basis, including (i) establishing annual financial performance objectives; (ii) providing a strategy for delivering such objectives; (iii) providing projections of operating and maintenance expenses, capital expenditures, and tariff requirements; and (iv) identifying the need for, and availability of, grants and subsidies.	PIA, Schedule (v)	Complied with in 2000.
The corporation shall implement procedures to promote the continuing institutional improvement of the corporation, including: (i) preparation of a fixed assets register; (ii) development of an appropriate billing, accounting, and management information system; (iii) development of an appropriate staffing structure; (iv) identification of short-term capital works and maintenance requirements; (v) preparation of annual budgets for water supply and sewerage operations; (vi) adoption of appropriate connection and disconnection policies and practices; (vii) implementation of water and sewerage tariffs; (viii) promotion of the development of appropriate regulations for water resources management; (ix) implementation of O&M impact statements; and (x) development of long-term corporate plans.	PIA, Schedule (vi)	Partly complied with since procedures are not followed according to established accounting rules (posting, etc.) Not complied with. Partly complied with. Complied with. Partly complied with. Complied with. Complied with. Complied with. Long-term plan not complied with.

POHNPEI UTILITIES CORPORATION
STATUS OF COMPLIANCE WITH LOAN COVENANTS
OF PROJECT IMPLEMENTATION AGREEMENT

Covenant	Reference in Loan Agreement	Status of Compliance
The corporation shall furnish the Asian Development Bank (ADB), through the project management unit (PMU), quarterly reports on the execution of the Project and on the operation and management of facilities provided under the Project. Such report shall indicate progress made and problems encountered during the quarter under review, steps taken or proposed to be taken to remedy these problems, and the proposed program of activities and expected progress during the following quarter.	Project Implementation Agreement (PIA), Section 2.08(b)	Complied with.
The corporation shall: (i) maintain, or cause to be maintained, separate accounts for the Project; (ii) have such accounts and related financial statements (balance sheet, statement of income and expenses, and related statements) audited annually, in accordance with appropriate auditing standards consistently applied, by independent auditors acceptable to ADB; and (iii) furnish to ADB, promptly after their preparation, but in any event not later than 12 months after the close of the fiscal year to which they relate, certified copies of such audited accounts and financial statements and the report of the auditors relating thereto (including the auditor's opinion on the use of the loan proceeds and compliance with the covenants of the PIA, all in the English language).	PIA, Section 2.09(a)	Complied with.
The corporation shall make best efforts to generate revenues to fund (i) operating expenses (and thus eliminate the need for subsidies) within 5 years of project completion; and (ii) all operation and maintenance (O&M) expenses, including depreciation and interest expenses, within 10 years of project completion.	PIA, Schedule (i)	Being complied with.
The corporation shall adopt measures to reduce non-revenue water (NRW) to 30% by the end of FY2005, including the use of improved meter reading, computerized billing, operational procedures, construction standards, and leakage detection programs.	PIA, Schedule (iii)	Being complied with. NRW is still at 45%, measures have been instituted to reduce NRW

Covenant	Reference in Loan Agreement	Status of Compliance
The corporation shall implement procedures to promote the continuing institutional improvement of the Corporation, including: (i) preparation of a fixed assets register; (ii) development of an appropriate billing, accounting, and management information system; (iii) development of an appropriate staffing structure; (iv) identification of short-term capital works and maintenance requirements; (v) preparation of annual budgets for water supply and sewerage operations; (vi) adoption of appropriate connection and disconnection policies and practices; (vii) implementation of water and sewerage tariffs; (viii) promotion of the development of appropriate regulations for water resources management; (ix) implementation of O&M impact statements; and (x) development of long-term corporate plans.	PIA, Schedule (vi)	Complied with.

YAP STATE PUBLIC SERVICE CORPORATION
STATUS OF COMPLIANCE WITH LOAN COVENANTS
OF PROJECT IMPLEMENTATION AGREEMENT

Covenant	Reference in Loan Agreement	Status of Compliance
The corporation shall furnish the Asian Development Bank (ADB), through the project management unit (PMU), quarterly reports on the execution of the Project and on the operation and management of facilities provided under the Project. Such report shall indicate progress made and problems encountered during the quarter under review, steps taken or proposed to be taken to remedy these problems, and the proposed program of activities and expected progress during the following quarter.	Project Implementation Agreement (PIA), Section 2.08(b)	Complied with.
The corporation shall: (i) maintain, or cause to be maintained, separate accounts for the Project; (ii) have such accounts and related financial statements (balance sheet, statement of income and expenses, and related statements) audited annually, in accordance with appropriate auditing standards consistently applied, by independent auditors acceptable to ADB; and (iii) furnish to ADB, promptly after their preparation, but in any event not later than 12 months after the close of the fiscal year to which they relate, certified copies of such audited accounts and financial statements and the report of the auditors relating thereto (including the auditor's opinion on the use of the loan proceeds and compliance with the covenants of the PIA, all in the English language).	PIA, Section 2.09(a)	Complied with.
The corporation shall make best efforts to generate revenues to fund (i) operating expenses (and thus eliminate the need for subsidies) within 5 years of project completion; and (ii) all operation and maintenance (O&M) expenses, including depreciation and interest expenses, within 10 years of project completion.	PIA, Schedule (i)	Being complied with. As of 2003, operating revenues covered O&M expenses but not depreciation expense.
The corporation shall make best efforts to maintain a debt service ratio, within 5 years of project completion, of at least 1.0 and, within 10 years of project completion, of at least 1.2.	PIA, Schedule (ii)	Not yet due.

Covenant	Reference in Loan Agreement	Status of Compliance
The corporation shall implement procedures to promote the continuing institutional improvement of the corporation, including: (i) preparation of a fixed assets register; (ii) development of an appropriate billing, accounting, and management information system; (iii) development of an appropriate staffing structure; (iv) identification of short-term capital works and maintenance requirements; (v) preparation of annual budgets for water supply and sewerage operations; (vi) adoption of appropriate connection and disconnection policies and practices; (vii) implementation of water and sewerage tariffs; (viii) promotion of the development of appropriate regulations for water resources management; (ix) implementation of O&M impact statements; and (x) development of long-term corporate plans.	PIA, Schedule (vi)	Complied with. The corporation maintains an updated fixed assets registry with depreciation schedule. It has a fully computerized billing, accounting and management information system and approved staffing structure. It regularly updates its capital works and O&M budget and annual operating budgets for water supply and sewerage operation. It adapted connection and disconnection policies and tariffs approved by the board. It has not updated its long-term corporate plan.

ADB = Asian Development Bank**,** BME = benefit monitoring and evaluation, CPUC = Chuuk Power Utilities Corporation, DTCI = Department of Transport Communication and Infrastructure, FY = fiscal year, KUA = Kosrae Utilities Authority, NRW = non-revenue water, O&M = operation and maintenance, OMIP = Operation and Maintenance Improvement Program, PIA = Project Implementation Agreement, PIC = project implementation committee, PIO = project implementation officer, PMU= project management unit, PUC = Pohnpei Utilities Corporation, YSPSC = Yap State Public Service Corporation.
Source: Asian Development Bank Review Mission.

FINANCIAL AND ECONOMIC EVALUATION

A. Financial Evaluation

1. Scope and Methodology

1. The financial internal rates of return (FIRR) of the Chuuk, Yap and Pohnpei water supply components were evaluated. The results were compared with the appraisal estimates. Project costs, financing plan, and revenues were revised based on information provided during the Project Completion Review (PCR) mission.[1] The financial analysis was done at constant 2003 prices. The FIRR and sensitivity analysis are shown in Table A6.1 below.

2. Project Cost and Revenues

2. Capital costs were revised based on actual expenditures at project completion.[2] The costs of operations and maintenance (O&M) for 2002 were provided by the utilities corporations (UCs), and these were divided by the estimated volumes of water treated to arrive at the individual O&M cost per 1000 gallons.[3] O&M cost projections for succeeding years were based on 2003 prices.[4] The incremental operating costs were based on the 2003 average cost per 1,000 gallons of water treated for Chuuk, Yap and Pohnpei.

3. **Chuuk.** The capacity target of 1.08 million gallons per day (mgd) to augment the 0.2 mgd production before the Project was achieved with 16 new wells, instead of the 30 wells envisaged at appraisal. However, the increased capacity was not sustained starting in mid-2002, after project completion, because of the lack of (i) power supply, (ii) suitable chlorinators, and (iii) adequate O&M budget. Low water pressure, poor service reliability, and non-uniform water quality—with bacteriological contamination, and high iron was reported. The PCR Mission told management and the Executing Agency (EA) that appropriate and immediate measures must be undertaken to make the non-functional wells operational.

4. **Yap.** The project scope involved (i) the construction of seven water wells, (ii) the deepening of another well, (iii) construction of transmission and distribution pipelines and a pumping station, (iv) refurbishment of a water treatment plant, and (v) installation of chlorinating facilities and a water tank. The Project increased the capacity of the Yap water supply system to 175.3 mgd.

5. **Pohnpei**. The project scope involved the construction of distribution pipelines and service connections. This has provided water to about 3,500 people in remote villages through an additional 500 connections.

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[1] Pohnpei Utilities Corporation's (PUC's) financial and operational data was from 1995–2002; Chuuk Power Utilities Corporation (CPUC) data was for 1999–2001 (2002 was not complete due to absence of a comptroller); and Yap State Public Service Corporation (YSPC) data prior to 2001 was destroyed by a fire in early 2001.

[2] The FSM Water Supply and Sanitation Project was financed by a loan from the Asian Development Bank (ADB) and Government equity, comprising contributions from national and state governments.

[3] One cubic meter (m^3) is equivalent to 263.85 gallons.

[4] The UCs provided O&M data for 2002 based on actual operating conditions. They comprise (i) labor cost for operation, preventive maintenance, and minor repairs; (ii) electricity cost; (iii) chemical cost; (iv) reticulation system maintenance; and (v) mechanical and electrical plant maintenance.

B. Financial Reevaluation

6. The FIRRs were recalculated for Chuuk, Yap, and Pohnpei physical components as well as the Project as a whole based on actual project cost, financing revenue, and cost data.[5] The financial reevaluation of the components was carried out on an incremental basis (with and without the Project), using 2003 constant prices in dollars. The economic life of the water treatment plants was set at 30 years. Capacity utilization of Chuuk in 2003 was 46%, which was projected to increase to 60% in 2005 once the new wells were operational and the increase in the number of connections was attained. In Yap and Pohnpei, the capacity utilization was about 80% in 2003, and was projected to increase to 90% in 2005 if connection targets are met in expansion areas.

7. The FIRRs of the three components were recalculated and compared with WACC of 3.3%. The FIRRs for Yap and Pohnpei were 7.3% and 5.9%, respectively, higher than the 6.7% and 4.6% estimated at appraisal. The recalculated FIRR for Chuuk was 4.7%, significantly lower than the 7.4% envisage at appraisal. The lower-than-expected FIRR for Chuuk was caused by the low number of connections and poor revenue collection efficiency due to variable water quantity and quality. The FIRR for the Project was 5.1%, which was lower than the 7.0% estimate at appraisal due to the failure of Chuuk to improve water supply services despite meeting the targeted capacity improvement. Standard and additional sensitivity analyses were undertaken for sales volume, non-revenue water (NRW), and tariffs. The results indicated that the FIRRs of the three components were more vulnerable to decreases in revenues than increases in O&M costs, as projected at appraisal. Tables A6.2, A6.3, A6.4, and A6.5 present the FIRR calculations for Chuuk, Yap and Pohnpei, and the Project. The Project was rated less efficient due to inability of CPUC to charge appropriate tariffs and increase collection efficiency.

Table A6.1: Financial Internal Rate of Return and Sensitivity Analysis

Item		At Appraisal (%)	At Project Completion (%)
1.	**Overall Project: Base Case**	**7.0**	**5.1**
(i)	Capital cost increase by 10%	6.2	—-
(ii)	Revenues decrease by 10%	5.9	4.3
(iii)	O&M increase by 10%	6.8	4.9
(iv)	Project delay	6.6	—-
(v)	Combination of (i)–(iv)	4.8	—-
(vi)	Combination of (ii) & (iii)	—	4.1
(vii)	Decrease in sales volume by 30%	—	3.0
(viii)	Increase in NRW by 20%	—	3.8
(ix)	Decrease in Tariff revenues by 20%	—	3.6
2.	**Chuuk Component: Base Case**	**7.4**	**4.7**
(i)	Capital cost increase by 10%	6.6	—-
(ii)	Revenues decrease by 10%	6.4	4.0
(iii)	O&M increase by 10%	7.2	3.6
(iv)	Project delay	—-	—
(v)	Combination of (i)–(iv)	5.3	—
(vi)	Combination of (ii) & (iii)	—	3.9
(vii)	Decrease in sales volume by 30%	—	3.1
(viii)	Increase in NRW by 20%	—	2.3
(ix)	Decrease in tariff revenues by 20%	—	4.0

Continued on next page

[5] The weighted average cost of capital (WACC) was 3.3% based on the project financing mix: ADB and Government equity.

Table A6.1—*continued*

Item	At Appraisal (%)	At Project Completion (%)
3. Yap Component: Base Case	**6.7**	**7.3**
(i) Capital cost increase by 10%	6.0	—
(ii) Revenues decrease by 10%	6.0	6.0
(iii) O&M increase by 10%	6.6	7.0
(iv) Project delay	6.4	—
(v) Combination of (i)–(iv)	4.2	—
(vi) Combination of (ii) & (iii)	—	5.7
(vii) Decrease in sales volume by 30%	—	3.8
(viii) Increase in NRW by 20%	—	5.6
(ix) Decrease in tariff revenues by 20%	—	3.8
4. Pohnpei Component: Base Case	**4.6**	**5.9**
(i) Capital cost increase by 10%	3.8	—
(ii) Revenues decrease by 10%	3.6	3.1
(iii) O&M increase by 10%	4.4	3.7
(iv) Project delay	—	—
(v) Combination of (i)–(iv)	2.5	—
(vi) Combination of (ii) & (iii)	—	2.8
(vii) Decrease in sales volume by 30%	—	2.7
(viii) Increase in NRW by 20%	—	3.6
(ix) Decrease in tariff revenues by 20%	—	3.3

— = no data available, NRW = non-revenue water, O&M = operation and maintenance.
Source: Asian Development Bank.

8. In Chuuk, despite staff training in financial management, urgent measures must be taken to ensure the sustainability of the project assets. These include (i) improvements in billing and collection through immediate follow-up on defaulting customers and collection of arrears from government customers; (ii) reduction in NRW by undertaking meter testing, recalibration, and a replacement program; (iii) and management reforms, such as institutionalizing cost-efficiency measures and proper accounting procedures.[6] These measures are needed to address serious deficiencies in management and operations, and to enable CPUC to cover at least O&M costs from its water and sewerage operations. Revenues from (i) connection and reconnection fees, (ii) water tariffs for metered and unmetered customers,[7] (iii) water truck deliveries, (iv) water deliveries by big tankers, and (v) water loaded to ships must be closely monitored and reported. The lack of capable accounting staff in recent years resulted in inconsistent and incomplete customer accounts, incorrect amounts collected by customer type, no data for customer arrears, and no aging of customer accounts receivables.

9. CPUC has to undertake drastic changes in financial management and operations to prevent further losses in water and sewerage operations, and to ensure debt servicing on its ADB loan starting in 2007. If it follows the best practices of YSPSC and PUC in financial management and control, such as collections of outstanding arrears, CPUCs' short-term liquidity and financial viability would improve substantially. YSPSC's policy to disconnect nonpaying customers 60 days after issuance of notice of disconnection has been an effective

[6] The PCR Mission noted several inefficiencies in the management and operations of the CPUC: (i) despite its policy of metering customers and undertaking meter reading, CPUC has not been consistently conducting monthly meter readings for billing purposes since all its customers are charged a flat monthly fee, not the progressive fee structure as envisioned; and (ii) despite disconnection policy for customers with arrears, nonpaying customers have not been disconnected and still consume CPUC water without being obliged to pay.

[7] Once the application for water service is approved, the service connection and meter are installed by CPUC at the expense of the applicant. The cost of service connection must be paid in advance.

deterrent to customers' failure to pay on time. Further, a reconnection fee of $45 (following involuntary disconnection) and $10 (for voluntary disconnection) after paying the arrears has been an effective measure that CPUC and PUC can adopt. For new water connections, customers pay $45 and $50 security deposits. For water quality control, YSPSC conducts water quality tests for bacteria and faecal choliform on a weekly or monthly basis. Other capital works are financed mainly from external sources, such as the national legislature, grant funds or community contributions.

B. Economic Evaluation

1. Scope and Methodology

10. The economic analysis recalculated the economic internal rates of return (EIRR) of the two components. The results were compared with the appraisal and revised project scope estimates. Project costs and benefits were reassessed based on (i) information provided to the PCR Mission by the UCs and government offices, such as the Department of Health and Office of Planning and Statistics; and (ii) detailed field interviews with beneficiaries in the newly served areas under the Project. The EIRRs were compared with the economic opportunity cost of capital (EOCC), which was assumed to be 10%, same at appraisal.

2. Project Cost and Benefits

11. The updated financial costs were converted to economic costs to reflect the true cost and value to the economy of goods and services. Items such as transfer payments, price contingencies, and depreciation were excluded in the computation of the economic costs.[8] The analysis described the economic rationale and target beneficiaries, and set out the without-project situation. The analysis compared the calculated EIRR for the two components to the EOCC, which was assumed to be 10%. Standard and project-specific sensitivity tests were undertaken to assess the robustness of the EIRR calculation. The analysis used the domestic price numeraire, as benefits are non-tradable in nature, and was undertaken in constant 2003 prices.

12. The major quantifiable benefits of the water supply project were (i) cost savings on the installation of individual water tanks due to supply shortages;[9] (ii) cost savings on the purchase of additional water requirements by households; (iii) revenues earned from the sale of water to new consumers, which represented the benefits to commercial, industrial and institutional users; and (iv) revenues collected from existing customers based on the present water tariff, which was taken to represent the consumers' minimum willingness to pay.[10]

[8] ADB. 1997. *Guidelines for the Economic Analysis of Projects.* Manila.

[9] Water rationing was evident since service was available for only 4–6 hours daily in Chuuk and Yap during droughts. Capital cost of water tanks range from $350 to $750, with capacity of 1,000 gallons and up.

[10] Households not served by piped water supply relied more on rainwater collected from roofs and stored in circular tanks made of thin galvanized steel sheets, such as those found in Chuuk (which are mostly old and not maintained). Most households have 1,000 gallon tanks or two or three smaller tanks. Stored rainwater is not adequate to meet consumption needs during dry season, which lasts for 4 months. A significant number of households, as well as villagers, had to purchase water from vendors every other day, particularly in Yap. Other households that cannot afford to buy water relied on creeks, rivers, shallow water wells, or neighbors' supplies (larger storage tanks or piped water supply).

3. Results

13. The results of the economic evaluation showed that the Project is economically viable, with the recalculated EIRR estimated at 12.7%, compared with the EOCC of 10%. However, the recalculated EIRR was lower than the EIRR estimate of 16.2% at appraisal. The EIRR calculated for Chuuk indicated that the component is not economically viable due to inefficient operations since the start of the Project. The base case EIRR for Chuuk was 5.5%, compared with an estimated EIRR of 19.9% at appraisal. Yap's EIRR of 15.2% was higher than the 14.9% estimated at appraisal. This resulted from improved water supply system with lower maintenance costs (following the switch from a booster-fed to gravity-fed system) and more connections in remote villages. Pohnpei's recalculated EIRR was 20.9%, higher than the 14.0% appraisal estimate. This was due to improved services to residents and public institutions, such as schools and hospitals, and the provision of village community supplies to remote villages. Sensitivity analyses showed that the Project was most sensitive to decreases in benefits. The results are presented in Table A6.6. Tables A6.7–A6.10 present the detailed calculation of benefits, EIRR, and sensitivity analyses.

14. Other unquantifiable benefits from the Project include (i) access to safe water for low-income communities; (ii) benefits to women and children in terms of time saved for economic activities, such as fishing and selling agricultural crops;[11] (iii) long-term employment for UC staff on plant operation, maintenance, and operation; (iv) employment of contractors and suppliers; (v) improvement of people's health, particularly villagers' children who suffer the most from water-borne diseases from drinking from unprotected sources, such as rainwater tanks and creeks;[12] (vi) short-term local employment during project construction, and the experience gained in project construction that enabled them to be employed as semi-skilled labor; (vii) improved business activities of hotels and restaurants in Yap and Pohnpei; (viii) other social benefits, such as more time for women to do household chores and rear children, and reduced visits to hospitals and clinics due to child illnesses; (ix) positive impact on education sector, where schools no longer experience disruption of classes due to water interruptions; and (x) sale and lease of property by the land owners, which enabled them to generate capital for small-scale businesses.

[11] Women's traditional role in Micronesian society has been focused close to the family home, even when they are assisting in economic activities, such as subsistence agriculture. Women's burden of tending the sick was reduced by the Project. Women also have must ensure sufficient quantity of water for family needs. Improvement in water supply reliability in Kolonia, Pohnpei, was reflected in the positive responses received in social surveys. The improved reliability of the water supply illustrates the benefits, which will accrue to women as improvement spreads in other areas.

[12] The most common water-borne disease is diarrhea. Based on the Department of Health, the incidence of diarrhea and other water-borne diseases declined: (i) Chuuk: 772 in 1999 to 708 in 2001 (but increased to 1,382 in 2002); (ii) Yap, 507 cases in 2000 to 349 cases in 2002; and (iii) Pohnpei: 3,831 cases in 2000 to 1,228 cases in 2002 (mainly people outside Kolonia).

Table A6.2 Financial Internal Rate of Return Calculation–Chuuk ($'000)

Year	Capital Cost	Incremental Production	Incremental O&M Cost	Incremental NRW (%)	Incremental Water Sales (mill. gals)	Revenues Tariffs	Revenues Con-nection Fees	Revenues Total	Net Revenues	Sensitivity Cases 10% Dec In Rev	10% Incr. O&M Costs	Combina. (I) & (ii)	30% Dec In Sales Vol.	20% Inc. In NRW	20% Dec. In Tariffs
1997	42.3								(42.3)	(42.3)	(42.3)	(42.3)	(42.3)	(42.27)	(42.27)
1998	323.8								(323.8)	(323.8)	(323.8)	(323.8)	(323.8)	(323.8)	(323.8)
1999	174.3	176,196	4	0.40	141,718	139.7	4.5	25.0	(34.3)	(48.3)	(154.0)	(48.7)	(76.3)	(83.7)	(62.3)
2000	1,651.6	202,440	14	0.40	157,464	155.3	4.5	49.4	(1,506.0)	(1,521.6)	(1,617.8)	(1,523.0)	(1,552.6)	(1,557.5)	(1,537.1)
2001	551.7	231,600	18	0.40	174,960	172.5	4.5	36.5	(392.2)	(409.4)	(534.4)	(411.2)	(443.9)	(445.9)	(426.7)
2002	310.0	264,000	19	0.40	194,400	191.7	4.5	37.8	(133.2)	(152.4)	(293.5)	(154.3)	(190.7)	(189.5)	(171.5)
2003	408.2	166,800	22	0.50	113,400	111.8	4.5	37.8	(313.7)	(324.8)	(394.3)	(327.0)	(347.2)	(359.7)	(336.0)
2004		166,800	22	0.60	90,720	89.4	4.5	89.5	71.9	63.0	65.3	60.8	45.1	28.5	54.0
2005		166,800	22	0.60	90,720	93.9	5.4	94.0	77.1	67.7	69.6	65.5	48.9	31.5	58.3
2006		166,800	22	0.55	102,060	110.9	5.4	111.1	93.9	82.8	86.3	80.5	60.6	44.6	71.7
2007		166,800	23	0.55	102,060	116.5	5.4	116.6	99.2	87.5	91.6	85.3	64.2	47.4	75.9
2008		166,800	23	0.55	102,060	122.3	5.4	122.4	104.8	92.6	97.2	90.3	68.1	50.4	80.3
2009		166,800	23	0.55	102,060	128.4		128.4	105.3	92.4	103.0	90.1	66.7	48.2	79.6
2010		166,800	23	0.50	113,400	149.8		149.8	126.5	111.5	124.1	109.1	81.5	64.8	96.5
2011		166,800	24	0.50	113,400	157.3		157.3	133.7	118.0	131.4	115.6	86.5	68.9	102.2
2012		166,800	24	0.50	113,400	165.2		165.2	141.3	124.8	139.0	122.4	91.8	73.3	108.3
2013		166,800	24	0.50	113,400	173.5		173.5	149.4	132.0	147.0	129.6	97.3	78.0	114.7
2014		166,800	24	0.50	113,400	182.1		182.1	157.8	139.6	155.4	137.1	103.2	82.8	121.4
2015		166,800	25	0.50	113,400	191.2		191.2	166.7	147.5	164.2	145.1	109.3	87.9	128.4
2016		166,800	25	0.50	113,400	200.8		200.8	176.0	155.9	173.5	153.4	115.7	93.3	135.8
2017		166,800	25	0.50	113,400	210.8		210.8	185.8	164.7	183.3	162.2	122.5	99.0	143.6
2018		166,800	25	0.50	113,400	221.4		221.4	196.1	173.9	193.5	171.4	129.6	104.9	151.8
2019		166,800	26	0.50	113,400	232.4		232.4	206.9	183.6	204.3	181.1	137.1	111.2	160.4
2020		166,800	26	0.50	113,400	244.1		244.1	218.2	193.8	215.7	191.3	145.0	117.8	169.4
2021		166,800	26	0.50	113,400	256.3		256.3	230.2	204.6	227.6	201.9	153.3	124.7	178.9
2022		166,800	26	0.50	113,400	269.1		269.1	242.7	215.8	240.1	213.2	162.0	132.0	188.9
2023		166,800	27	0.50	113,400	282.5		282.5	255.9	227.7	253.3	225.0	171.2	139.6	199.4
2024		166,800	27	0.50	113,400	296.7		296.7	269.8	240.1	267.1	237.4	180.8	147.7	210.5
2025		166,800	27	0.50	113,400	311.5		311.5	284.4	253.2	281.6	250.5	190.9	156.1	222.1
2026		166,800	27	0.50	113,400	327.1		327.1	299.7	267.0	296.9	264.2	201.5	165.0	234.2
2027		166,800	28	0.35	147,420	446.5		446.5	418.8	374.1	416.0	371.4	284.8	265.3	329.5

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Table A6.2—*continued*

Year	Capital Cost	Incremental Production	Incremental Cost	NRW (%)	Revenues Water Sales (mill. gals)	Revenues Tariffs	Revenues Connection Fees	Revenues Total	Net Revenues	Sensitivity Cases 10% Dec In Rev	10% Incr. O&M Costs	Combine (I) & (ii)	30% Dec. In Sales Vol.	20% Inc. In NRW	20% Dec. In Tariffs
2028		166,800	28	0.35	147,420	468.8		468.8	440.8	393.9	438.0	391.1	300.2	279.7	347.1
2029		166,800	28	0.35	147,420	492.2		492.2	464.0	414.8	461.2	411.9	316.3	294.8	365.5
2030		166,800	29	0.35	147,420	516.8		516.8	488.3	436.6	485.5	433.8	333.3	310.6	384.9
2031		166,800	29	0.35	147,420	542.7		542.7	513.9	459.6	511.0	456.7	351.1	327.3	405.3
2032		166,800	29	0.35	147,420	569.8		569.8	540.7	483.7	537.8	480.8	369.8	344.8	426.7
2033		166,800	29	0.35	147,420	598.3		598.3	568.9	509.1	566.0	506.1	389.4	363.2	449.2
NPV									**(116.7)**	**(414.2)**	**(643.1)**	**(447.1)**	**(705.5)**	**(993.8)**	**(375.1)**
FIRR									**4.7%**	**4.0%**	**3.6%**	**3.9%**	**3.1%**	**2.3%**	**4.0%**

FIRR = financial internal rate of return, NPV = net present value, NRW = non-revenue water, O&M = operations and maintenance.
Note: Actual revenues from 1999 to 2000.
Sources: Benefits estimation and interviews of stakeholders.

Table A6.3 Financial Internal Rate of Return Calculation–Yap ($'000)

		Incremental			Revenues					Sensitivity Cases				
Year	Capital Cost	Production mil. Gals	Cost	Water Sales mil. Gals	Tariff	Connection Fees	Total	Net Revenues	10% Dec. in Revenues	10% Incr. In O&M Costs	Combined (I) & (ii)	30% Dec. In Sales Vol.	20 % Inc. In NRW	20 % Dec. In Tariffs
1997														
1998														
1999														
2000	1,216.6		7			4.5	5	(1,219.4)	(1,219.9)	(1,220.2)	(1,220.6)	(1,219.4)	(1,219.42)	(1,219.42)
2001	911.3	396	32	278	333	4.5	338	(605.7)	(639.5)	(608.9)	(642.7)	(938.5)	(938.43)	(938.46)
2002	142.9	172,544	39	139,761	168	4.5	172	(9.8)	(27.0)	(13.7)	(30.9)	(43.3)	(17.62)	(43.29)
2003		172,544	39	139,761	168	4.5	172	133.1	115.9	129.2	112.0	99.6	125.28	99.61
2004		173,225	40	138,580	171	4.5	176	135.5	118.0	131.5	113.9	101.3	126.98	101.29
2005		173,225	41	138,580	176	4.5	181	139.5	121.4	135.3	117.2	104.2	130.66	104.20
2006		173,225	43	138,580	182	4.5	186	143.5	124.9	139.3	120.6	107.2	134.44	107.19
2007		173,225	44	138,580	187	4.5	192	147.7	128.5	143.3	124.1	110.3	138.34	110.27
2008		173,225	45	138,580	193	4.5	197	152.0	132.3	147.5	127.7	113.4	142.36	113.44
2009		173,225	47	138,580	199		199	151.9	132.1	147.3	127.4	112.2	141.99	112.21
2010		173,225	48	138,580	205		205	156.5	136.0	151.7	131.2	115.6	146.25	115.57
2011		173,225	50	138,580	211		211	160.2	139.1	155.2	134.1	118.1	149.68	118.08
2012		173,225	53	138,580	217		217	164.0	142.3	158.7	137.0	120.6	153.16	120.61
2013		173,225	56	138,580	223		223	167.9	145.5	162.3	140.0	123.2	156.70	123.17
2014		173,225	58	138,580	230		230	171.8	148.8	166.0	142.9	125.8	160.29	125.76
2015		173,225	61	138,580	237		237	175.8	152.1	169.6	145.9	128.4	163.93	128.36
2016		173,225	64	138,580	244		244	179.8	155.4	173.4	149.0	131.0	167.62	130.99
2017		173,225	68	138,580	252		252	183.9	158.8	177.2	152.0	133.6	171.36	133.63
2018		173,225	71	138,580	259		259	188.1	162.2	181.0	155.1	136.3	175.15	136.28
2019		173,225	75	138,580	267		267	192.3	165.6	184.9	158.2	139.0	178.98	138.95
2020		173,225	78	138,580	275		275	196.6	169.1	188.8	161.3	141.6	182.86	141.63
2021		173,225	82	138,580	283		283	200.9	172.6	192.7	164.4	144.3	186.78	144.31
2022		173,225	86	138,580	292		292	205.3	176.2	196.7	167.5	147.0	190.74	147.00
2023		173,225	91	138,580	300		300	209.8	179.7	200.7	170.7	149.7	194.74	149.69
2024		173,225	95	138,580	309		309	214.2	183.3	204.7	173.8	152.4	198.77	152.36
2025		173,225	100	138,580	319		319	218.8	186.9	208.8	176.9	155.0	202.83	155.03
2026		173,225	105	138,580	328		328	223.3	190.5	212.8	180.0	157.7	206.92	157.69
2027		173,225	110	138,580	338		338	227.9	194.1	216.9	183.1	160.3	211.03	160.32
2028		173,225	116	138,580	348		348	232.6	197.7	221.0	186.2	162.9	215.15	162.93
2029		173,225	121	138,580	359		359	237.2	201.4	225.1	189.2	165.5	219.30	165.50

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Table A6.3—*continued*

Year	Capital Cost	Incremental Production mil. Gals	Cost	Water Sales mil. Gals	Tariff	Revenues Connection Fees	Total	Net Revenues	10% Dec. in Revenues	Sensitivity Cases 10% Incr. In O&M Costs	Combined (I) & (ii)	30% Dec. In Sales Vol.	20 % Inc. In NRW	20 % Dec. In Tariffs
2030		173,225	127	138,580	369		369	241.9	205.0	229.2	192.2	168.0	223.45	168.04
2031		173,225	134	138,580	380		380	246.6	208.6	233.2	195.2	170.5	227.60	170.53
2032		173,225	141	138,580	392		392	251.3	212.2	237.3	198.1	173.0	231.75	172.97
2033		173,225	148	138,580	404		404	256.1	215.7	241.3	201.0	175.3	235.89	175.35
NPV								**640.6**	**270.1**	**545.0**	**174.4**	**(335.5)**	**171.2**	**(335.5)**
FIRR								**7.3%**	**6.0%**	**7.0%**	**5.7%**	**3.8%**	**5.6%**	**3.8%**

FIRR = financial internal rate of return, mil = million, NPV = net present value, NRW = non-revenue water, O&M = operations and maintenance.
Note: Actual revenues from 1999 to 2000.
Sources: Benefits estimation and interviews of stakeholders.

Table A6.4 Financial Internal Rate of Return Calculation–Pohnpei ($'000)

	Incremental						Revenues		Sensitivity Cases					
Year	Capital Cost	Volume 000 gals	Cost	Water Sales 000 gals	Tariffs	Con-nection Fees	Total	Net Revenues	10% Dec. in Rev.	10 % Incr. In O&M Costs	Combined Case	30% Dec. In Sales Vol.	20 % Inc. In NRW	20% Dec. in Tariffs
1997	37.8						(37.80)	(37.80)	(37.80)	(37.80)	(37.80)	(37.80)	(37.80)	(37.80)
1998														
1999	19.0		0		139.7	1.5	6.00	3.50	6.00	3.50	85.88	94.26	91.47	6.00
2000	1,003.2		10		155.3	1.5	(953.80)	(968.74)	(964.80)	(969.74)	(896.78)	(887.46)	(890.57)	(953.80)
2001	602.2	7	16	5	172.5	1.5	(565.70)	(585.35)	(583.30)	(586.95)	(489.05)	(478.70)	(482.15)	(565.70)
2002	191.8	13	18	9	191.7	1.5	(154.00)	(175.78)	(173.80)	(177.58)	(66.44)	(54.94)	(58.77)	(154.00)
2003	264.8	20	21	11	111.8	1.5	(227.00)	(251.78)	(250.10)	(253.88)	(201.57)	(194.86)	(197.10)	(227.00)
2004		22	22	13	89.4	1.5	89.50	58.55	65.30	56.35	45.66	51.02	49.23	89.50
2005		24	24	14	92.1	1.8	92.20	58.98	65.80	56.58	45.95	51.48	49.64	92.20
2006		26	25	16	106.8	1.8	106.80	71.12	79.30	68.62	55.83	62.24	60.10	106.80
2007		28	26	17	110.0	1.8	110.00	73.00	81.40	70.40	57.20	63.80	61.60	110.00
2008		30	27	20	113.3	1.8	113.30	74.97	83.60	72.27	58.64	65.44	63.17	113.30
2009		33	29	21	116.7		116.70	76.03	84.80	73.13	57.36	64.36	62.03	116.70
2010		35	30	23	133.5		133.50	90.15	100.50	87.15	68.79	76.80	74.13	133.50
2011		37	32	24	137.5		137.50	91.75	102.30	88.55	69.75	78.00	75.25	137.50
2012		40	33	28	141.6		141.60	94.44	105.30	91.14	71.78	80.28	77.45	141.60
2013		43	35	30	145.9		145.90	96.31	107.40	92.81	72.97	81.72	78.80	145.90
2014		45	37	32	150.3		150.30	98.27	109.60	94.57	74.22	83.24	80.23	150.30
2015		48	38	34	154.8		154.80	101.32	113.00	97.52	76.55	85.84	82.74	154.80
2016		51	40	36	159.4		159.40	103.46	115.40	99.46	77.96	87.52	84.33	159.40
2017		54	42	38	164.2		164.20	105.78	118.00	101.58	79.51	89.36	86.08	164.20
2018		57	45	40	169.1		169.10	107.19	119.60	102.69	80.13	90.28	86.90	169.10
2019		60	47	42	174.2		174.20	109.78	122.50	105.08	81.91	92.36	88.88	174.20
2020		63	49	44	179.4		179.40	112.46	125.50	107.56	83.76	94.52	90.93	179.40
2021		66	52	46	184.8		184.80	114.32	127.60	109.12	84.75	95.84	92.14	184.80
2022		70	54	52	190.4		190.40	117.36	131.00	111.96	86.90	98.32	94.51	190.40
2023		73	57	55	196.1		196.10	119.49	133.40	113.79	88.11	99.88	95.96	196.10
2024		77	60	57	201.9		201.90	121.71	135.90	115.71	89.41	101.52	97.48	201.90
2025		80	63	60	208.0		208.00	124.20	138.70	117.90	90.92	103.40	99.24	208.00
2026		84	66	63	214.2		214.20	126.78	141.60	120.18	92.51	105.36	101.08	214.20
2027		88	69	66	286.9		286.90	189.21	211.00	182.31	143.31	160.52	154.78	286.90
2028		92	73	69	295.5		295.50	192.95	215.20	185.65	145.67	163.40	157.49	295.50

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Table A6.4—*continued*

	Incremental					Revenues				Sensitivity Cases			
Year	Capital Cost	Volume 000 gals	Cost	Water Sales 000 gals	Tariffs	Con-nection Fees	Total	Net Revenues	10% Dec. in Rev.	10 % Incr. In O&M Costs	Combined Case	30% Dec. In Sales Vol.	20 % Inc. In NRW	20% Dec. in Tariffs
2029		96	76	72	304.3		304.30	197.87	220.70	190.27	149.18	167.44	161.35	304.30
2030		100	80	75	313.5		313.50	202.15	225.50	194.15	151.99	170.80	164.53	313.50
2031		105	84	79	322.9		322.90	206.61	230.50	198.21	154.95	174.32	167.86	322.90
2032		109	88	82	332.6		332.60	211.34	235.80	202.54	158.12	178.08	171.43	332.60
2033		114	93	86	342.5		342.50	215.25	240.20	205.95	160.45	181.00	174.15	342.50
NPV							**(640.78)**	**(859.50)**	**(815.08)**	**(875.35)**	**(699.08)**	**(642.67)**	**(661.47)**	**(640.78)**
FIRR							**5.9%**	**3.1%**	**3.7%**	**2.8%**	**2.8%**	**3.6%**	**3.3%**	**5.9%**

FIRR = financial internal rate of return, NPV = net present value, NRW = non-revenue water, O&M = operations and maintenance.
Notes: Actual revenues from 1999 to 2000.
Incremental production as a result of increase in connections to the system.
Sources: Benefits estimation and interviews of stakeholders.

Table A6.5 Overall Project Financial Internal Rate of Return ($'000)

Year	Capital Cost	Incremental Production	Revenues				Net Revenues	Sensitivity Analysis					
			Cost	Tariffs	Con-nection Fees			10% Dec. in Rev	10% Incr. in O&M Costs	Combined . Case	30% Dec. in Sales Vol.	20% Increase in NRW	20% Dec. In Tariffs
1997	80.1						(80.1)	(80.1)	(80.1)	(80.1)	(80.1)	(80.07)	(80.07)
1998	323.8						(323.8)	(323.8)	(323.8)	(323.8)	(323.8)	(323.75)	(323.8)
1999	193.3	176,196.0	4.4	139.7	19.5	40.0	(157.7)	(161.7)	(158.1)	(162.1)	(80.4)	(87.84)	(66.4)
2000	3,871.5	202,440.0	31.7	155.3	21.0	65.9	(3,837.2)	(3,843.8)	(3,840.4)	(3,847.0)	(3,773.4)	(3,778.32)	(3,757.9)
2001	2,065.2	232,003.1	65.6	513.3	16.2	388.9	(1,741.9)	(1,780.7)	(1,748.4)	(1,787.3)	(1,988.2)	(1,988.52)	(1,970.1)
2002	644.7	436,557.1	76.5	374.6	16.2	232.4	(488.9)	(512.1)	(496.5)	(519.8)	(426.1)	(396.13)	(405.4)
2003	672.9	339,363.7	82.3	299.9	16.2	237.6	(517.6)	(541.4)	(525.8)	(549.6)	(512.3)	(496.33)	(499.1)
2004		340,046.6	84.8	293.2	9.0	297.8	213.0	183.2	204.5	174.7	146.6	161.02	158.8
2005		340,048.7	87.3	307.9	9.9	312.5	225.2	193.9	216.5	185.2	155.8	171.08	168.9
2006		340,050.8	90.0	335.6	9.9	340.2	250.2	216.2	241.2	207.2	173.0	191.40	188.4
2007		340,053.0	92.7	352.5	9.9	357.1	264.4	228.7	255.1	219.4	182.6	202.04	199.2
2008		340,055.2	95.6	375.0	9.9	379.6	284.1	246.1	274.5	236.6	196.1	218.93	214.4
2009		340,057.5	98.5	394.7		394.7	296.2	256.7	286.3	246.9	197.6	221.89	217.2
2010		340,059.9	101.6	430.6		430.6	329.0	286.0	318.9	275.8	220.3	248.89	242.9
2011		340,062.3	105.7	453.6		453.6	347.9	302.5	337.3	291.9	232.9	263.36	257.2
2012		340,064.8	110.1	485.5		485.5	375.4	326.9	364.4	315.9	251.5	287.70	278.3
2013		340,067.4	114.6	512.4		512.4	397.8	346.6	386.4	335.1	266.4	305.34	295.3
2014		340,070.0	119.4	541.2		541.2	421.8	367.7	409.9	355.7	282.5	324.26	313.6
2015		340,072.8	124.4	571.8		571.8	447.5	390.3	435.0	377.8	299.6	344.58	333.1
2016		340,075.6	129.6	604.6		604.6	475.0	414.5	462.0	401.5	318.0	366.41	354.0
2017		340,078.5	135.1	639.5		639.5	504.4	440.5	490.9	427.0	337.7	389.86	376.5
2018		340,081.5	140.8	676.8		676.8	536.0	468.3	521.9	454.2	358.8	415.08	400.6
2019		340,084.6	146.9	716.7		716.7	569.9	498.2	555.2	483.5	381.5	442.19	426.5
2020		340,087.8	153.2	759.4		759.4	606.2	530.2	590.9	514.9	405.9	471.36	454.3
2021		340,091.1	159.8	805.0		805.0	645.2	564.7	629.2	548.7	432.0	502.75	484.2
2022		340,094.4	166.8	874.7		874.7	707.9	620.5	691.3	603.8	474.7	561.66	533.0
2023		340,097.9	174.1	929.1		929.1	755.0	662.1	737.6	644.7	506.3	600.63	569.2
2024		340,101.5	181.7	987.3		987.3	805.6	706.9	787.5	688.7	540.4	642.64	608.2

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Table A6.5—*continuation*

Year	Capital Cost	Incremental Production	Revenues Cost	Tariffs	Con-nection Fees	Net Revenues	Sensitivity Analysis 10% Dec. in Rev	10% Incr. in O&M Costs	Combined Case	30% Dec. in Sales Vol.	20% Increase in NRW	20% Dec.In Tariffs
2025		340,105.2	189.7	1,049.8	1,049.8	860.1	755.1	841.1	736.1	577.0	687.94	650.1
2026		340,109.0	198.1	1,116.7	1,116.7	918.6	806.9	898.8	787.1	616.4	736.80	695.3
2027		340,112.9	206.9	1,291.5	1,291.5	1,084.6	955.5	1,063.9	934.8	731.0	880.46	826.3
2028		340,116.9	216.1	1,373.7	1,373.7	1,157.6	1,020.2	1,136.0	998.6	780.3	941.90	882.8
2029		340,121.1	225.8	1,461.8	1,461.8	1,236.0	1,089.8	1,213.4	1,067.2	833.3	1,008.09	943.6
2030		340,116.9	236.0	1,556.2	1,556.2	1,320.2	1,164.6	1,296.6	1,141.0	890.3	1,079.40	1,009.0
2031		340,116.9	246.7	1,657.4	1,657.4	1,410.8	1,245.0	1,386.1	1,220.4	951.6	1,156.26	1,079.3
2032		340,116.9	257.8	1,766.0	1,766.0	1,508.2	1,331.6	1,482.4	1,305.8	1,017.6	1,239.10	1,155.0
2033		340,116.9	269.6	1,882.5	1,882.5	1,613.0	1,424.7	1,586.0	1,397.8	1,088.6	1,328.41	1,236.5
NPV						**81.0**	**(723.1)**	**(85.1)**	**(889.3)**	**(1,847.1)**	**(1,158.1)**	**(1,320.9)**
FIRR						**5.1%**	**4.3%**	**4.9%**	**4.1%**	**3.0%**	**3.8%**	**3.6%**
Loan	0.065											
Equity	0.03											

FIRR = financial internal rate of return, NPV = net present value, NRW = non-revenue water, O&M = operations and maintenance.
Sources: Benefit estimations and interviews of stakeholders.

Table A6.6: Economic Internal Rate of Return and Sensitivity Analyses

Item	At Appraisal (%)	At Project Completion (%)
1. Overall Project: Base Case	**16.2**	**12.7**
(i) Capital cost increase by 10%	14.8	─
(ii) Revenues decrease by 10%	16.0	11.3
(iii) O&M increase by 10%	14.5	12.5
(iv) Project delay	14.7	─
(v) Combination of (i)–(iv)	12.0	
(vi) Combination of (ii) & (iii)	─	11.1
(vii) Decrease in WTP by 20%	─	11.2
(viii) Decrease in cost savings by 20%	─	11.3
2. Chuuk Component: Base Case	**19.9**	**5.5**
(i) Capital cost increase by 10%	18.3	──
(ii) Revenues decrease by 10%	19.8	4.6
(iii) O&M increase by 10%	19.8	5.4
(iv) Project delay	17.7	──
(v) Combination of (i)–(iv)	14.8	──
(vi) Combination of (ii) & (iii)	──	4.4
(vii) Decrease in WTP by 20%	──	4.7
(viii) Decrease in cost savings by 20%	──	4.4
3. Yap Component: Base Case	**14.9**	**15.2**
(i) Capital cost increase by 10%	13.7	──
(ii) Revenues decrease by 10%	14.8	13.7
(iii) O&M increase by 10%	13.6	15.0
(iv) Project delay	13.5	──
(v) Combination of (i)–(iv)	11.4	──
(vi) Combination of (ii) & (iii)	──	13.5
(vii) Decrease in WTP by 20%	──	13.1
(viii) Decrease in cost savings by 20%	──	14.2
4. Pohnpei Component: Base Case	**14.0**	**20.9**
(i) Capital cost increase by 10%	12.8	──
(ii) Revenues decrease by 10%	13.9	18.6
(iii) O&M increase by 10%	12.5	20.7
(iv) Project delay	12.6	──
(v) Combination of (i)-(iv)	10.2	──
(vi) Combination of (ii) & (iii)	──	18.4
(vii) Decrease in WTP by 20%	──	19.1
(viii) Decrease in cost savings by 20%	──	18.1

─ = no data available, O&M = operations and maintenance, WTP = water treatment plant.
Sources: Benefit estimations and interviews of stakeholders.

Table A6.7: Economic Reevaluation–Chuuk ($'000)

Year				Without Project		Incremental			Benefits			Sensitivity Cases					
	Capital Cost	O&M	Total Costs	Production	O&M	Production	Volume	Cost	Non Incre-mental	Incre-mental	Total	Net Benefits	10% Dec. in Rev	10% Incr. In O&M Costs	Combined Cases	20% Dec. in WTP	20% Dec. In Cost Savings
1997	42.3		42.3									(42)	(42)	(42)	(42)	(42.3)	(42.3)
1998	323.8	16.2	339.9					16				(340)	(340)	(342)	(342)	(339.9)	(339.9)
1999	174.3	21.4	195.7	236,196.0	13	60,000	176,196	8	85.1	38.3	123.4	(59)	(71.6)	(60.1)	(72.4)	(66.9)	(76.3)
2000	1,651.6	71.0	1,722.6	262,440.0	43	60,000	202,440	28	94.7	41.4	136.1	(1,543)	(1,556.9)	(1,546.1)	(1,559.7)	(1,551.6)	(1,562.2)
2001	551.7	87.5	639.2	291,600.0	53	60,000	231,600	34	100.7	44.7	145.4	(441)	(455.1)	(444.0)	(458.5)	(449.5)	(460.7)
2002	310.0	96.8	406.8	324,000.0	59	60,000	264,000	38	107.9	48.3	156.2	(192)	(207.4)	(195.6)	(211.2)	(201.4)	(213.4)
2003	408.2	109.1	517.2	226,800.0	66	60,000	166,800	43	112.8	52.2	165.0	(286)	(302.4)	(290.2)	(306.7)	(296.4)	(308.5)
2004		110.1	110.1	226,800.0	67	60,000	166,800	43	116.4	56.3	172.8	130	112.3	125.3	108.0	118.3	106.3
2005		111.3	111.3	226,800.0	68	60,000	166,800	44	120.0	63.9	183.9	140	121.9	135.9	117.5	127.5	116.3
2006		112.4	112.4	226,800.0	68	60,000	166,800	44	123.6	72.4	196.1	152	132.4	147.6	128.0	137.5	127.3
2007		113.5	113.5	226,800.0	69	60,000	166,800	44	127.2	82.1	209.4	165	143.9	160.4	139.5	148.4	139.4
2008		114.6	114.6	226,800.0	70	60,000	166,800	45	133.2	93.1	226.4	181	158.8	176.9	154.3	162.8	154.8
2009		115.8	115.8	226,800.0	70	60,000	166,800	45	139.2	105.6	244.9	199	175.0	194.9	170.4	178.3	171.6
2010		116.9	116.9	226,800.0	71	60,000	166,800	46	146.4	119.8	266.2	220	193.8	215.8	189.2	196.4	191.1
2011		118.1	118.1	226,800.0	72	60,000	166,800	46	156.0	135.8	291.9	246	216.4	240.9	211.8	218.4	214.4
2012		119.3	119.3	226,800.0	73	60,000	166,800	47	165.6	154.0	319.7	273	240.9	268.2	236.3	242.1	239.8
2013		120.5	120.5	226,800.0	73	60,000	166,800	47	175.2	174.7	349.9	303	267.7	298.0	263.0	267.7	267.6
2014		121.7	121.7	226,800.0	74	60,000	166,800	48	175.2	198.1	373.3	326	288.3	320.8	283.5	286.0	290.6
2015		122.9	122.9	226,800.0	75	60,000	166,800	48	175.2	198.1	373.3	325	287.8	320.3	283.0	285.5	290.1
2016		124.1	124.1	226,800.0	75	60,000	166,800	49	175.2	198.1	373.3	325	287.3	319.8	282.5	285.0	289.6
2017		125.4	125.4	226,800.0	76	60,000	166,800	49	175.2	198.1	373.3	324	286.8	319.3	281.9	284.6	289.1
2018		126.6	126.6	226,800.0	77	60,000	166,800	50	175.2	198.1	373.3	324	286.3	318.7	281.4	284.1	288.6
2019		127.9	127.9	226,800.0	78	60,000	166,800	50	175.2	198.1	373.3	323	285.8	318.2	280.8	283.6	288.1
2020		129.2	129.2	226,800.0	79	60,000	166,800	51	175.2	198.1	373.3	323	285.3	317.6	280.3	283.1	287.6
2021		130.5	130.5	226,800.0	79	60,000	166,800	51	175.2	198.1	373.3	322	284.8	317.1	279.7	282.6	287.1
2022		131.8	131.8	226,800.0	80	60,000	166,800	52	175.2	198.1	373.3	322	284.3	316.5	279.2	282.0	286.6
2023		133.1	133.1	226,800.0	81	60,000	166,800	52	175.2	198.1	373.3	321	283.8	315.9	278.6	281.5	286.1
2024		134.4	134.4	226,800.0	82	60,000	166,800	53	175.2	198.1	373.3	321	283.3	315.4	278.0	281.0	285.6
2025		135.7	135.7	226,800.0	83	60,000	166,800	53	175.2	198.1	373.3	320	282.8	314.8	277.4	280.5	285.1
2026		137.1	137.1	226,800.0	83	60,000	166,800	54	175.2	198.1	373.3	320	282.2	314.2	276.9	279.9	284.5
2027		138.5	138.5	226,800.0	84	60,000	166,800	54	175.2	198.1	373.3	319	281.7	313.6	276.3	279.4	284.0
2028		139.9	139.9	226,800.0	85	60,000	166,800	55	175.2	198.1	373.3	318	281.2	313.0	275.7	278.9	283.4
2029		141.3	141.3	226,800.0	86	60,000	166,800	55	175.2	198.1	373.3	318	280.6	312.4	275.1	278.3	282.9

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Table A6.7—*continued*

Year				Without Project		Incremental			Benefits				Sensitivity Cases				
	Capital Cost	O&M	Total Costs	Production	O&M	Production	Volume	Cost	Non Incre-mental	Incre-mental	Total	Net Benefits	10% Dec. in Rev	10% Incr. In O&M Costs	Combined Cases	20% Dec. in WTP	20% Dec. In Cost Savings
2030		142.7	142.7	226,800.0	87	60,000	166,800	56	175.2	198.1	373.3	317	280.1	311.8	274.5	277.8	282.3
2031		144.1	144.1	226,800.0	88	60,000	166,800	56	175.2	198.1	373.3	317	279.5	311.2	273.2	277.2	281.8
2032		145.5	145.5	226,800.0	88	60,000	166,800	57	175.2	198.1	373.3	316	278.9	310.6	273.2	276.6	281.2
2033		147.0	147.0	226,800.0	89	60,000	166,800	58	175.2	198.1	373.3	316	278.4	309.9	272.6	276.1	280.6
NPV												**(899.9)**	**(1,072.1)**	**(932.9)**	**(1,105.2)**	**(1,038.0)**	**(1,106.3)**
EIRR												**5.5%**	**4.6%**	**5.4%**	**4.4%**	**4.7%**	**4.4%**

EIRR = economic internal rate of return, NPV = net present value, O&M =operations and maintenance, WTP = water treatment plant.
Sources: Benefit estimations and interviews of stakeholders.

Table A6.8: Economic Reevaluation–Yap ($'000)

Year	Incremental		Benefits				Sensitivity Cases					
	Capital Cost	Volume	Cost	Non Incremental	Incremental	Total	Net Benefits	10% Dec. in Revenues	10% Incr. In O&M Costs	Combined Case	20% Dec. in WTP	20% Dec. In Cost Savings
1997												
1998												
1999												
2000	1,216.6		7.3	88	102	190.0	(1,034)	(1,052.9)	(1,034.6)	(1,053.6)	(1,054.4)	(1,051.46)
2001	911.3	396	31.9	95	110	205.4	(738)	(758.4)	(741.0)	(761.6)	(759.9)	(756.82)
2002	142.9	172,544	39.1	104	119	222.9	41	18.6	37.0	14.7	17.0	20.20
2003		172,544	39.1	112	129	240.9	202	177.7	197.9	173.8	176.1	179.42
2004		173,225	40.2	116	143	259.7	219	193.5	215.4	189.5	190.8	196.18
2005		173,225	41.4	121	159	280.1	239	210.7	234.5	206.5	206.8	214.54
2006		173,225	42.7	122	177	299.8	257	227.1	252.8	222.8	221.6	232.60
2007		173,225	44.0	122	197	319.7	276	243.8	271.3	239.4	236.3	251.26
2008		173,225	45.3	122	219	341.9	297	262.4	292.1	257.9	252.7	272.12
2009		173,225	46.6	122	244	366.6	320	283.3	315.2	278.6	271.1	295.43
2010		173,225	48.0	122	272	394.0	346	306.6	341.1	301.7	291.6	321.47
2011		173,225	50.4	122	302	424.5	374	331.6	369.0	326.6	313.7	349.60
2012		173,225	53.0	122	336	458.5	406	359.7	400.2	354.4	338.3	381.04
2013		173,225	55.6	122	374	496.3	441	391.0	435.1	385.5	365.9	416.16
2014		173,225	58.4	122	416	538.3	480	426.1	474.0	420.2	396.7	455.40
2015		173,225	61.3	122	463	585.0	524	465.2	517.6	459.1	431.2	499.23
2016		173,225	64.4	122	477	598.9	535	474.6	528.1	468.2	439.2	510.04
2017		173,225	67.6	122	491	613.2	546	484.3	538.8	477.5	447.4	521.12
2018		173,225	71.0	122	506	627.9	557	494.1	549.8	487.1	455.8	532.46
2019		173,225	74.5	122	521	643.1	569	504.2	561.1	496.8	464.4	544.08
2020		173,225	78.3	122	536	658.7	580	514.6	572.6	506.8	473.2	555.97
2021		173,225	82.2	122	552	674.8	593	525.1	584.4	516.9	482.1	568.15
2022		173,225	86.3	122	569	691.4	605	536.0	596.5	527.3	491.3	580.61
2023		173,225	90.6	122	586	708.4	618	547.0	608.8	537.9	500.6	593.37
2024		173,225	95.1	122	604	726.0	631	558.3	621.4	548.8	510.2	606.42
2025		173,225	99.9	122	622	744.1	644	569.8	634.3	559.9	519.9	619.77
2026		173,225	104.9	122	640	762.8	658	581.6	647.4	571.1	529.8	633.43
2027		173,225	110.1	122	660	782.0	672	593.7	660.9	582.7	540.0	647.40
2028		173,225	115.6	122	679	801.8	686	606.0	674.6	594.4	550.3	661.68

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Table A6.8—*continued*

Year	Incremental Benefits					Sensitivity Cases					
	Capital Cost	Volume	Cost	Non Incremental	Incremental	Total	Net Benefits	10% Dec. in Revenues	10% Incr. In O&M Costs	Combined Case	20% Dec. in WTP	20% Dec. In Cost Savings
2029		173,225	121.4	122	700	822.2	701	618.5	688.6	606.4	560.8	676.28
2030		173,225	127.5	122	721	843.2	716	631.4	702.9	618.6	571.5	691.20
2031		173,225	133.8	122	742	864.8	731	644.5	717.5	631.1	582.5	706.45
2032		173,225	140.5	122	765	887.1	747	657.8	732.5	643.8	593.6	722.03
2033		173,225	147.6	122	788	910.0	762	671.4	747.7	656.7	604.9	737.94
NPV							**893.9**	**621.7**	**858.8**	**586.7**	**514.2**	**729.20**
EIRR							**15.2%**	**13.7%**	**15.0%**	**13.5%**	**13.1%**	**14.2%**

EIRR = economic internal rate of return, NPV = net present value, O&M = operations and maintenance, WTP =water treatment plant
Sources: Benefit estimations and interviews of stakeholders.

Table A6.9: Economic Reevaluation–Pohnpei ($'000)

Year	Incremental			Benefits				Sensitivity Cases				
	Capital Cost	Volume	Cost	Non Incremental	Incremental	Total	Net Benefits	10% Dec. in Revenues	10% Incr. In O&M Costs	Combined Cases	20% Dec. in WTP	20% Dec. In Cost Savings
1997	37.8						(38)	(38)	(38)	(38)	(37.8)	(37.8)
1998												
1999	19.0		0.1		61	61.4	42	36.2	42.3	36.2	30.0	42.3
2000	1,003.2		10.2	170	64	233.4	(780)	(803.3)	(781.0)	(804.4)	(792.7)	(814.0)
2001	602.2	6.6	16.2	175	65	240.5	(378)	(402.0)	(379.6)	(403.6)	(391.0)	(413.0)
2002	191.8	13.2	18.1	182	70	252.9	43	17.7	41.1	15.9	28.9	6.5
2003	264.8	19.8	21.4	193	84	276.9	(9)	(36.9)	(11.4)	(39.1)	(26.0)	(47.9)
2004		21.8	22.5	200	121	321.3	299	266.7	296.5	264.4	274.6	258.7
2005		23.8	23.6	208	137	344.7	321	286.6	318.7	284.2	293.6	279.6
2006		25.9	24.8	274	156	429.9	405	362.1	402.6	359.6	373.8	350.4
2007		28.1	26.0	274	164	437.7	412	367.9	409.0	365.3	378.8	356.9
2008		30.3	27.3	274	172	445.9	419	374.0	415.8	371.2	384.1	363.8
2009		32.6	28.7	274	181	454.5	426	380.4	422.9	377.5	389.6	371.1
2010		35.0	30.1	274	190	463.6	433	387.1	430.4	384.0	395.4	378.7
2011		37.4	31.7	274	199	473.1	441	394.1	438.2	390.9	401.5	386.7
2012		39.9	33.2	274	209	483.0	450	401.5	446.5	398.2	407.9	395.1
2013		42.5	34.9	274	220	493.5	459	409.3	455.1	405.8	414.6	403.9
2014		45.2	36.6	274	231	504.5	468	417.4	464.2	413.7	421.7	413.1
2015		47.9	38.5	274	242	516.0	478	426.0	473.7	422.1	429.1	422.8
2016		50.8	40.4	274	255	528.2	488	434.9	483.7	430.9	436.9	433.0
2017		53.7	42.4	274	267	540.9	498	444.4	494.2	440.1	445.0	443.8
2018		56.7	44.5	274	281	554.3	510	454.3	505.3	449.8	453.6	455.0
2019		59.8	46.8	274	295	568.3	522	464.7	516.8	460.0	462.6	466.8
2020		62.9	49.1	274	309	583.0	534	475.6	529.0	470.7	472.0	479.2
2021		66.2	51.6	274	325	598.5	547	487.1	541.8	481.9	482.0	492.2
2022		69.6	54.1	274	341	614.7	561	499.1	555.2	493.7	492.4	505.9
2023		73.1	56.8	274	358	631.8	575	511.8	569.3	506.1	503.3	520.2
2024		76.6	59.7	274	376	649.7	590	525.0	584.0	519.1	514.8	535.3
2025		80.3	62.7	274	395	668.5	606	539.0	599.6	532.7	526.9	551.1
2026		84.1	65.8	274	415	688.3	622	553.6	615.9	547.0	539.5	567.7
2027		88.0	69.1	274	435	709.0	640	569.0	633.0	562.1	552.8	585.2
2028		92.1	72.5	274	457	730.8	658	585.1	651.0	577.9	566.8	603.5

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Table A6.9—*continued*

Year	Incremental Benefits						Sensitivity Cases				
	Capital Cost	Volume	Cost	Non Incremental	Incremental	Total	Net Benefits	10% Dec. in Revenues	10% Incr. In O&M Costs	Combined Cases	20% Dec. in WTP	20% Dec. In Cost Savings
2029		96.2	76.2	274	480	753.6	677	602.1	669.8	594.5	581.4	622.7
2030		100.5	80.0	274	504	777.6	698	619.9	689.6	611.9	596.8	642.9
2031		104.9	84.0	274	529	802.8	719	638.6	710.4	630.2	613.0	664.1
2032		109.4	88.2	274	556	829.3	741	658.2	732.3	649.3	630.0	686.4
2033		114.1	92.6	274	583	857.1	764	678.8	755.2	669.5	647.8	709.7
NPV							**1,417.0**	**1,118.9**	**1,395.8**	**1,097.7**	**1,158.4**	**1,079.3**
EIRR							**20.9%**	**18.6%**	**20.7%**	**18.4%**	**19.1%**	**18.1%**

EIRR = economic internal rate of return, NPV = net present value, O&M = operations and maintenance, WTP = water treatment plant.
Sources: Benefit estimations and interviews of stakeholders.

Table 6.10: Economic Internal Rate of Return of the Project ($'000)

Year			Without Project		Incremental			Benefits				Sensitivity Cases				
		Capital Cost	O&M	Production	O&M	Production	Volume	O&M	Non-Incre-mental	Incre-mental	Total	Net Benefits	10% Dec. in Rev	10% Incr. In O&M Costs	Combined Cases	20% Dec. in WTP	20% Dec. In Cost Savings
1997	.0	80.1										(80.1)	(80.1)	(80.1)	(80.1)	(80.1)	(80.1)
1998	2.0	323.8	16.2					16.2				(339.9)	(339.9)	(341.6)	(341.6)	(339.9)	(339.9)
1999	3.0	193.3	22.0	236,196.0	13.5	60,000.0	176,196.0	8.5	85.1	99.7	184.9	(16.9)	(35.4)	(17.8)	(36.3)	(36.9)	(34.0)
2000	4.0	3,871.5	148.2	265,129.2	102.9	62,689.2	202,440.0	45.3	352.2	207.3	559.5	(3,357.2)	(3,413.2)	(3,361.7)	(3,417.7)	(3,398.7)	(3,427.7)
2001	5.0	2,065.2	216.1	294,824.4	133.7	62,821.4	232,003.1	82.4	370.8	220.5	591.3	(1,556.3)	(1,615.4)	(1,564.6)	(1,623.7)	(1,600.4)	(1,630.5)
2002	6.0	644.7	247.4	499,378.5	152.3	62,821.4	436,557.1	95.1	393.8	238.1	631.9	(107.9)	(171.1)	(117.4)	(180.6)	(155.5)	(186.7)
2003	7.0	672.9	272.9	402,185.1	169.6	62,821.4	339,363.7	103.2	418.0	264.8	682.8	(93.4)	(161.6)	(103.7)	(172.0)	(146.3)	(177.0)
2004	8.0		280.6	402,868.0	174.7	62,821.4	340,046.6	105.9	433.2	320.6	753.7	647.8	572.4	637.2	561.9	583.7	561.2
2005	9.0		288.6	402,870.1	179.9	62,821.4	340,048.7	108.7	448.3	359.2	807.5	698.8	618.1	688.0	607.2	627.0	609.2
2006	10.0		296.9	402,872.2	185.4	62,821.4	340,050.8	111.5	519.6	403.4	923.0	811.4	719.1	800.3	708.0	730.8	707.5
2007	11.0		305.6	402,874.3	191.1	62,821.4	340,053.0	114.5	523.2	438.9	962.2	847.7	751.4	836.2	740.0	759.9	743.0
2008	12.0		314.6	402,876.6	197.0	62,821.4	340,055.2	117.6	529.2	478.0	1,007.3	889.7	789.0	877.9	777.2	794.1	783.9
2009	13.0		323.9	402,878.9	203.2	62,821.4	340,057.5	120.7	535.2	521.0	1,056.2	935.5	829.9	923.4	817.8	831.3	828.5
2010	14.0		333.6	402,881.2	209.6	62,821.4	340,059.9	124.0	542.4	568.3	1,110.7	986.7	875.6	974.3	863.2	873.0	878.2
2011	15.0		345.6	402,883.7	217.2	62,821.4	340,062.3	128.4	552.0	620.3	1,172.3	1,043.9	926.7	1,031.1	913.9	919.9	933.5
2012	16.0		358.2	402,886.2	225.2	62,821.4	340,064.8	133.0	561.6	677.6	1,239.2	1,106.2	982.3	1,093.0	969.0	970.7	993.9
2013	17.0		371.3	402,888.8	233.6	62,821.4	340,067.4	137.7	571.2	740.7	1,311.9	1,174.2	1,043.0	1,160.4	1,029.2	1,026.0	1,059.9
2014	18.0		385.0	402,891.4	242.3	62,821.4	340,070.0	142.7	571.2	810.2	1,381.4	1,238.7	1,100.6	1,224.4	1,086.3	1,076.7	1,124.5
2015	19.0		399.4	402,894.2	251.5	62,821.4	340,072.8	148.0	571.2	868.5	1,439.7	1,291.8	1,147.8	1,277.0	1,133.0	1,118.1	1,177.5
2016	20.0		414.5	402,897.0	261.0	62,821.4	340,075.6	153.4	571.2	894.5	1,465.7	1,312.3	1,165.7	1,296.9	1,150.4	1,133.4	1,198.0
2017	21.0		430.2	402,899.9	271.1	62,821.4	340,078.5	159.2	571.2	921.5	1,492.7	1,333.6	1,184.3	1,317.7	1,168.4	1,149.3	1,219.3
2018	22.0		446.7	402,902.9	281.6	62,821.4	340,081.5	165.2	571.2	949.6	1,520.8	1,355.7	1,203.6	1,339.2	1,187.1	1,165.8	1,241.4
2019	23.0		464.0	402,906.0	292.6	62,821.4	340,084.6	171.4	571.2	978.8	1,550.0	1,378.6	1,223.6	1,361.5	1,206.5	1,182.8	1,264.4
2020	24.0		482.1	402,909.2	304.1	62,821.4	340,087.8	178.0	571.2	1,009.2	1,580.4	1,402.4	1,244.4	1,384.6	1,226.6	1,200.6	1,288.1
2021	25.0		501.0	402,912.5	316.2	62,821.4	340,091.1	184.9	571.2	1,040.7	1,611.9	1,427.1	1,265.9	1,408.6	1,247.4	1,218.9	1,312.8
2022	26.0		520.9	402,915.8	328.8	62,821.4	340,094.4	192.1	571.2	1,073.5	1,644.8	1,452.7	1,288.2	1,433.5	1,269.0	1,238.0	1,338.5
2023	27.0		541.6	402,919.3	342.0	62,821.4	340,097.9	199.6	571.2	1,107.7	1,678.9	1,479.3	1,311.4	1,459.3	1,291.4	1,257.8	1,365.0
2024	28.0		563.4	402,922.9	355.9	62,821.4	340,101.5	207.5	571.2	1,143.2	1,714.4	1,506.9	1,335.4	1,486.1	1,314.7	1,278.3	1,392.6
2025	29.0		586.2	402,926.6	370.4	62,821.4	340,105.2	215.8	571.2	1,180.1	1,751.3	1,535.5	1,360.4	1,514.0	1,338.8	1,299.5	1,421.3
2026	30.0		610.1	402,930.4	385.6	62,821.4	340,109.0	224.4	571.2	1,218.5	1,789.7	1,565.3	1,386.3	1,542.8	1,363.9	1,321.6	1,451.0
2027	31.0		635.1	402,934.3	401.6	62,821.4	340,112.9	233.5	571.2	1,258.4	1,829.6	1,596.1	1,413.2	1,572.8	1,389.8	1,344.5	1,481.9
2028	32.0		661.3	402,938.3	418.3	62,821.4	340,116.9	243.0	571.2	1,300.0	1,871.2	1,628.2	1,441.1	1,603.9	1,416.8	1,368.2	1,514.0
2029			688.8	402,942.5	435.8	62,821.4	340,121.1	253.0	571.2	1,343.2	1,914.4	1,661.5	1,470.0	1,636.2	1,444.7	1,392.8	1,547.2
2030			717.6	402,946.7	454.2	62,821.4	340,125.3	263.4	571.2	1,388.2	1,959.4	1,696.0	1,500.1	1,669.7	1,473.8	1,418.4	1,581.8

Continued next page

Table A6.10—*continued*

Year		Without Project				Incremental		Benefits				Sensitivity Cases				
	Capital Cost	O&M	Production	O&M	Production	Volume	O&M	Non-Incremental	Incremental	Total	Net Benefits	10% Dec. in Rev	10% Incr. In O&M Costs	Combined Cases	20% Dec. in WTP	20% Dec. In Cost Savings
2031		747.7	402,951.1	473.4	62,821.4	340,129.7	274.3	571.2	1,435.0	2,006.3	1,731.9	1,531.3	1,704.5	1,503.9	1,444.9	1,617.7
2032		779.4	402,955.7	493.6	62,821.4	340,134.3	285.8	571.2	1,483.8	2,055.0	1,769.2	1,563.7	1,740.6	1,535.1	1,472.5	1,655.0
2033	33.0	812.5	402,960.3	514.7	62,821.4	340,138.9	297.8	571.2	1,534.5	2,105.7	1,807.9	1,597.4	1,778.1	1,567.6	1,501.0	1,693.7
NPV											**1,411.0**	**668.4**	**1,321.7**	**579.2**	**634.6**	**702.2**
EIRR											**12.7%**	**11.3%**	**12.5%**	**11.1%**	**11.2%**	**11.3%**

EIRR = economic internal rate of return, NPV = net present value, O&M= operations and maintenance, WTP = water treatment plant.
Sources: Benefit estimations and interviews of stakeholders.

PROJECT PERFORMANCE RATING ASSESSMENT

Relevance	Results/Remarks
Project preparation is relevant to project output at the time of approval	Relevant
Project output is relevant to achieving project goals and objectives at the time of approval	Yes
High priority of the Project in the context of the country's development strategy at the time of approval	Yes
High priority of the Project in the context of the operational strategy of Asian Development Bank (ADB) for the country at the time of approval	Yes
High priority of the Project in the context of the country's development strategy at the time of evaluation	Yes
High priority of the Project in the context of one or more of ADB's strategic objectives at the time of evaluation	Yes
Percentage of subcriteria that met assessment	100%
Evaluation rating	2.0
Efficacy	
Most project physical outcomes achieved[1]	Partly
Most project intangible outcomes (e.g., technical assistance) achieved[2]	Partly
Project outcomes leading to project goals	Partly
Percentage of subcriteria that met assessment	100%
Evaluation rating	1.6
Efficiency	
Efficient and satisfactory ADB's internal processing of the Project	Yes
Effective organization and management of Executing Agency and implementing agencies	Yes
Effective project management	Yes
Efficient in recruitment of consultants and other procurement	Partly
Timely and adequate availability of counterpart funding	Partly
Percentage of subcriteria that met assessment	100%
Evaluation rating	1.6
Sustainability	
Adequate demand for project services	Yes
Effective operating and financial performance of the utilities and ability to recover costs[3]	Partly
Existence of appropriate maintenance policy and procedures[4]	Partly
Available funds (cash flow) for continued operations, maintenance, and growth requirements	Partly
Adequate skills to continue project operation	Yes

[1] While project implementation was delayed due to delays in compliance by the states with loan disbursement conditions and a major change in project design in Yap, the project achieved capacity targets. In Chuuk, most physical outcomes were achieved, except for completion of pipeline due to land acquisition problems.

[2] Intentionally designed to meet 2005 targets with achieved capacity and the rehabilitation of sewerage treatment plant. The current demand in Yap and Pohnpei were met but not in Chuuk.

[3] Cost efficiency measures have been implemented and billing and collections are being improved in the Yap State Public Service Corporation (YSPSC) and Pohnpei Utility Corporation (PUC), but not in Chuuk Power Utility Corporation (CPUC).

[4] Operating and maintenance (O&M) manuals and procedures were instituted, and UCs had undertaken improvements in O&M and provided adequate O&M budgets.

Relevance	Results/Remarks
Availability of appropriate technology and equipment to operate the Project	Yes
Availability of enabling environment (subsidies, tariffs, prices, competitiveness, and political development) in which the Project is operating at the time of evaluation[5]	Yes
Strong ownership and commitment of the Government to the Project	Yes
Adequate community participation and beneficiary incentives to maintain the project facilities	Partly
Percentage of subcriteria that met assessment	100%
Evaluation rating	1.5
Institutional Development and Other Impacts	
Formal laws, regulations, and procedures being established at the national and state levels	Yes
Strong institutional/organization arrangements to maintain operation of the project facilities	Partly
Adequate institutional skills and capacities[6]	Partly
Active participation of the public	Partly
Macroeconomic or sector policy framework in place	Yes
Positive impact on poverty reduction	Yes
Positive impact on the environment	Yes
Positive impact on social organization[7]	Yes
Positive impact on political development[8]	Yes
Percentage of subcriteria that met assessment	80%
Evaluation rating	1.8

[5] The Government supported tariff increases to sustain viable operations, but the state government was reluctant to support the UCs in this area.

[6] Institutional capacity in technical aspects was adequate; needed measures to further strengthen the financial management and records management are now underway.

[7] Some communities were coordinating with the UCs on connecting to the systems in PUC and YSPSC, but CPUC needs to undertake similar activities geared towards community organization and better integration of residential areas with the water supply system.

[8] The UCs in Yap and Pohnpei have been working closely with the state government in the provision of better water supply for schools, hospitals, and new communities.

Table A7.1: Assessment of Project Overall Performance

Criteria (a)	**Weights** (%) (b)	**Assessment** (c)	**Rating Value** (d)	**Weighted Rating**[a] (b x d)
Relevance	20	Highly relevant	2.0	0.41
Efficacy	25	Less Efficacious	1.6	0.40
Efficiency	20	Less Efficient	1.6	0.36
Sustainability	20	Moderately Sustainable	1.5	0.32
Institutional Development and Other Impacts	15	Moderate	1.8	0.27
Overall rating				**1.73** (Successful)

[a] Highly successful = overall weighted average (OWA) > 2.5, and no criteria less than 2; successful = OWA 1.6-2.5, and no criteria less than 1; less than successful = OWA 0.6-1.6, and not less than 2 criteria less than 1; unsuccessful = OWA < 0.6.

Source: Asian Development Bank estimates.

PROJECT BENEFIT MONITORING AND EVALUATION

1. Monitoring of the Project's impact on beneficiary households and other users of the new project facilities is one of the measures to evaluate the sustainability of the FSM Water Supply and Sanitation Project (the Project). Under the Loan Agreement, the Executing Agency (EA) was required to provide a project benefit monitoring and evaluation (BME) report to the Asian Development Bank (ADB) in October 2001. However, it has not undertaken BME activities, based on the evaluation criteria and achievement indicators formulated at appraisal.

A. Performance Indicators

2. The Project was aimed at increasing the water supply capacity and improving water quality in Chuuk, Yap, and Pohnpei. The project design incorporated the principles of affordability, cost effectiveness, operational efficiency, financial sustainability, governance, and accountability. Benefit monitoring indicators were developed to monitor improvements in water supply services in areas such as (i) production, (ii) distribution and consumption, (iii) operation and maintenance (O&M) costs, (iv) administration and billing, and (v) collection performance ratios. The utility companies (UCs), through their customer services divisions, have not consolidated the performance indicators reports from other divisions for a more effective monitoring and evaluation of their respective operations.

3. The UCs have not established a comprehensive benefit monitoring system to evaluate the benefits of the Project in Chuuk, Yap, and Pohnpei. Such a monitoring system could assist management in evaluating project performance and operational sustainability. The Pacific Water Association, in coordination with ADB, introduced a benchmarking system for the UCs that needs to be updated regularly, and can be linked directly with a BME system. In the absence of a comprehensive database on non-revenue water, collection efficiency, arrears collection, and disconnection of nonpaying customers, assessing the results of productivity measures undertaken by the UCs would be difficult.[1] In each UC, the customer services division could consolidate this information and provide progress reports on the status of UCs in (i) meeting connection targets, (ii) improving collection efficiency, and (iii) reducing non-revenue water.

4. Table A9.1 presents the benefit monitoring indicators established at appraisal to be a management tool for the UCs and EA to evaluate project performance, and to enable them to address inefficiencies in a timely manner. The BME database could be shared with the Health Department to effectively monitor the incidence of water-related diseases and to assist the UCs in conducting public awareness campaigns on the disadvantages of using alternative water supplies for drinking. In Chuuk, the Project Completion Review (PCR) Mission noted the need to closely coordinate with the provincial health inspectors in assessing the unsafe conditions of rainwater tanks of households to prevent any disease outbreaks as occurred in the past.[2]

[1] To varying degrees, the UCs have undertaken measures to improve operational performance, with the reduction in the number of staff and periodic training of their technical personnel.

[2] This also will help avoid another cholera outbreak, as happened in 1982. The PCR Mission visited some households in newly served areas that are used to getting drinking water from rainwater tanks that collect water flowing from the roofs that are not regularly cleaned of debris.

Table 8.1 Project Benefit Monitoring and Evaluation

Project Objective	Evaluation Criteria	Achievement Indicators
Delivery of Improved Quality of Water	Water quality vs. predefined standards	Regular water testing after treatment and throughout the system
Delivery of Improved Quality of Service	Average water availability per day meets target Minimum water availability per day meets target Adequate pressure and delivery is maintained for all users Customer complaints are addressed and reviewed	Regular water testing after treatment and throughout the system Hours operating per month Days in month Periodic checking and pressure testing at problem points in the system Customer problems recorded and action taken
Delivery of Adequate Quantities of Water	Total population served = target Daily water production = target Total connections = target Population served by house connections = target, new connection rate matching population growth Average production per capita per day = target Average consumption per capita per day = target	Number of house connections x average number of persons per house connection + number of stand posts x average number of people served by a stand post Monthly water production No. of days in a month Number of total connection Number of domestic connections x average household size Daily water production Population served Metered water sold in month Population served x days in month
Affordability	House connection tariff affordable for basic needs Actual tariff affordable Active connections as an indicator of satisfaction and ability to pay	Average household size x minimum quantity per capita x tariff Billings for all house connections/ Consumption for all house connections Active house connections Total house connections
Cost Effectiveness	Unit production cost vs. target Number of active connections Nonrevenue water < target Revenue sufficient to target cost recovery Collection efficiency = target	Operation and maintenance cost Monthly water production Water sold Water produced Collections from all users Water produced
Operational Efficiency	Staff per 1,000 connections within target Operations (connections, meter maintenance, and repairs) are completed in a timely manner Preventive maintenance program is developed and made operational	Staff (full time equivalent) Total connections / 1,000 Work orders complete in month Work orders initiated in month Maintenance operations recorded daily and reviewed monthly
Financial Sustainability	Account receivable collection rate is stable, within the target	Accounts receivable Average day sales

Project Objective	Evaluation Criteria	Achievement Indicators
	Budget sufficient to cover cost of operations, plus the greater of finance charges or interest plus depreciation Actual operations meet budget Cash flow sufficient to maintain operations	Budget prepared annually. Long range planning undertaken at least every 5 years, updated every 5 years Monthly comparative financial statements produced with major variances noted and addressed Cash flow plan, including capital budget, prepared annually and updated quarterly
Governance and Accountability	Public utility corporation maintains a forum for public input into the decision making process. Liaison committees to be established through community leaders and/or municipalities. The utility communicates its plans and results of operations to client groups The utility is sensitive to parties whose interest may not be adequately represented through normal channels	Public meetings held regularly. Surveys or other assessments of customer needs and satisfaction with utility services conducted and reviewed periodically. Reporting and public relations initiatives planned and reviewed regularly Corporate policies reviewed regularly to ensure that they are non-discriminatory and take appropriate opportunities to include women, lower income, or other groups in their application

Source: ADB. 1996. *Report and Recommendation of the President to the Board of Directors on a proposed Loan and Technical Assistance to the Federated States of Micronesia for the Water Supply and Sanitation Project*. Manila.

5. Further, UCs should try to be more cost efficient by integrating the requirements and operations of technical services, administrative, and financial divisions. Based on the PCR Mission assessment, the performance indicators presented in Table 9.2 must be consolidated, updated, and reported during monthly management meetings to ensure that UC staff contribute to achieving satisfactory levels of service.

Table A8.2 Benefit Monitoring Indicators

Indicator	Basis
1. Production	
1.1 Raw water intake	Gallons
1.2 Treated water at treatment plant	Gallons
Production: O&M Cost	
1.3. Power consumption raw water	Kwh/ dollar
1.4 Power consumption treated water	Kwh/ dollar
1.5 Total power consumption	Kwh/ dollar
1.6 Total staff	Number
1.7 Staff training	Number
1.8 Staff leave	Number
1.9 Total staff, salaries and wages	In dollar
1.10 Total consumption–disinfectant	Kg/ dollar
1.11 Total consumption–coagulant	Kg/ dollar
1.12 Other utility costs	Dollar
1.13 Total production costs	Dollar
2. Distribution and Consumption	
2.1 Active domestic connections	Number
2.2 Active institutional and government connections	Number
2.3 Active industrial connections	Number
2.4 Total active connections	Number
2.5 Bulk distribution	Gallons
2.6 Consumption–Domestic	Gallons
2.7 Consumption–Institutional/Government	Gallons
2.8 Consumption–Commercial	Gallons
2.9 Consumption–Industrial	Gallons
2.10 Total consumption	Gallons
2.11 Availability of water per day	Hours
2.12 Bacteriological tests taken	Number
2.13 Bacteriological test failures	Number
2.14 Leak repairs	Number
2.15 Meter repair and/or replaced	Number
2.16 Customer complaints	Number
2.17 Public relations expenditure	Dollar
2.18 Disconnection due to nonpayment	Number
2.19 Disconnection due to customer change	Number
2.20 Disconnection due to bill settlement	Number
2.21 Reconnection due to customer change	Number
2.22 Applicants for new service	Number
2.23 Outstanding applications for new service	Number
2.24 Total Illegal customers	Number
2.25 Illegal customers disconnected	Number
3. O&M Costs for Distribution and Consumption	
3.1 Total staff	Number
3.2 Staff on training	Number
3.3 Staff on leave	Number
3.4 Staff salaries and wages	Dollar
3.5 Vehicle maintenance	Dollar
3.6 Fuel cost	Dollar
3.7 Electricity	Dollar
3.8 Telephone	Dollar
3.9 Supplies consumables	Dollar
3.10 Water and sewerage	Dollar
3.11 Other costs	Dollar
3.12 Total expenses	Dollar
4. Administration and Billing	
4.1 Amount billed–Domestic	Dollar
4.2 Amount billed–Institutional	Dollar
4.3 Amount billed–Commercial	Dollar

Indicator		Basis
4.4	Total billings–all users	Dollar
4.5	Amount collected–Domestic	Dollar
4.6	Amount collected–Institutional	Dollar
4.7	Amount collected–Commercial	Dollar
4.8	Amount collected–Industrial	Dollar
4.9	Total collections–all users	Dollar
4.10	Accounts receivables–Total	Dollar
	Aging of accounts receivables:[a]	
	31–60 days	
	61–120 days	
	121–180 days	
	181–360 days	
	more than 360 days	
4.11	Reconnection fees[b]	Dollar
4.12	New connection fees[c]	Dollar
5.	**O&M Costs for Administration and Billing**	
5.1	Total staff	Number
5.2	Staff on training	Number
5.3	Staff on leave	Number
5.4	Staff salaries and wages	Dollar
5.5	Fuel cost	Dollar
5.6	Vehicle maintenance	Dollar
5.7	Electricity	Dollar
5.8	Water and sewerage	Dollar
5.9	Other costs	Dollar
5.10	Total expenses	Dollar
5.11	Grand total O&M costs	Dollar
6.	**Performance Ratios**	
6.1	Population served by domestic connections = No. of household connections x average number of persons/ household	Number
6.2	No. of standposts provided water by the UCs x persons/school (church, community or village)[d]	Gallons
6.3	Daily water production = Volume of treated water / no. of days in the month	Gallons
6.4	Daily water distribution = Volume of bulk distribution / no. of days in a month	Liters
6.5	Consumption per capita per day = Consumption House connections / (population x days)	Dollar/Gallon
6.6	Average tariff - domestic = Domestic billings/ domestic consumption	Dollar/Gallon
6.7	Average tariff -institution = Institution billings/ institution consumption	Dollar/Gallon
6.8	Average tariff- commercial = Comm'l billings/ Commercial consumption	Dollar/Gallon
6.9	Total average tariff = All users billings/All users consumption	Dollar/Gallon
6.10	Unit production cost = Total production cost/ treated volume	Dollar/Gallon
6.11	Unit distribution cost = Total distribution cost/ distributed volume	Dollar/Gallon
6.12	Unit administration cost = total administration cost/ billed volume	Percent
6.13	Accounted water = Bulk distribution/ Treated Water	Gallon
6.14	Unaccounted for water	
	= 100% – Accounted Water (%)	Percent
	= Treated volume – Bulk distribution	Gallon
6.15	Non-revenue water	
	= (Bulk distribution – Billed Volume)/ Bulk Distribution	Dollar
	= Bulk distribution – Billed Volume	Dollar
6.16	Production Cost of NRW = Unit cost production x	Percent

Indicator		Basis
	volume of NRW	
6.17	Distribution Cost of NRW = Unit cost distribution x volume of NRW	Percent
6.18	Administration Cost of NRW = Unit cost administration x volume of NRW	Percent
6.19	Production Cost of NRW = Unit cost production x volume of NRW	Percent
6.20	Opportunity Cost of NRW = Total average tariff x volume of NRW	Percent
6.21	Domestic water use = Domestic use/ bulk distribution	Percent
6.22	Institutional water use = Institutional use/ bulk distribution	Percent
6.23	Commercial water use = Commercial use/ bulk distribution	Percent
6.24	Industrial water use = Industrial use/ bulk distribution	Percent
6.25	Other water use = Other use / bulk distribution	Percent
6.26	Water lost (Balance) = 100% – (All consumption/ raw water)	Percent
6.27	Accounts receivable = Accounts receivable/ Average day sales	Dollar
6.28	Operating Ratio = Total O&M costs/ Billings All Users	Dollar
6.29	Collection Efficiency = Collections all users / (Billings all users + Accounts receivables) at opening balance	Dollar
6.30	Staff/ 1000 connections = [1000 x No. of staff]/ No. of connections	Number

[a] PUC Accounting Division is undertaking aging of contracts receivable. Yap has no arrears, and Chuuk does not undertake aging of accounts receivable.
[b] Reconnection fees are collected from customers disconnected on a voluntary basis in all UCs.
[c] New connection fees are collected from customers for those disconnected for non-payment if they want to be reconnected to the system.
[d] In Pohnpei, the UC provides 24 hour potable water supply to public institutions through standposts built near schools, churches, and remote communities in response to the drought in 1998.
Source: PCR Mission assessment based on benchmarking data and other references.

6. Customer satisfaction must be the major objective of a BME system to ensure regular payment of water bills and unpaid accounts. The UCs must closely coordinate with the state government to collect huge arrears from government institutions to improve their cash flow positions and enhance the long-term financial sustainability of water supply operations in each state. Further, the UCs should provide their management and the board timely information on operational efficiency, water quality test results, operational costs, annual budgets, income sources, water tariffs, collection efficiencies, and new connection fees on a regular basis. Such information could greatly enhance staff efficiency in addressing customers' concerns.

7. At the community level, the UCs must regularly monitor the benefits experienced by households from a regular water supply, such as (i) fewer delays in getting children to school and getting ready for work; (ii) a safer supply of water than river water or rainwater collected from roofs; (iii) convenience of obtaining water for immediate use, and no intermittent supply; and (iv) better water quality reducing diarrhea cases.[3]

[3] Based on the Department of Health, the incidence of diarrhea and other water-borne diseases declined in the three participating states: (i) Chuuk: 772 in 1999 to 708 in 2001 (but increased to 1,382 in 2002); (ii) Yap, 507 cases in 2000 to 349 cases in 2002; and (iii) Pohnpei, 3,831 cases in 2000 to 1,228 cases in 2002 (mainly people outside Kolonia).

B. Institutional Strengthening

8. One significant benefit of the Project was using the experience gained to provide training on the design and operation of water supply production and treatment facilities in other UCs. The UCs in Yap and Pohnpei had assisted Chuuk in the operation and maintenance of its water systems.

9. The UCs envision that the staff trained under the Project in construction and O&M of water supply systems can be organized as a core group of trainers for other staff in their UCs. Further, management and operational training manuals prepared under the Project on water supply production and treatment plants benefited the other UCs. About 20 employees from UCs benefited from the technical assistance (TA). Only Yap State Public Service Corporation (YSPSC) and Public Utilities Corporation (PUC) have routine maintenance programs and provisions for emergency repairs. O&M budget is likewise adequate, with availability of key spare parts and equipment.

10. Despite the knowledge and practical experience gained from the TA in management of project facilities, the more capable staff still need to be motivated to undertake (i) production and distribution monitoring system for detecting system leakages, (ii) data collection system in pumping stations for operational flow control, (iii) control and monitoring system for water supply treatment plant, and (iv) daily and monthly record management. Strengthening of corporate planning capabilities and formulation of corporate objectives that address the need for more cost efficient and improved water supply service on commercial terms must be immediately undertaken in Chuuk Public Utilities Corporation (CPUC), based on the PUC and YSPSC experience.

C. Economic

11. Major economic benefits resulting from the Project have been sustained in Yap and Pohnpei: (i) reduced costs for the installation of rain water tanks due to provision of 24-hour water services, particularly in urban areas; (ii) reduced costs for water bought from vendors, and transport costs for fetching water from private providers during droughts in more remote villages; (iii) cost savings in treating water-borne diseases, such as diarrhea, and skin diseases among children and adults; (iv) increased business activities among commercial establishments; (v) a willingness to pay for improved water supply services and water quality; and (vi) economic gains to the business, health, and education sectors. These UCs will continue to monitor these benefits and ensure their sustainability with the support of their respective health departments and beneficiary communities.

12. To ensure that project benefits are sustainable, the UCs will have to collect relevant data to measure these benefits as part of their periodic BME report. This data would include (i) cost comparisons of water tariffs of connected households with the cost of water of alternative supplies, such as water of community systems; (ii) production and distribution costs; (iii) the amount that households are willing to pay for UC water, and if this is in line with household incomes from salaries and informal employment; (iv) the number of households, institutional, and commercial establishments that benefit from the extension of the distribution network; (v) the employment created and construction gains due to the network expansion; (vi) the increased tourism benefits, particularly hotels and restaurants, measured in terms of the number of tourists visiting the state and estimated tourist expenditures; (vii) health indicators, particularly water-borne diseases, such as diarrhea, for children and adults; (viii) indirect benefits, such as the acceleration of urbanization measured by the increase in commercial and industrial

establishments, particularly in Pohnpei and Yap; (ix) the provision of safe and potable water to school children, and improved sanitary conditions in schools, hospitals, and public places; and (x) employment created for lagoon and outer islands.

D. Social

13. Unquantifiable social benefits from the Project include (i) benefits to women and children in terms of time saved for economic activities, such as fishing and selling agricultural crops (as in the case of villagers in Pohnpei); (ii) long-term employment for UC staff for plant operation, maintenance, and operation; (iii) improvement of people's health, particularly the school children who suffer from water-borne diseases as a result of drinking water from unprotected sources such as rainwater tanks and creeks; (iv) short-term employment during project construction, particularly the locals who gained experience in project construction and are now employed as plumbers and semi-skilled labor; (v) improvement in business activities of commercial establishments, such as hotels and restaurants; (vi) other social benefits such as more time for women to do household chores and rear children due to reduced visits to hospitals and clinics; (vii) the positive impact on the education sector as schools no longer experience disruptions of classes due to a lack of water during droughts (particularly Yap); (viii) sale and lease of property by the land owners, which generates capital for small-scale businesses; (ix) improved personal hygiene, such as washing hands, and better sanitary conditions; (x) improved safety of food preparation for public consumption; and (xi) better health care and sanitary conditions in public hospitals, and commercial establishments.

14. The UCs initially conducted few public information campaigns to educate local residents about the importance of using water services provided under the Project, and the need for them to connect and pay a water tariff to bring the service to them as well as sustain the O&M of project facilities. In Yap and Pohnpei, residents were more than willing to connect and pay for improved water supplies and improved water quality. In Chuuk, the water supply was available only a few hours each day, and the water was not safe for drinking.[4] Rainwater was preferred for drinking.

15. In Chuuk and Pohnpei, payment of water bills was not strictly enforced, leading to huge arrears that remain unpaid (more than 360 days). In recent months, the CPUC's policy has been to disconnect nonpaying customers. Payment of reconnection fees provide disincentive to nonpaying customers. However, CPUC could not enforce payment since it failed to provide consistently improved service.

E. Land Issues

16. Particularly in Chuuk, landowners demanded huge compensation for the land to be used for wells and distribution pipelines. This greatly affected site selection of wells and the completion of expanded distribution networks, as originally envisaged under the Project.

[4] The PCR Mission team learned that there were more than 1,800 complains lodged due to poor water quality and refused to pay their bills to CPUC.

PROJECT IMPLEMENTATION PROBLEMS IN CHUUK

1. In Chuuk, the FSM Water Supply and Sanitation Project (the Project) suffered from cost and implementation problems. To get a better appreciation of the issues and the cultural climate in Chuuk, this appendix highlights the key problems, and recommends specific actions before the Asian Development Bank (ADB) embarks on any new intervention in Chuuk.

(i) The drilling was much more difficult and expensive than anticipated due to unprecedented land problems and significant cost escalation, as the lack of local expertise necessitated bringing in more expensive imported equipment and services;

(ii) The treatment plant was found to be in much poorer condition than first assessed, highlighting the poor maintenance culture;

(iii) Most equipment needed to be replaced rather than repaired;

(iv) A section of the road where a new pipeline was to be laid had been eroded, necessitating changes in the design;

(v) Installation of the power supply to the seven of the 16 new well stations was delayed due to land access problems;

(vi) Landowner disputes caused serious delays in the construction of well houses and the Epinup-to-Sapuk transmission pipeline;

(vii) Lack of coordination and frequent disagreements among the general manager, the utility company's board of directors, and the state administration added to the delays; and

(viii) Due to a lack of commitment and required counterpart funding, the proposed rehabilitation of the sewerage plant was canceled.

2. The Mission identified several measures that need to be undertaken to improve project sustainability and maximize project benefits:

(i) Chuuk Power Utilities Corporation (CPUC) needs to update its organization chart for internal control, administrative, and management purposes. This would enable management to determine the line functions and delegate authority to key positions. This information should be kept in the *Administrative and Accounting Manual*.

(ii) CPUC should develop more detailed, updated, and authorized procedures for internal control and delegation of authority specific to its operations, and stop using the generic accounting manual prepared by the technical assistance (TA) consultants. This should show the latest delegations of authority of board members and officers for authorizing, as well as approving, purchases and payments of accounts that comply with CPUC's policies.

(iii) CPUC management should address urgently its operational problems, constraints, and deficiencies in billing and collection. This should cover the

absence of meter reading, setting appropriate tariffs for water supply and sewerage service to recover at least the operation and maintenance (O&M) costs, and establishing a disconnection policy for overdue accounts and unauthorized connections. Without a clear framework for improving CPUC's financial performance, it will face greater difficulties in revenue collection, which ultimately will affect its ability to sustain its operation and repay the loan.

(iv) CPUC should undertake a physical asset inventory and internal control procedures for the verification, identification, and labeling of fixed assets, such as wells, reservoirs, water tanks, and assets constructed and repaired under the Project. An assessment of capital asset controls also should be undertaken. A fixed assets register should be established and updated on a regular basis. Adequate insurance cover for all fixed assets also should be in place.

(v) CPUC should properly account for the lease of land where capital assets are constructed.[1] Lease of land is not shown in the chart of accounts, which affects CPUC projects. The accounting manual has to be updated to include a chapter on this item.

(vi) CPUC should undertake accountability and control of fully depreciated fixed assets with general ledger, particularly for proper disposition of property acquired with loan funds. Accounting records should be adjusted for the asset and allowance for depreciation when capital items are retired, sold, or transferred.[2]

(vii) CPUC should establish better O&M procedures, provide timely O&M budget, and conduct meter reading of production and customer consumption daily.

(viii) CPUC should computerize fully its accounting system to improve operational usefulness and efficiency of financial management.

(ix) A formal non-revenue control program should be established that includes leak detection, meter testing and replacement, and illegal connection detection and resolution.

(x) PUC and CPUC should develop and implement a comprehensive connection program accompanied by a community awareness and education program to improve the connection rate and collection efficiency.

3. CPUC's Customer Services, Corporate Relations, Finance Division, and Technical Services must work together towards achieving improved commercial operations, similar to the internal coordination at PUC and Yap State Public Service Corporation.

[1] The generic accounting manual prepared by the TA Consultants did not contain a section detailing the accounting procedures for lease transactions, or determine how this is taken up in the financial statements.

[2] The generic accounting manual did not segregate the assets into: capital projects fund, operating budget expenditure, and ADB loan funded capital assets.

TECHNICAL ASSISTANCE COMPLETION REPORT

Division: Pacific Operations Division

<table>
<tr><td colspan="3">TA No. and Name
TA No. 2646-FSM: Capacity Building for Management and Operation of Water Supply and Sanitation Systems</td><td colspan="2">Amount Approved: $587,000
Revised Amount: —</td></tr>
<tr><td colspan="2">Executing Agency: Department of Transport, Communications and Infrastructure</td><td>Source of Funding
TASF</td><td>TA Amount Undisbursed
$38,307.53</td><td>TA Amount Utilized
$548,692.47</td></tr>
<tr><td colspan="3">Date
Approval 19 Sept. 1996 Signing 11 March 1997 Fielding of Consultants 16 October 1997</td><td colspan="2">Completion Date
Original 30 November 1997 Actual 30 June 1998
Account Closing Date
Original 30 November 1997 Actual 30 September 1999</td></tr>
</table>

Description

A project preparatory technical assistance (TA)[1] was approved on 18 August 1994 to assist the Government with the formulation of a Water Supply and Sewerage System. During project preparation, the consultant identified the need for institutional strengthening, and improvement of financial management capacities of the utility corporations (UCs) in various states of the Federated States of Micronesia (FSM).

Objectives and Scope

The objectives of the technical assistance were to develop financial and management systems, operations and maintenance (O&M) capability, and public education and participation capability in Chuuk Public Utilities Corporation (CPUC), Pohnpei Utilities Corporation (PUC), Kosrae Utilities Authority (KUA) and Yap State Public Services Corporation (YSPSC).

The overall services included (i) determination of requirements for leakage detection and prevention measures; (ii) determination of water supply and sewerage system O&M requirements; (iii) determination of Management Information Services (MIS), billing, and accounting requirements; (iv) identification of public education and public participation measures relevant to the socioeconomic background of each state; (v) establishment of the necessary systems to address these issues; (vi) provision of staff training; and (vii) preparation of operational manuals. The TA was to address the specific level of development and capabilities presently in each of the four UCs.

Evaluation of Inputs

The TA was formulated recognizing the technical and financial management inadequacies of each State utility. The TA covered a range of inputs for capacity building activities tailored to the needs of the UCs. KUA did not participate in the Project due to non-compliance of loan disbursement conditions. However, for KUA, some basic training in financial management was carried out along with training in operation and maintenance and public education related to a water supply system.[2] The involvement of YSPSC was limited as they already had in place a financial management information system, and effective operation and maintenance personnel.

The overall performance of the Consultants is considered satisfactory. Considering the differing needs of the four States and varying conditions under which they operated, the Consultants provided satisfactory support. The States of Pohnpei and Yap benefited most, but Chuuk did not fully benefit from the TA due to political and institutional constraints. Although the Consultants provided follow-up evaluations of its billing and financial management systems to CPUC, the impact was limited.

The performance of the EA and ADB is rated as satisfactory and the Government was generally satisfied with the quality of TA inputs.

Evaluation of Outputs

An O&M operations manual, and a financial management manual for the UCs were prepared.

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[1] ADB. 1994. *Technical Assistance to the Federated States of Micronesia for Water Supply and Sewerage Project.* Manila.

[2] With immediate benefits to KUA's power supply services.

The PCR Mission for *Loan 1459-FSM: Water Supply and Sanitation Project* noted that the financial management reports were prepared and covered (i) budgeting and procurement procedures, (ii) asset registration system, (iii) inventory management software, and (iv) an accounting manual. However, the accounting manual completed was generic, and it failed to clarify treatment of specific expenditures, such as lease payments in its accounting policies for the States. Nevertheless, the reports were highly appreciated by the UCs.

The TA generally produced the expected outputs. However, due to the delay in the loan project implementation, the outputs lacked the expected impacts. Adhering to the TA schedule rather than the loan project schedule in this case, produced less than expected results.

Overall Assessment and Rating
The TA has been instrumental in the improvement of the O&M and financial management capacities of the UCs. Despite the inability of KUA to participate in the Loan Project, it benefited from the TA capacity building program. Those trained outside of the UCs, mainly the State health, education and environment agencies have also benefited from the TA.

The PCR Mission noted that the TA activities were not timed with the implementation of the loan Project. As a result, the overall performance of the TA can, at best, be rated as partly successful.

Major Lessons Learned
The success of the TA greatly depended on the quality of the TA consultants. Selection of appropriate team and team leader, therefore, are vital for any capacity building assistance to succeed.

Timing of piggy-backed TA is crucial. In this case, the TA implementation should have been scheduled after the commencement of project implementation. This would have resulted in a more focused capacity development in the UCs.

Recommendation and Follow-Up Action
There is a need to assess the UCs' overall capacity to sustain the TA benefits. PARD will follow up on the progress.

Prepared by Amarnath Hinduja Designation Senior Project Specialist

Water for People's Approach to Building Sustainable Capacity in Sanitation and Wastewater Management: Case Studies

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Description of Organization

Water For People (WFP) is an international, humanitarian, non-profit organization that was started in 1991 through the efforts of water professionals from the American Water Works Association (AWWA). Water For People – Canada was formed in 1995. Our mission is to help impoverished people worldwide improve their quality of life by supporting sustainable drinking water, sanitation and hygiene projects. WFP has become the charity of choice of the North American water industry and all the major professional water associations. These associations provide financial, in-kind, and volunteer support. We also receive support from engineering firms, manufacturing companies, Rotary Clubs, churches, schools, and other organizations. In turn, we provide volunteers with technical expertise to assist with special projects such as trainings, assessments, strategic planning, and many other skills that are needed by governments and utilities in developing countries.

Project Model

Water For People's program is a self-help approach. We help communities construct their drinking water and sanitation systems by using technology that is easy for the communities to use, maintain and repair. WFP mobilizes communities by helping organize water committees, using locally available materials, and conducting community-based training so the communities are empowered and responsible for the long-term benefits from their water and sanitation systems. Water For People's programs also involve health and hygiene education and the training of community health promoters.

Water For People assists rural communities by partnering with local indigenous nongovernmental organizations (NGO's) that help manage the community-based projects and support our self-help model. This model uses a community development approach that involves women working with men on local water committees. Through this process, community members are educated about the technical, financial, institutional and social elements of sustainable projects. Concepts include water and sanitation system design, construction, maintenance and repair, fundraising, rate-setting and revenue collection, selecting and electing coordinators and officials, health and hygiene, and data collection and project evaluation. With this education the local water committee can make informed decisions about which culturally- and technology-appropriate water and sanitation systems will work best for them. Once these decisions are made locally, WFP, working through the NGO with the local water committee, helps the community implement simple, low-cost water pumps, water tap stands, hand-washing stations, clothes-washing stations, showers and latrines, using local materials whenever possible. WFP also includes a large amount of health and hygiene education in its programs by creating a network of community health promoters so water and sanitation systems are used properly and kept clean and free from re-contamination.

This approach has been successful with building local capacity so communities are not dependent on outside groups for long-term sustainability.

In urban and peri-urban areas, WFP has had success with bringing all parties (community, government, utilities, NGOs) together to develop a plan that addresses issues which have been barriers to successful projects, such as land ownership, payment for water and sanitation infrastructure and maintenance, protection of the hardware, training, and health and hygiene education. WFP volunteers work with local staff to bring the technical skills that might be needed for training, assessment, strategic planning, evaluations and other capacity building activities.

Case Studies

WFP works with all organizations and businesses in a non-exclusive arrangement, which has resulted in over 80 successful projects per year serving around 500,000 people annually in countries around the world. We are currently working in Asia (Vietnam and India), Africa (Kenya, Malawi, Tanzania, Uganda and Zambia), and Latin America (Bolivia, Ecuador, Guatemala and Honduras). The following case studies highlight Water For People's approach to building sustainable capacity for water, sanitation and wastewater management, and hygiene education by strengthening technical, financial, institutional, and social capabilities of community, non-governmental and professional organizations.

Vietnam

Water For People is currently working in the Mekong Delta of Vietnam to improve water and sanitation facilities and basic hygiene knowledge for school children in and around the U Minh Thuong National Park buffer zone. In partnership with CARE Vietnam and the Kien Giang Provincial Education Department, the "Clean Water for Schools" program is a response to assessment findings that show a high incidence of health problems among children from 37 schools within the region. The illnesses encountered include stomach aches, diarrhea, headaches, and dengue fever, virtually all of which are water and sanitation related.

Kien Giang Province is located on the southern coast of Vietnam, bordering the Gulf of Thailand and Cambodia. The U Minh Thuong National Park within the province is an important wetland area and rare plant and animal habitat. The area includes a network of canals which serve a number of purposes ranging from a source of potable water to rubbish disposal and a means for human waste disposal. This situation poses a threat not only to the health and wellbeing of the human population, but also negatively impacts the fragile wetlands environment.

The "Clean Water for Schools" program will implement the design and construction of water and sanitation facilities within the schools, directly benefiting more than 4,600 students. The decision to partner with CARE Vietnam was based on that organization's past and current successes and its strong working relationships with government agencies and officials at all levels. The program itself will be undertaken by the Water Facilitator staff member of CARE who will be responsible for the on-site work and assessment.

Through the partnership with CARE-Vietnam, we are extending this assistance to those communities connected with the schools, educating community members about how to build hand washing stations and latrines. To date we have helped about 30 schools to build these structures and more importantly, we have taught the young people how to share health and hygiene information with their families.

WFP has also been supporting our mission of sustainability by providing volunteers to governmental and non-governmental organizations in Southeast Asia for technical assistance, mentoring and train-the-trainer programs. Specifically, WFP has helped identify and mobilize North American water and wastewater professionals for the following projects:

- the Southeast Asia Water Utility Network (SEAWUN) Certification and Training Support for Professional Associations in Water (CATSPAW) project; and
- the Indonesian Water Supply Association (PERPAMSI) to help establish the first sustainable drinking water zones in 3 cities in Indonesia.

Both of these projects resulted in the development of local expertise for respective project objectives. For the CATSPAW project, the volunteers helped SEAWUN professionals develop a regional infrastructure for a wastewater operator/manager training program based on local need-to-know assessments, provided initial training resource material, and facilitated a relationship between SEAWUN and the Water Environment Federation (WEF). For the PERPAMSI project, the volunteers helped Indonesian water professional develop a standard operating procedures manual for use by Indonesian utilities and facilitated a relationship between PERPAMSI and the American Water Works Association (AWWA).

India

Water For People began working in India in 1996. What started as a small pilot project has grown into a full-fledged program to help eliminate arsenic from community wells in West Bengal. West Bengal is very rich in groundwater and more than 80 percent of its population taps this source for its drinking water. Arsenic occurrence in the region's aquifers has been attributed to geological factors. Arsenic mobilization in the water is speculated to have been caused by over withdrawal of groundwater during cultivation, application of arsenic pesticides followed by phosphate fertilizers, or both.

The contaminated groundwater constitutes the sole source of drinking water for 5.3 million people in West Bengal who use hand pumps to draw water from scattered wells. The effects of arsenic accumulation in the human body are well documented – skin lesions and disorders of the circulatory and nervous system. Current evidence indicates that symptoms of arsenicosis develop after years of exposure to arsenic contaminated water.

WFP is partnering with the Deemed University Bengal Engineering College (BEC) to design and install domestic and well-head arsenic removal units. A single arsenic filter unit may serve 200-300 families and needs regeneration (back flushing and maintenance of the filter) after eight to 12 months. The cost of a single well-head is offset by the fact that it provides safe drinking water to a greater number of people. The community well-head unit is preferable to individual units with respect to maintenance and monitoring. A fundamental component to this initiative is fostering community participation, developing an educational model and establishing operational capacity through the establishment and collection of appropriate and equitable tariffs.

The crisis in West Bengal unfolded over many years, and its solution will demand a commitment of time, expertise and funds. While the accumulated effects of arsenic poisoning will take years to reverse, the West Bengal arsenic filter project has already improved the health and quality of life for significant numbers of villagers.

Water For People has now established India as a full-time Country Program with an office and staff person. We will use the office to expand our arsenic abatement work in

West Bengal while providing technical assistance in urban areas, and community-based, appropriate technology projects in peri-urban and rural areas.

Africa

Water For People and the U.S. Environmental Protection Agency (EPA) formed a unique partnership, "Water For Africa," in October 2000. The work of Water For Africa (WFA) aims to help the growing number of urban poor in the unplanned and informal settlements of African cities obtain safe drinking water. The African urban population is expected to more than double over the next 25 years, with the majority of the increase taking place in urban centers as people continue to migrate to the cities. Our work generally falls into the following areas:

- support innovative approaches to serve the underserved by working with local nonprofit organizations and self-help groups to provide advocacy, training and community coordination on water and sanitation-related issues;
- foster water sector reform by supporting municipal and utility operator-training workshops and other advisory activities within the water sector;
- strengthen local water associations as an agent of change by positioning local associations as resource centers for the respective water sector; and
- share lessons learned with other agencies and practitioners.

Our Water For Africa (WFA) initiative was one of the first attempts to meet the water and sanitation needs in 12 urban poor areas of five African countries - Kenya, Malawi, Tanzania, Uganda and Zambia. WFA has been successful with building capacity of the communities, nongovernmental organizations, and local governments to develop small scale, community-based solutions to drinking water, basic sanitation, and health and hygiene education challenges. Lessons learned from Phase I of WFA include:

- the urban poor pay much more for their water than in other areas of the same city;
- the urban poor are willing to organize and be advocates with their government officials to solve their own problems; and
- the urban poor are very motivated to use innovative means to carry out health and hygiene education so their neighbors understand how to reduce the incidence of water-related illnesses.

Many of the lessons learned would be appropriate in any large urban area in the world. WFA Phase I was supported by the US EPA and recently, we received a second grant from the EPA and the Conrad Hilton Foundation for Phase II. We will continue to work in the same five countries.

Latin America

Water For People began working in Latin America in 1992 (Boliva-1992, Honduras-1994, Guatemala-1995). Our work in these countries support 28 to 40 rural communities each year, helping approximately 12,500 to 15,000 people annually obtain safe drinking water, sanitation services, and health and hygiene education.

Typical projects include:

- village-wide gravity water systems
- rain catchment systems
- spring captures and protection
- hand-dug wells
- storage tanks
- community clothes washing stations
- school hand washing stations

- family shower stations
- family latrines

To accomplish these projects WFP partners with local, indigenous organizations, and government and non-governmental water, sanitation and health organizations. These partner organizations in turn mentor recipient communities through project planning and decision making for their unique project. In addition to their ideas for the type of infrastructure they prefer, community residents also contribute locally available construction material, 'sweat' equity and equitably established tariffs to offset capital, operation and maintenance, and repair costs.

Post-project evaluations indicate that this model effectively nurtures a sense of system ownership for the completed project, and provide the community with valuable experience, confidence and skills to manage their own system and help other communities develop their systems with minimal or no outside assistance.

As partners manage projects, they gain valuable experience, confidence, and the necessary skills help develop future water systems without help from outside agencies. Communities are involved in project planning and decision-making, which nurtures a sense of ownership for completed projects. In this way WFP's mission is attained – helping people help themselves so projects are sustainable.

In addition to sustainable hardware infrastructure, WFP believes that health and hygiene education is a critical component to the work. WFP funds workshops and educational sessions and provides materials to complement rural construction efforts. In some instances, WFP funds the work of local health promoters on an ongoing basis. Experience indicates that without a strong health program, a water system alone is ineffective in combating water-related disease.

Over the last ten to thirteen years the local water committees have matured through the implementation of the project model and are now showing a strong desire for technical and managerial training. Consequently, WFP supports technical and managerial assistance on water-related topics by funding local NGO and government efforts. This has resulted in an increased comfort level with more technical treatment alternatives, such as the use of hypochlorination for disinfection, increased local hygiene training and education programs, and improved governance and tariff structures.

Conclusions

The challenges caused by rapid, unplanned growth in large urban areas are a special problem in all developing countries. In addressing urban sanitation concerns, Water For People would draw upon and expand a number of proven community-based solutions such as:

- construction of culturally- and technology-appropriate latrines, utilizing different designs to fit the needs of the communities, and the training on how to maintain and dispose of the waste materials properly;
- the safe reuse of gray water by utilizing the water for family gardens and pour-flush latrines;
- construction and maintenance of absorption pits and other low-tech on-site disposal technologies so wastewater can be safely re-introduced into the environment without impacting water supplies or creating other problems (cesspools – mosquitoes, other health hazards);
- implementation of community-based health and hygiene education so communities and elected officials learn the importance of safe local disposal practices of human and animal waste until proper sanitation systems can be developed by the local utility;
- facilitating discussions between communities and elected officials about longer-term solutions to keep wastewater from flowing untreated into rivers and streams;
- facilitating discussions between communities and elected officials about watershed management and river basin protection and amplifying the link between wastewater management and (drinking) water quality;
- working with communities to keep solid waste from accumulating and becoming vector attractants.

Anaerobic waste stabilization ponds: a low-cost contribution to a sustainable wastewater reuse cycle

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Introduction

The increasing scarcity of water in the world along with rapid population increase in urban areas gives reason for concern and the need for appropriate water management practices. According to the World Bank, “The greatest challenge in the water and sanitation sector over the next two decades will be the implementation of low cost sewage treatment that will at the same time permit selective reuse of treated effluents for agricultural and industrial purposes” (Looker, 1998).

Wastewater is composed of over 99% water. In a developing urban society, the wastewater generation is usually approximately 30-70 m^3per people per year. In a city of one million people, the wastewater generated would be sufficient to irrigate approximately 1500-3500 hectare (SIDA, 2000). Innovative and appropriate technologies can contribute to urban wastewater treatment and reuse.

Water contaminated by human, chemical or industrial wastes can cause a number of diseases through ingestion or physical contact. Water-related diseases include dengue, filariasis, malaria, onchocerciasis, trypanosomiasis and yellow fever. Consequently, no other type of intervention has greater impact upon a country’s development and public health than the condition of clean drinking water and the appropriate disposal of human waste (SIDA, 2000).

One approach to sustainability is through decentralization of the wastewater management system and this approach leads to treatment and reuse of water, nutrients, and byproducts of the technology (i.e. energy, sludge, and mineralized nutrients) in the direct location of the settlement.

More emphasis is being placed on the need to separate domestic and industrial waste and to treat them individually to make recovery and reuse more sustainable. The system must be able to isolate industrial toxins, pathogens, carbon, and nutrients (Rose, 1999).

2. Methodology

2.1. Pond Design

Anaerobic Ponds Design: Anaerobic ponds can be satisfactorily designed, and without risk of odor nuisance, on the basis of volumetric BOD loading (l_v, g/m^3d), which is given by:
$l_v = L_i\ Q\ /\ V_a$
where L_i = influent BOD, mg/l (= g/m^3)
Q = flow, m^3/d
V_a = anaerobic pond volume, m^3

2.2 Anaerobic Digestion

Anaerobic bacteria degrade organic materials in the absence of oxygen and produce methane and carbon dioxide. The methane can be reused as an alternative energy source **(**biogas). Other benefits include a reduction of total bio-solids volume of up to 50-80% and a final waste sludge that is biologically stable can serve as rich humus for agriculture (Rose, 1999). Much advantage is noticed in this treatment. The Advantages of Anaerobic Digestion Treatment (Van Leir, 1998)**;**No, or very low energy demand; Production of valuable energy in the form of methane; Low investment costs and low space requirement; Applicable at small as well as large scale; Low production of excess sludge, which is well stabilized; Low nitrogen and phosphorus requirements; High loading capacity (5-10 times that of aerobic treatment) ; High treatment efficiencies; Suitable for camps with long term periods without discharge of wastewater ;Effluents contain valuable fertilizers (ammonium salts) and the beauty of the anaerobic treatment technology is that it can be applied to a very small and very big scale. This makes it a sustainable option for a growing community.

2.3 Role of Anaerobic Ponds in wastewater treatment- Low cost technology

Anaerobic ponds are deep treatment ponds that exclude oxygen and encourage the growth of bacteria, which break down the effluent (Annexure1). It is in the anaerobic pond that the effluent begins breaking down in the absence of oxygen "anaerobically". The anaerobic pond acts like an uncovered septic tank. Anaerobic bacteria break down the organic matter in the effluent, releasing methane and carbon dioxide. Sludge is deposited on the bottom and a crust forms on the surface as shown in Fig. 2 in Annexure 1.

Anaerobic ponds are commonly 2-5 m deep and receive such a high organic loading (usually > 100 g BOD/m^3 d equivalent to > 3000 kg/ha/d for a depth of 3 m). They contain an organic loading that is very high relative to the amount of oxygen entering the pond, which maintains anaerobic conditions to the pond surface. Anaerobic ponds don't contain algae, although occasionally a thin film of mainly *Chlamydomonas* can be seen at the surface. They work extremely well in warm climate (can attain 60-85% BOD removal) and have relatively short retention time (for BOD of up to 300 mg/l, one day is sufficient at temperature > 20^oC).

3. Result and Discussion

Anaerobic ponds reduce N, P, K and pathogenic microorganisms by sludge formation and the release of ammonia into the air. As a complete process, the anaerobic pond serves to:
Separate out solid from dissolved material as solids settle as bottom sludge. Dissolve further organic material; Break down biodegradable organic material; Store undigested material and non-degradable solids as bottom sludge; Allow partially treated effluent to pass out. This is a very cost-effective method of reducing BOD_5. Normally, a single anaerobic pond in each treatment train is sufficient if the strength of the influent wastewater is less than 1000 mg/l BOD_5((McGarry and Pescod, 1970). Designers have been in the past too afraid to incorporate anaerobic ponds in case they cause odor. However, results obtained from a more recent study in northern Brazil carried out by Pearson et al. (1996) suggest that maximum design volumetric loadings may increase to 350 g BOD_5/m^3d at 25°C rather that restricting it to 300 g BOD_5/m^3d at 20°C. Furthermore, Mara and Pearson (1986) propose a maximum sulphate volumetric loading rate of 500 g SO_4/m^3 d (equivalent to 170 g S/ m^3d) in order to avoid odor nuisance.

In anaerobic ponds, methane production increases sevenfold for every 5^oC rise in temperature. (Marais, 1970)

Table 1
BOD removals in Anaerobic Ponds loaded at 250 g BOD_5/m^3 d (Mara, 1976)

Retention Time (days)	BOD_5 removal %
1	50
2.5	60
5	70

Anaerobic ponds are normally designed on the basis of a temperature, pH and saline dependent PH maintenance through anaerobic pond. A study on anaerobic pond treatment of tapioca starch waste conducted by Uddin (1970) revealed that a volumetric BOD loading rate of around 750 $g/m^3 \cdot d$ resulted in a pond pH of 6.0. Fig. 3, which is based on Uddin's results shows that when the BOD loading rate was increased above this value, the volumetric BOD removal rate was reduced. Most likely, pond overloading impaired methanogenesis. Experiments conducted by Sergrist (1997) showed a 50% growth inhibition at a NH_3-N/l concentration of 25-30 mg/l. Strong ammonia inhibition in anaerobic ponds can occur at concentrations >80 mg NH_3-N/l and may reduce significantly COD elimination to as low as 10% in primary anaerobic ponds (Data is still scarce in this matter). Arridge et al. (1995) working on an experimental WSP complex in Northeast Brazil found a one log unit removal in the AP for each of the following indicators: faecal coliforms, faecal streptococci and Clostridium perfringens. Salmonellae were reduced from 130 to 70 MPN/100 ml and Vibrio cholerae 01 was reduced from 40 to 10 MPN/l respectively. Anaerobic ponds appear to be essential for high levels of V. cholerae removal.

3.2 New Techniques in Ponds

Two PC-based waste stabilization pond design procedures, based on parameter uncertainty and 10,000-trial Monte Carlo simulations, were developed for a series of anaerobic, facultative and maturation ponds to produce < or = 1000 E. coli per 100 ml for both 50% and 95% compliance.

3.3 Duckweed Based Wastewater Treatment System and Assessment of Nutritive Value and Economic Return

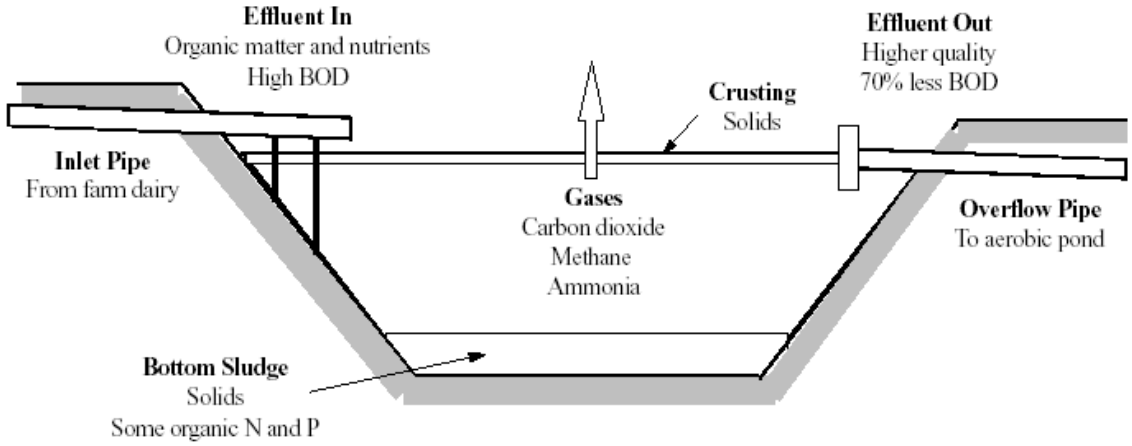
With the objective to evolve a low cost treatment technology, the project has been undertaken to study the efficacy of treatment of wastewater by duckweed, to assess the economic return from pisciculture (fed on duckweed) as well as evaluating the nutritive value of duckweed.

The duckweed based stabilization pond functions as anaerobic pond except at the top layer where aerobic condition prevails. The top aerobic zone effectively controls the odour problems of the pond. The capability of up taking nutrients and other substrate from wastewater has attributed this plant to be biological purifier. There is remarkable reduction of BOD, COD, Total Suspended Solid, Nitrogen, Phosphorus and Heavy metals from wastewater in duckweed based stabilization pond. Wastewater treatment by duckweed based stabilization pond provides the treatment at a low cost. This type of treatment system can therefore help in meeting the challenges posed in developing countries for environmental protection, due to resource recovery advantages over the conventional lagoon system.

Conclusion

The common characteristic of all of the described types is that they encourage “zero-discharge” technology. This cyclical, rather than linear approach includes the reuse of the treated effluent for agricultural reuse. The reuse of the wastewater decreases the money spent on fertilizers and it is considered safe, since it has been treated for pathogens.

Annex 1



Annex 2

References:

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ADB

Completion Report

Project Number: 28028
Loan Number: 1451
December 2005

Nepal: Second Tourism Infrastructure Development Project

Asian Development Bank

CURRENCY EQUIVALENTS

Currency Unit – Nepalese rupee/s (NRe/NRs)

		At Appraisal	At Project Completion
		April 1996	October 2005
NRe1.00	=	$0.0181	$0.0143
$1.00	=	NRs55.25	NRs69.75

ABBREVIATIONS

ADB	–	Asian Development Bank
BME	–	benefit monitoring and evaluation
CAAN	–	Civil Aviation Authority of Nepal
DCA	–	Department of Civil Aviation
DOT	–	Department of Tourism
EIRR	–	economic internal rate of return
FIRR	–	financial internal rate of return
IA	–	implementing agency
ICB	–	international competitive bidding
IDC	–	interest during construction
IRAD	–	Integrated Research Application and Development
IS	–	international shopping
KMTNC	–	King Mahendra Trust for Nature Conservation
kW	–	kilowatt
LCB	–	local competitive bidding
MLD	–	Ministry of Local Development
MOCTCA	–	Ministry of Culture, Tourism and Civil Aviation
MOTCA	–	Ministry of Tourism and Civil Aviation
MOF	–	Ministry of Finance
NGO	–	nongovernment organization
NTB	–	Nepal Tourism Board
O&M	–	operation and maintenance
PCP	–	public communications policy
PCR	–	project completion report
PEA	–	project executing agencies
PEC	–	Pokhara Environment Committee
PIU	–	project implementation unit
PMU	–	project management unit
PSC	–	project steering committee
PSM	–	Pokhara Sub-Metropolis
PVTDC	–	Pokahara Valley Town Development Committee
RSDC	–	Rural Self-Reliance Development Center
SARD	–	South Asia Department
SDR	–	special drawing rights
TA	–	technical assistance
TD	–	technical division

NOTES

(i) The fiscal year (FY) of the Government ends on 15 July.

(ii) In this report, "$" refers to US dollars.

Vice President	L. Jin, Operations Group 1
Director General	K. Senga, South Asia Department (SARD)
Director	H. Kim, Social Sectors Division, SARD
Team leader	N. Mawilmada, Urban Development Specialist, SARD
Team members	R. Romasanta, Associate Operations Analyst, SARD

CONTENTS

BASIC DATA

A. Loan Identification

1.	Country	NEPAL
2.	Loan Number	1451
3.	Project Title	Second Tourism Infrastructure Development Project
4.	Borrower	Kingdom of Nepal
5.	Executing Agency	Ministry of Tourism and Civil Aviation
6.	Amount of Loan	SDR11,891 million
7.	Project Completion Report Number	930

B. Loan Data

1.	Appraisal	
	– Date Started	15 January 1996
	– Date Completed	28 January 1996
2.	Loan Negotiations	
	– Date Started	19 May 1996
	– Date Completed	19 May 1996
3.	Date of Board Approval	02 July 1996
4.	Date of Loan Agreement	27 August 1996
5.	Date of Loan Effectiveness	
	– In Loan Agreement	27 November 1996
	– Actual	05 December 1996
	– Number of Extensions	1
6.	Closing Date	
	– In Loan Agreement	31 December 2001
	– Actual	15 July 2004
	– Number of Extensions	2
7.	Terms of Loan	
	– Interest Rate	1 percent per annum
	– Maturity (number of years)	40 years
	– Grace Period (number of years)	10 years
8.	Terms of Relending (if any)	
	– Interest Rate	N/A
	– Maturity (number of years)	
	– Grace Period (number of years)	
	– Second-Step Borrower	

9. Disbursements

a. Dates

Initial Disbursement	Final Disbursement	Time Interval
15 April 1997	15 July 2004	87 months
Effective Date	**Original Closing Date**	**Time Interval**
05 December 1996	31 December 2001	60 months

b. Amount ($)

Category	Original Allocation	Last Revised Allocation	Amount Canceled	Net Amount Available	Amount Disbursed	Undisbursed Balance
Civil Works	5,981,550	5,348,335	(633,215)	5,348,335	7,870,715	0
Equipment and Materials	5,456,556	4,759,762	(696,794)	4,759,762	716,919	0
Incremental Administration Costs	499,805	457,831	(41,974)	457,831	623,819	0
Institutional Development and Strengthening	42,323	36,865	(5,458)	36,865	0	0
Consulting Services	1,814,820	1,650,795	(164,025)	1,650,795	1,765,900	0
Service Charge	564,297	493,313	(70,984)	493,313	241,373	0
Unallocated	2,972,973	1,336,133	(1,636,840)	1,336,133	0	0
Total	**17,332,324**	**14,083,034**	**(3,249,290)**[a]	**14,083,034**	**11,218,726**	**0**

[a] Indicates amount cancelled during implementation. Total amount cancelled at loan closing was $6,113,596.

10. Local Costs (ADB Financed)
    - Amount ($ million) 6.74
    - Percent of Local Costs 52.41
    - Percent of Total Cost 38.87

C. Project Data

1. Project Cost ($ million)

Cost	Appraisal Estimate	Actual
Foreign Exchange Cost	9.73	4.48
Local Currency Cost	7.47	6.74
Total	**17.20**	**11.22**

2. Financing Plan ($ million)

Cost	Appraisal Estimate	Actual
Implementation Costs		
Borrower Financed	5.70	6.12
ADB Financed	17.20	11.22
Beneficiary Contribution	0.02	0.00
Total	**22.92**	**17.34**
IDC Costs		
Borrower Financed	0.56	
ADB Financed	0.45	0.24
Total	**1.01**	**0.24**

ADB = Asian Development Bank, IDC = interest during construction.

3. Cost Breakdown by Project Component ($ million)

Component	Appraisal Estimate	Actual
Part A: Pokhara Environmental Improvements	5.12	5.14
Part B: Ecotourism Development	1.07	0.50
Part C: Domestic Airports Improvement	8.59	4.82
Part D: Implementation Assistance	1.86	0.53
IDC and Service Charge	0.55	0.24
Total	**17.19**	**11.23**

IDC = interest during construction.

4. Project Schedule

Item	Appraisal Estimate	Actual
Date of Contract with Consultants	Aug 1996	Aug 1997
Civil Works Contract		
Date of Award	Sep 1996	Apr 1997
Completion of Work	Dec 2001	Mar 2003[a]
Equipment and Supplies		
Dates		
First Procurement	Jul 1996[b]	Oct 1997
Last Procurement	Jun 2001[b]	Dec 2002
Completion of Equipment Installation		Mar 2003

[a] Actual delivery of waste treatment equipment was in 2005.
[b] Projected dates not mentioned in the implementation schedule. Estimates were based on the commencement and completion dates of the Project as envisaged at appraisal.

5. Project Performance Report Ratings

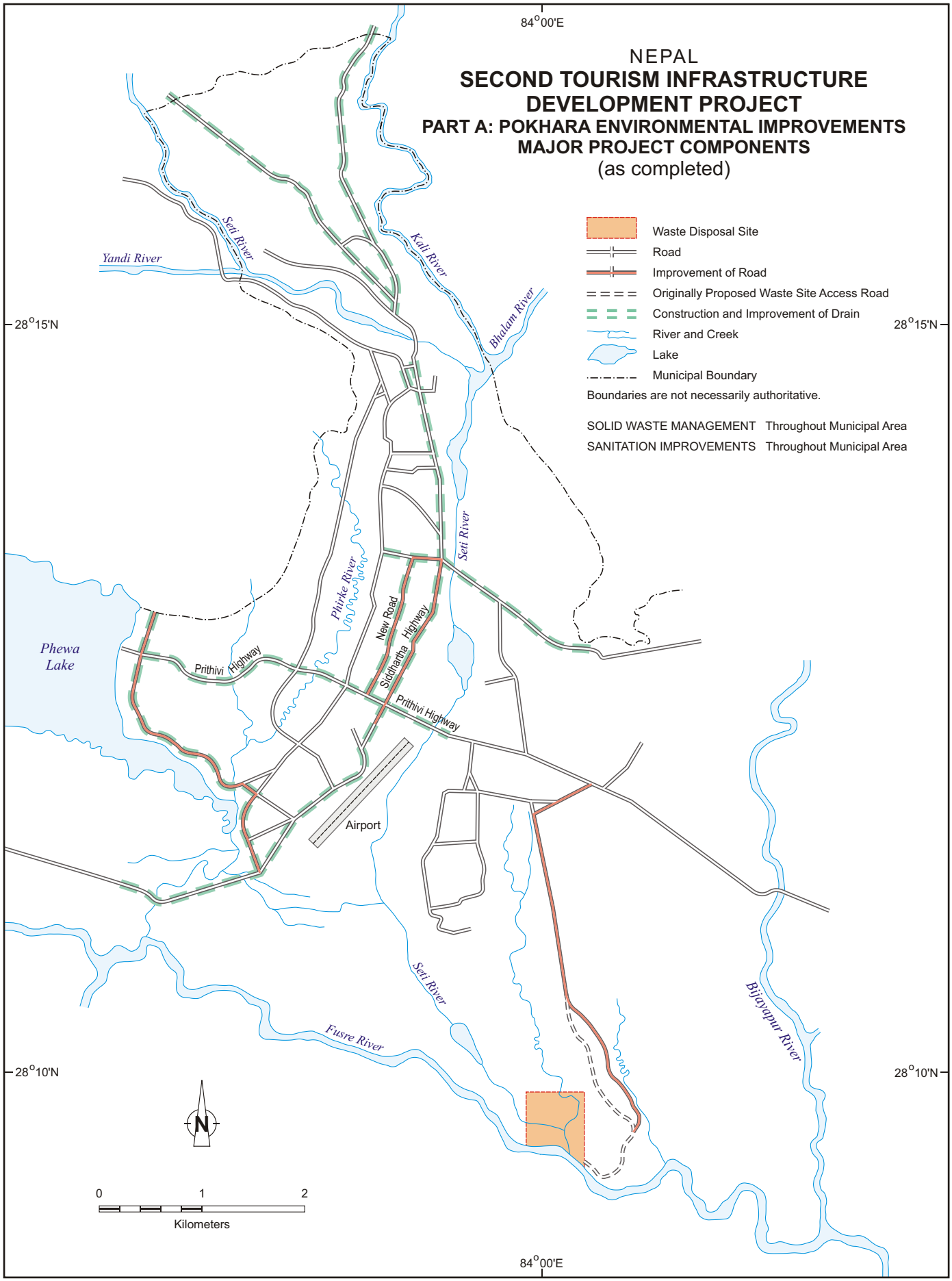
	Ratings	
Implementation Period	Development Objectives	Implementation Progress
From 1 Nov 1998 to 31 Dec 1998	Satisfactory	Satisfactory
From 1 Jan 1999 to 31 Dec 1999	Satisfactory	Satisfactory
From 1 Jan 2000 to 31 Dec 2000	Satisfactory	Satisfactory
From 1 Jan 2001 to 31 May 2001	Satisfactory	Highly Satisfactory
From 1 Jun 2001 to 31 Jul 2001	Satisfactory	Satisfactory
From 1 Aug 2001 to 31 Aug 2001	Satisfactory	Highly Satisfactory
From 1 Sep 2001 to 31 Dec 2001	Satisfactory	Satisfactory
From 1 Jan 2002 to 31 Dec 2002	Satisfactory	Satisfactory
From 1 Jan 2003 to 31 Jul 2003	Satisfactory	Satisfactory
From 1 Aug 2003 to 31 Dec 2003	Satisfactory	Unsatisfactory
From 1 Jan 2004 to 31 Jul 2004[a]	Satisfactory	Unsatisfactory

[a] The project performance report was kept open until July 2004, which is the loan account closing date of the Project.

D. Data on Asian Development Bank Missions

Name of Mission	Date	No. of Persons	No. of Person-Days	Specialization of Members[a]
Fact-Finding	30 Aug–15 Sep 1995	6	102	a, b, c, d
Appraisal	15–28 Jan 1996	4	56	a, b, c, e
Loan Inception	30 Sep–11 Oct 1996	3	36	d, e, f
Loan Review 1	2–7 Apr 1997	1	6	e
Loan Review 2	5–10 May 1998	1	6	e
Loan Review 3	8–15 Dec 1998	1	8	b
Loan Review 4	7–16 Apr 1999	1	10	b
Midterm Review	24 Aug–2 Sep 1999	3	30	a, b, g
Loan Review 5	27 Jul–7 Aug 2000	1	12	b
Loan Review 6	19–29 Nov 2000	1	11	b
Loan Review 7	15–24 Mar 2001	1	10	b, d
Loan Review 8	2–11 Oct 2001	2	20	b, h
Loan Review 9	28 Feb–7 Mar 2002	2	16	b, i
Loan Review 10	15–19 June 2002	2	10	b, j
Project Completion Review[b]	24-29 Oct 2005	4	24	b, j, k, l

[a] a – senior financial analyst, b – urban development, c – institutional development, d – programs officer, Nepal Resident Mission, e – senior project specialist, f – senior project implementation, Nepal Resident Mission, g – assistant project analyst, h – senior sector analyst, i – private sector development, j – associate project analyst, k – international Project Completion Review consultant, l – domestic Project Completion Report consultant.
[b] The project completion report was prepared by Mr. Nayana Mawilmada, Urban Development Specialist.


NEPAL
SECOND TOURISM INFRASTRUCTURE DEVELOPMENT PROJECT
PART A: POKHARA ENVIRONMENTAL IMPROVEMENTS
MAJOR PROJECT COMPONENTS
(as completed)
Waste Disposal Site
Road
Improvement of Road
Originally Proposed Waste Site Access Road
Construction and Improvement of Drain
River and Creek
Lake
Municipal Boundary
Boundaries are not necessarily authoritative.
SOLID WASTE MANAGEMENT Throughout Municipal Area
SANITATION IMPROVEMENTS Throughout Municipal Area
84°00'E
28°15'N
28°10'N
Yandi River
Seti River
Kali River
Bhalam River
Phirke River
Phewa Lake
Prithivi Highway
New Road
Siddhartha Highway
Airport
Fusre River
Bijayapur River
N
0
1
2
Kilometers

I. PROJECT DESCRIPTION

1. The primary objective of the Second Tourism Infrastructure Development Project (the Project) was to support the Government's strategy for promoting sustainable economic growth by improving the environment and attractiveness of tourist areas, improving access, and ensuring required human resources for the smooth operation of tourism on a sustainable basis.

2. The scope of the Project as appraised comprised: (i) improvement of the urban environment of Pokhara and protection of scenic Phewa Lake through investments in public environmental education, sanitation facilities, septage management, solid waste management, roads, and drainage; (ii) development of the Manaslu area to enable higher tourist visitation rates; (iii) upgrading the infrastructure at selected tourist-related domestic airports and enabling improved access to tourist destinations; and (iv) strengthening local government capabilities to manage urban infrastructure and services more effectively.

3. The Project aimed to play a significant role in (i) promoting broad-based tourism to improve national income and reduce regional imbalances; (ii) improving the country's natural, cultural, and human environment; (iii) improving service quality within the tourism sector; and (iv) marketing Nepal as a popular tourist destination.[1] The project framework is in Appendix 1.

4. The Project was considered substantially complete in March 2003 and the loan was closed on 31 March 2003. Airport improvement at six domestic airports was completed satisfactorily in December 2001. Ecotourism developments at Manaslu were successfully completed and early reports show that the improvements have resulted in increased tourist visits. However, major equipment procurement for the waste management component at Pokhara was not finalized until July 2004. The landfill portion of the waste disposal operations began in mid-2005, but septage collection and treatment has not been started (as of October 2005) and the upgrading of the road to the waste disposal site had not been completed. Urban road and drainage improvements in Pokhara have been completed successfully. The institutional strengthening component had minimal impact.

II. EVALUATION OF DESIGN AND IMPLEMENTATION

A. Relevance of Design and Formulation

5. Tourism plays a pivotal role in Nepal's economy. The Government recognizes the distinct comparative advantage of tourism relative to other economic sectors and has accorded high priority to tourism development. The Government's objective to spur tourism by rehabilitating and developing infrastructure, while protecting the environment, provided the setting for the Project. The Asian Development Bank's (ADB's) strategy for Nepal at appraisal recognized the significant economic role of tourism development. ADB's operational plans for tourism at appraisal focused on (i) maintaining or improving the physical and human environment in popular tourist destinations in a sustainable manner, (ii) introducing environmentally benign tourism management practices in fragile cultural and natural environments, (iii) facilitating improved transportation services for tourists, (iv) developing infrastructure in attractive non-mountain destinations to diversify the benefits of tourism countrywide, (v) strengthening cost recovery concepts and practices to improve sectoral resource mobilization, and (vi) improving product and service standards sector-wide (footnote 1).

[1] ADB. 1996. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan to the Kingdom of Nepal for the Second Tourism Infrastructure Project.* Manila.

The Project was relevant at appraisal and remains so at completion. The Project was prepared under ADB technical assistance (TA).[2]

B. Project Outputs

1. Part A: Pokhara Environmental Improvements

6. The environmental improvements under Part A included:

(i) A public environmental education program to promote awareness among the residents of Pokhara about public hygiene and sanitation. The public awareness program was conducted over 1 year with staff from the Pokhara Sub-Metropolis (PSM) seconded to work with the consultants.

(ii) Improvements in public and private sanitation facilities. At the time of appraisal, it was estimated that 5,000 households were expected to avail of improved sanitary facilities. However, only 165 households constructed new septic tanks with loans from the municipality.

(iii) Introduction of a septage management program, including the establishment of a regular cleanout service and the sanitary disposal of septage at the waste management facility. The septage treatment facility has been completed and equipment has been procured under the loan for pumping septic tanks and transporting the septage to the disposal site. However, at the time of the Project Completion Report (PCR) Mission, collection and disposal of septage had not begun.

(iv) Introduction of a solid waste management system to provide regular household collection, recycling of waste where possible, and disposal at the waste management facility. The landfill area has been completed and equipment has been procured under the loan for collection and transport of solid waste to the disposal area. Regular collection has begun and a fee schedule has been enacted by the Sub-Metropolis. However, no fees have yet been collected (as of October 2005).

(v) Improvements to drainage through the construction of roadside drains along main roads in the town's core area. At appraisal, 33 kilometers (km) of storm drains were to be constructed in Pokhara. More than 50 km were actually constructed. However, the design of the drains was changed at the demand of the local population from reinforced concrete pipe to a masonry section with reinforced concrete covers. This allows for easier breaking into the drain for the discharge of sanitary waste into the storm drain.

(vi) Improvements to roads including paving of the 2.7 km access road to the waste management facility. Approximately 10.5 km of urban roads (not included at appraisal) were improved, and 9.7 km of the access road to the waste disposal site (through the suburban housing area) were improved to a high standard.[3]

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[2] ADB. 1994. *Technical Assistance to the Kingdom of Nepal for the Second Tourism Infrastructure Development Project*. Manila. (TA 2140-NEP, for $460,000, approved 19 August 1994).

[3] The road was widened from 3.5 meters (m) to 5.0 m and masonry drains were constructed along both sides of the road.

However, the final 2 km of the access road to the waste disposal site have not yet been completed.

(vii) Preparation and introduction of a revised land use plan. The revised land use plan was developed by consultants in 1998. However, the plan is still being discussed and the municipality has not yet adopted it.

2. Part B: Manaslu Ecotourism Development

7. The components under Part B include:

(i) Construction of helipads at selected locations. Two helipads were constructed.

(ii) Construction of community owned and managed campsites, lodges, and kerosene depots. Five community-owned campgrounds have been developed, 5 privately-owned campgrounds have constructed toilets, 3 privately-owned lodges have been upgraded, and 7 kerosene depots have been established. Some 11 km of trail sections have been improved, 16 new wooden bridges constructed, 3 old bridges restored, and sign posts installed along the trails.

(iii) Construction of micro-hydro stations. Four micro-hydro schemes have been completed and are operational (Samagaon 33 kilowatts [kW], Lho 30 kW, Prok 23 kW, and Namrung 15 kW).

(iv) Monastery conservation. Fourteen community monasteries have received various levels of assistance under the Project.

(v) Establishment of radio communication facilities and a medical clinic. Wireless radio sets have been installed at 9 locations and 3 health posts have been upgraded (Chhekam, Philim, and Namrung). In addition, 14 drinking water supply schemes have been completed, covering 87% of the population; 14 community toilets developed; solid waste dumping pits constructed; and rubbish collection bins distributed to households at several locations

(vi) Training of local communities in tourism management and marketing. Various training and capacity building initiatives have been completed under the Project, including: (a) formation of local committees for Conservation Area Management, Forest Management, Women's Group, Micro-Hydro Management and Tourism Management; and (b) skill development courses conducted for painting, trekking guide, stove repair and maintenance, microenterprise creation and management, lodge management and cooking, Thanka painting, and kitchen gardening.

3. Part C: Domestic Airport Upgrading

8. This part of the Project included the upgrading/improvement of six, tourism-related domestic airports at Pokhara, Jomsom, Lukla, Bharatpur, Biratnagar, and Jumla. Improvements comprised: (i) paving or repaving of runways considered unsafe or potentially unsafe; (ii) provision of navigation aids and communication facilities to improve operational safety; (iii) building and refurbishing of passenger facilities to improve passenger throughput, increase passenger comfort and dispose of passenger and other wastes; and (iv) provision of airport rescue and firefighting equipment. This component was delayed due to the late recruitment of consultants, but the actual duration of construction activities was less than estimated at

appraisal. At appraisal, there was provision for some navigation aids and firefighting and rescue equipment to be provided under the Project. However, the Civil Aviation Authority of Nepal (CAAN) secured separate grant aid for these items and they were therefore dropped from ADB financing. The improvements completed at each airport are summarized in Table 1.

Table 1: Domestic Airport Upgrading

Airport	Improvements
Biratnagar	Asphalt concrete paving of runway, apron, and taxiway; grading of side strips; realignment and capacity improvement of drainage facilities; water supply improvement including a new well, leakage repair, and new overhead tanks.
Lukla	Runway, apron, and taxiway improvement; drainage improvements; new terminal building and control tower; chain link fencing; new staff quarters; and helipad.
Bharatpur	Runway, apron and taxiway improvement; drainage improvements; service roads and site development; chain link fencing; new staff quarters; and additional floor on the control tower.
Pokhara	Apron extension[a]
Jomsom	Runway, apron, and taxiway improvement; grading of side strips; drainage improvements; new terminal building and control tower; chain link fencing; and river protection works.
Jumla	Runway, apron, and taxiway improvement; drainage improvements; renovation of terminal building and control tower; chain link fencing; and renovation of staff quarters and police house.

[a] Under the Project, only the apron extension was included. Under the first Tourism Infrastructure Development Project, the runway and taxiway were resurfaced, the terminal building was repaired and renovated, and the access road improved.

4. Part D: Implementation Assistance and Institutional Strengthening

9. Under this component, implementation assistance was intended to provide (i) staff and cover operational costs related to the project management unit (PMU) in the Department of Tourism (DOT) and the project implementation units (PIUs) established in PSM, King Mahendra Trust for Nature Conservation (KMTNC), and Department of Civil Aviation (DCA); (ii) logistic and equipment support (initial ground surveys, office equipment and utility vehicles, capital and running costs); and (iii) 714 person-months of consulting services (45 international and 729 domestic) for project management, public environmental education program, detailed engineering design, and construction supervision. Implementation assistance was provided through the recruitment of international and domestic consultants. The consultants recruited for implementation assistance were generally satisfactory, and provided assistance as anticipated.

10. The institutional strengthening subcomponent was to provide for the following.

(i) Establishment of a technical division in PSM for (a) planning and managing operation and maintenance (O&M) of urban infrastructure, and (b) implementing the revised land use plan. The technical division has been included in the organization for the Pokhara Sub-Metropolis, but insufficient staff were recruited and assigned, and existing staff have not been adequately trained. During the public awareness campaign, two Pokhara Sub-Metropolis staff members were seconded for 1 year to the consultants carrying out the campaign.

(ii) Classroom and on-the-job training of Pokhara Sub-Metropolis staff to enable effective discharge of operational responsibilities connected with septage and solid waste management services. It is evident that there has been little, if any, training of staff to manage the waste management services. The staff assigned does not understand the operation of the septage treatment facility and could not locate the operations manual during the PCR Mission's visit to the site. Septage collection and treatment has not yet commenced (as of October 2005).

(iii) Training of PMU staff to improve DOT's implementation and management capabilities. There were some positive impacts on the PMU staff who gained knowledge from working with the consultants engaged to assist the PMU in contract management and accounting.

C. Project Costs

11. The actual final cost of the Project was $17.33 million compared with $22.92 million estimated at appraisal. This final cost comprised $4.48 million in foreign exchange cost (compared with $9.73 million estimated at appraisal) and $12.87 million equivalent in local currency cost (compared with $13.19 million estimated at appraisal). Appendix 2 presents a detailed comparison of the project costs at appraisal and at completion. The actual cost of civil works was $13.53 million compared with the appraisal estimate of $9.42 million. This difference is due mostly to (i) cost overruns on the three contract packages associated with the development of the Pokhara waste disposal site; and (ii) addition of urban roads upgrading, not included at appraisal.. For equipment and materials, the actual cost was $0.80 million compared with the appraisal estimate of $5.52 million. This difference is due to (i) procurement of navigation, fire, and rescue equipment for domestic airports under grant financing, thus deleted from project financing (about $4.07 million); and (ii) lower costs of equipment procured for the Manaslu ecotourism component (about $0.07 million). The actual cost of consulting services was $1.78 million compared with the appraisal estimate of $1.80 million. Interest during construction and service charge was $0.24 million compared with the appraisal estimate of $1.01 million. This reduction was primarily due to lower than expected utilization of the ADB loan, as $6.11 million was cancelled. Land acquisition costs were minimal, NRs344,900 (approximately $4,800), and no resettlement was required.

12. The financing plan envisaged at appraisal expected $17.20 million (75% of the total project cost) from ADB to finance 100% of the estimated foreign exchange expenditure and 56.6% of estimated local currency expenditures. The remaining $5.70 million of estimated local currency expenditure was to be financed by the Government and beneficiaries. The actual utilization of the ADB loan was $11.22 million, accounting for 100% of foreign exchange expenditures and 64.6% of total project costs. For the actual local currency requirement of $12.87 million, $6.12 million was financed by the Government and $6.75 million by ADB. The underutilization of the ADB loan was due primarily to less equipment purchased and lower

expenditure related to institutional development and strengthening. Appendix 2 provides a comparison between the appraisal and actual financing plans.

D. Disbursements

13. Of the $17.20 million of loan proceeds, $6.11 million was cancelled due to less than expected expenditure for equipment, primarily related to upgrading of the domestic airports and the ecotourism component (para. 11), and less expenditure related to institutional strengthening. Disbursement started in April 1997 and was completed in July 2004. While the loan closing date was on 31 March 2003, the loan account remained open until July 2004 to cover expenditures related to equipment purchased late in the implementation period. Appendix 3 shows the actual quarterly disbursement during the implementation period. Projected disbursements were not prepared at appraisal. Disbursements were made through direct payment, reimbursement, and commitment procedures. An imprest account and statement of expenditure facility was also used which facilitated the disbursement procedures of the Project.

E. Project Schedule

14. The loan was approved on 2 July 1996, signed 27 August 1996, and became effective on 5 December 1996. At appraisal, the Project was expected to be implemented from February 1996 to June 2001. The Project suffered delays from the outset, with slow mobilization and slow recruitment of consultants. The first consultants were not mobilized until August 1997, a delay of about 1 year, due primarily to the Implementing Agencies' internal procedures. A graphical comparison of the actual and appraisal implementation schedule is presented in Appendix 4.

15. For Part A (Pokhara Environmental Improvements), the civil works procurement was delayed so civil works began later than anticipated at appraisal. Significant delays also ensued because of (i) less than satisfactory performance of some civil works contractors, and (ii) community protests related to the waste disposal facility and the access road to that facility. The civil works for the waste management facility and access road were expected to commence in April 1996 and be completed by the end of 1999, but work actually started in April 1997 has not been fully completed (as of October 2005). Drainage works started about 3 months later than envisaged at appraisal, progressed reasonably well, and were completed 3 months later than estimated at appraisal. Sanitation improvements began in the first quarter of 2000, 3 years late, and were completed 21 months later than estimated at appraisal. However, the number of improvements was significantly less than set out at appraisal. The environmental education and training component was late to begin and lasted less than envisaged at appraisal. Three subcomponents were not considered in the appraisal schedule: urban road improvement, Phewa Lake preservation, and implementation of the land use plan. The urban road improvement was added and, while it started later than planned, works were completed within the extended implementation period. Phewa Lake preservation works consisted mainly of fencing and was completed on a timely basis. Preparation and implementation of the revised land use plan for Pokhara commenced as planned. However, the plan is yet to be adopted and enforced by the municipality.

16. For Part B (Ecotourism Development in the Manaslu Conservation Area), works started later than envisaged at appraisal, but were completed on a timely basis and without delays.

17. For Part C (Domestic Airport Improvements), works started later than envisaged at appraisal (April 1999 vs. April 1996), however, all works were completed within the extended implementation period. While the commencement of the works was delayed, once started, the

works were completed on a timely basis. The implementation period was extended on two occasions due to delays encountered in Part A.

F. Implementation Arrangements

18. The Ministry of Tourism and Civil Aviation (MOTCA)[4] was the main Executing Agency, with overall responsibility for implementation of the Project. The Ministry of Local Development (MLD) was designated as the Executing Agency for Part A of the Project to be carried out in Pokhara. PSM was the Implementing Agency for Part A, KMTNC for Part B, and DCA for Part C.[5] At the central level, the PMU within DOT[6] coordinated and managed all project implementation activities and reported to the Secretary of MOTCA. KMTNC and CAAN were considered effective in the implementation of their respective components. However, PSM was less effective, leading to delays, disputes, and increased costs.

G. Conditions and Covenants

19. The status of compliance with loan covenants is provided in Appendix 5. Major covenants were generally complied with, particularly those relating to counterpart funds, implementation arrangements, reporting, environmental protection, and land acquisition. However, significant issues of noncompliance did occur. Annual benefit monitoring and evaluation (BME) reports were submitted as required in Schedule 6, para. 13. CAAN failed to provide audited financial statements, thereby not complying with Section 4.06(b) of the Loan Agreement. In addition, Schedule 6 of the Loan Agreement, para. 10(f), stipulates that "The Pokhara Sub-Metropolis by 31 March 1998 shall have commenced implementation of a revised Land Use Plan". The revised land use plan was prepared by consultants under the Project in 2000 but has not yet been implemented. In accordance with Schedule 6, para. 17 of the Loan Agreement, CAAN was to be formed to replace DCA as a fully autonomous body. While CAAN was formed on 31 December 1998, it is still not fully autonomous because asset transfer from DCA to CAAN has not been finalized. No covenants were modified, suspended, or waived.

H. Consultant Recruitment and Procurement

20. Consultants were engaged in accordance with ADB's *Guidelines on the Use of Consultants* and other procedures acceptable to the ADB. At appraisal, 774 person-months (45 international and 729 domestic) of consulting inputs were envisaged. The first consultants were not engaged until August 1997, a delay of about 1 year compared with appraisal expectations.

21. Procurement was carried out in accordance with ADB's *Guidelines for Procurement* and procedures acceptable to ADB. Procurement for civil works was all carried out under local competitive bidding (LCB) procedures. Procurement of collection and waste management equipment was done under international competitive bidding (ICB) procedures.

I. Performance of Consultants, Contractors, and Suppliers

22. The consultants recruited for the design and supervision of the three contracts associated with the waste treatment facility and access road were weak in design, supervision,

[4] During implementation, MOTCA became the Ministry of Culture, Tourism and Civil Aviation (MOCTCA).
[5] Under the Project, DCA was to be replaced by an autonomous Civil Aviation Authority of Nepal (CAAN). CAAN was officially formed 31 December 1998 and DCA ceased to exist.
[6] As agreed at appraisal, DOT was replaced by the Nepal Tourism Board as an autonomous entity responsible for the coordination of all tourism sector development, including project planning, funding, and implementation.

and contract management, which contributed to the need for variations and led to delay. The same consultants were responsible for the urban roads improvement and demonstrated the same shortcomings, leading to frequent variations and delay. The consultants carrying out the design and supervision of the Pokhara drainage works performed satisfactory. The consultants responsible for the ecotourism component and the airport upgrading component performed satisfactorily. Individual consultants retained for assistance to the PMU performed satisfactorily.

23. The civil works contractors for Pokhara environmental improvements, associated with the landfill construction and access road, did not perform well. The contractor for construction of the septage disposal facility performed reasonably well. The contractor responsible for the landfill construction had cash flow problems, resulting in delayed completion. The contractor for the access road was problematic throughout, resulting in additional costs and delayed completion. Contractors for the airport upgrading and the Manaslu ecotourism component performed satisfactorily and completed works within their allotted contract periods, even though commencement was delayed, mostly due to late recruitment of consultants.

J. Performance of the Borrower and the Executing Agency

24. The performance of the Borrower and MOTCA as the Executing Agency was satisfactory. MOTCA was responsible for overall project coordination and monitoring. PSM, under direction from MLD, was the Implementing Agency for the Pokhara environmental improvements. PSM did not perform as well and lacked sufficient experienced staff. During the implementation of the waste treatment facility and access road, project activities were brought to a virtual standstill by the local community adjacent to these works. PSM did not deal effectively with the matter and allowed the local community to dictate an unjustified increase in the standard of the access road, resulting in delay and increased costs. The final 2 km of the access road has not yet been completed, to the detriment of the effective operation of the waste management facility. The training of PSM staff fell well below expectations, as the important Technical Division is understaffed and staff lack training and understanding of waste disposal operations, particularly septage collection and treatment activities. At appraisal, there was concern about PSM's capacity to implement, maintain, and operate the infrastructure constructed under the Project (RRP, paras. 45–47). A much more concentrated effort should have been made to ensure that staffing levels were adequate and appropriate training was carried out. KMTNC, responsible for the implementation of the Manaslu ecotourism development, performed satisfactorily and carried out appropriate training activities. CAAN, responsible for implementation of the domestic airport improvements, has considerable implementation experience and performed satisfactorily.

K. Performance of the Asian Development Bank

25. During project implementation (from September 1996 to June 2002), ADB dispatched 12 missions, including the Inception Mission, Midterm Review Mission, and 10 Review Missions. The review missions were not particularly effective in resolving implementation issues, particularly with respect to issues surrounding community objections related to construction of the waste treatment facility and access road. ADB's administration lacked continuity, as the Project was shifted between departments within ADB and project officers responsible for administration changed several times. ADB's approvals of procurement documents, contract awards, disbursements, etc. were effective and timely. ADB dealt with the political issues in Pokhara reasonably well, considering they were beyond ADB's control. Overall, ADB's administration of the Project was considered satisfactory.

III. EVALUATION OF PERFORMANCE

26. It is notable that the overall Project contained three virtually independent components, which were implemented with significantly varied degrees of success. Therefore, it is important to look at each component separately—in assessing relevance, efficacy, efficiency, sustainability, and institutional and other impacts—to extract a clearer picture of outcomes and lessons learned. Appendix 8 presents the weighted assessment of each component with respect to the above criteria.

A. Relevance

27. The rationale behind each component of the Project was sound, taking into account the priority given to tourism development, Nepal's comparative advantage in the tourism sector, private sector development potential, and the importance of domestic air travel to tourism development and sustenance of local communities. The Project is highly relevant to the Government's development strategy and ADB's country operational strategy. The Government's Ninth Plan (FY1997-FY2002) and Tenth Plan (FY2003–FY2007) accord high priority to fostering broad-based growth based on the revival in manufacturing, tourism, and exports. ADB's country strategy aims to (i) achieve sustained poverty reduction through broad-based growth in the development of rural areas, and (ii) improve basic social services and infrastructure. At appraisal, tourism was a primary driver of Nepal's economy, and was one of the few sectors with significant income generation potential for rural Nepal. The tourism sector is equally important today. Tourism revenue accounted for 1.5% of gross domestic product and 9.1% of total foreign exchange earnings during the Fiscal Year 2003/2004. Overall, the Project is rated relevant.

B. Efficacy in Achievement of Purpose

28. Efficacy varies across project components. The domestic airports upgrading component was highly efficacious. All of the physical outputs of this component were achieved and air traffic, passenger numbers, and cargo volumes have increased substantially (Appendix 6). The Manaslu area ecotourism development component was efficacious. All physical components were achieved, and benefits from alternative energy, environmental conservation, and improved access are being realized. However, the benefits expected from increased tourism have yet to be fully realized due to political instability. The Pokhara environmental improvement component was inefficacious. Improvements in Pokhara have not achieved the expected results and will only produce the expected benefits if (i) appropriate staffing is put in place in Pokhara, (ii) pollution of Phewa Lake is curtailed, (iii) planned sedimentation traps are constructed in the drainage system,[7] and (iv) the solid waste and septage management system is effectively implemented. Overall, the Project's effectiveness in achieving its stated purpose is rated efficacious.

C. Efficiency in Achievement of Outputs and Purpose

29. Efficiency in achievement of outputs and purpose was also significantly varied across project components. The domestic airport upgrading component was efficient. Despite some initial delays, the airport component was completed in a timely manner, without significant cost overruns. Benefits assessed at appraisal—including cost savings in aircraft maintenance, increased passenger arrivals, and more cost-effective essential cargo transport—are being achieved. The financial internal rate of return (FIRR) of the airport upgrading component is

[7] Sedimentation traps were included in the drainage system design.

10.24%, while the economic internal rate of return (EIRR) of the component is estimated to be 18.96% (Appendix 7).

30. The Pokhara environmental improvement component of the Project was inefficient. It is difficult to assign any significant benefits to this component due to (i) long delays and increased costs for the Pokhara environmental improvements, and (ii) the question whether there has been any significant improvement to the environment of Pokhara or Phewa Lake. The waste management facility is not yet fully functional (as of October 2005). The access road to the waste disposal in incomplete, and a significant length has been upgraded to an excessively high standard through the suburban area and is not considered cost-effective compared with its objective. Production of expected benefits from the Pokhara environmental improvements depends on (i) appropriate staffing of the PSM Technical Division, (ii) completion of the waste management facility and access road, (iii) implementation of a waste collection plan, (iv) implementation and enforcement of the revised land use plan, (v) enforcement of bylaws and regulations, (vi) further improvement of the drainage system by construction of additional sedimentation traps, and (vii) prevention of sanitary waste discharged into Phewa Lake via the storm drain system.

31. The Manaslu area ecotourism development component was efficient.[8] Despite initial delays, this component was completed in a timely manner. There is evidence that tourist visits to the Manaslu Conservation Area have increased and communities in the region are benefiting from improved access, enhanced communications, access to electricity, and environmental conservation due to reduced firewood usage. However, the full potential benefit to the region is not being realized because of political instability.

32. Economic and financial analyses are in Appendixes 6 and 7. Overall, the Project is rated less efficient.

D. Preliminary Assessment of Sustainability

33. The sustainability of improvements under the domestic airport upgrading and Manaslu area ecotourism development component are considered likely. The airports are generating positive financial returns and adequate funds for O&M. Manaslu area improvements were done with significant community involvement, and community engagement is likely in their upkeep. For the Pokhara component, the local authority's capacity to manage and maintain the urban infrastructure and waste management systems is questionable. It is critical that a concentrated effort be made to recruit appropriate and experienced staff and train existing staff to manage, operate, and maintain the infrastructure provided under the Project. The concerns expressed at appraisal with regard to O&M have been confirmed by PSM's inadequate staffing and capacity. The overall sustainability of the Project is rated marginally likely.

E. Institutional Development, Environmental, and Other Impacts

34. Institutional development was central to achieving benefits expected under the Project. For the ecotourism component, attention was paid to giving appropriate training to the local community, which will be responsible for managing and maintaining improvements made under the Project (para. 7[vi]). For the domestic airport upgrading component, the need for extensive training and capacity building was less critical since CAAN has built up its capacity through the implementation of several previous projects. However, for the Pokhara environmental improvements, institutional strengthening was essential to the success of this component.

[8] Assessment of Manaslu Component based on discussions with KMTWC, Government, and review of the Government's PCR. No field visits were possible due to security concerns.

However, PSM did not assign the necessary staff or avail of the necessary training under the Project, and the PMU seems not to have focused on this issue either.

35. Positive environmental impacts were achieved in connection with the ecotourism component through development of alternative energy sources, improved water supply, and conservation. The airport upgrading component also had positive environmental impacts through the improvement of drainage around the airports, grading of side strips, and expansion of aprons and paving runways. However, for the Pokhara environmental improvement component, evidence shows that—for the most part—there have been little or no positive impacts and hence, ADB's policy principles were not met. Raw septage is still being discharged directly into Phewa Lake and adjacent rivers, the waste management systems are only partially operative, and a relatively small number of new septic tanks have been constructed. The improved drainage in the urban area is positive, but negated by the failure to construct all the sedimentation basins, thus allowing continued deposit of sediment to the lake. Appendix 8 presents further analysis of the institutional strengthening, environmental, and other impacts. The lack of institutional development and capacity building in PSM and neglible environmental impacts in Pokhara mean that the overall rating for institutional environmental and other impacts is little.

IV. OVERALL ASSESSMENT AND RECOMMENDATIONS

A. Overall Assessment

36. The Project is rated partly successful, based on weighting the evaluation of each component according to its total cost.[9] This result is explained in paras. 26–35and presented in quantitative terms in Appendix 9. In summary, the Project is relevant to the development objectives of the Government and ADB and is considered capable of achieving a significant part of its purpose over time, including intended socioeconomic benefits. However, major shortfalls in the Pokhara environmental improvement component—such as weaknesses in terms of efficacy, efficiency, sustainability, and institutional development—prevent the Project from being classified in more successful terms.

B. Lessons Learned

37. Lessons learned as follows:

(i) Assurances of the Government and implementing agencies should be scrutinized more carefully at appraisal stage, in view of past experience during implementation of the first tourism infrastructure development project. Only realistic assurances, based on proper assessment of institutional capacity and political context, should be incorporated as covenants in the Loan Agreement.

(ii) Capability enhancement of implementing agencies should be carried out well in advance of implementing infrastructure components based on a thorough institutional assessment. Virtually all the problems in the Pokhara component of the Project were rooted in the poor capacity of the implementing agency. More emphasis should have been placed on strengthening its capacity prior to the commencement of physical works.

(iii) Entities intended to manage O&M for infrastructure should be established early in the project cycle, and staff trained throughout the implementation period, rather

[9] This PCR is part of a sample of PCRs independently reviewed by the Operations Evaluation Department. The review has validated the methodology used and the rating given.

than at the very end. ADB should be more involved in ensuring the appropriate institutions are in place, and that their capacity is strengthened. For example, PSM's Technical Division was established very late in the project cycle, and is staffed by one individual, who does not know how to operate some of the systems.

(iv) Assessment of community attitude to infrastructure, such as waste disposal, should be better assessed at appraisal. For example, a participatory process to identify a feasible waste disposal site would have prevented significant delays in the implementation of the Project.

(v) ADB should insist on enforcement of bylaws and regulations, such as penalties on illegal septage disposal and solid waste disposal. The drainage system, which was designed purely for storm water, is channeling raw sewerage into Phewa Lake, because of illegal dumping of septage.

(vi) Designs of environmentally sensitive infrastructure systems should anticipate the impacts of noncompliant behavior by the public. The drainage system in Pokhara discharges all water into Phewa lake. Although designed for storm water, many residents have directed their sewerage lines into the drains, which will, over time, cause significant contamination of the lake.

(vii) Airport expansions should have considered projected traffic forecasts, and allocated land for future expansion. In Lukla, airport traffic has increased significantly and is now congested. However, new land for expansion is difficult to acquire because of new construction around the airport.

(viii) Land acquisition needs should be addressed up front, before infrastructure construction is started. Designs should be modified if land acquisition is not likely. In Pokhara, the drainage system is generally complete. However, three sedimentation traps were not constructed because the proposed land could not be acquired. Over time, this will cause increased sedimentation in Phewa Lake.

C. Recommendations

38. The following recommendations are made:

1. Project Related

(i) PSM should urgently strengthen its Technical Division, and appoint more staff to manage the improved infrastructure systems. The Government should ensure adequate budget for this purpose.

(ii) PSM should train its staff in O&M of the solid waste and septage management facilities.

(iii) Fines for illegal dumping of septage into the newly constructed storm water drainage system should be strictly enforced by PSM.

(iv) Collection of solid waste management fees should begin immediately. The fee structure for solid waste management should be simplified significantly. Currently, there are over 25 categories of fees, which makes collection and tracking difficult.

(v) The private sector operators of septage collection services should be allowed to dump septage into the new septage management facility. Significant fines should be put in place and enforced, to curtail dumping of collected septage in the nearby rivers.

(vi) The entire septage collection and management system could be contracted out to private operators. If systems remain idle for much longer, they will become inoperable. PSM should aggressively pursue this option.

(vii) The solid waste collection and management system could also be managed under a private sector contract. PSM should aggressively pursue this option.

(viii) PSM should consider revising the land use plan developed by project consultants, if it is not acceptable. A modified plan, which is acceptable to both PSM and the local community, should be developed and adopted.

(ix) CAAN should ensure that the newly constructed civil works, especially the drainage around the airports, are properly maintained. Field observations showed that some drains were beginning to get clogged with debris.

2. Future Monitoring.

(i) Water quality of Phewa Lake should be monitored. Significant contamination because of septage disposal should be detected and remedied.

(ii) Staffing levels of PSM's Technical Division should be monitored, along with the financial performance of the overall waste management facility.

3. Timing of the Project Performance Audit Report

39. The positive impacts of the ecotourism component and airport upgrading component are evident, even though the waste management systems are not fully functional. It is suggested that the project performance audit report may be carried out in mid-2007.

PROJECT FRAMEWORK

Design Summary	Appraisal Targets	Project Achievements	Monitoring Mechanisms	Key Issues and Recommendations
Goal To encourage the growth of tourism in Nepal through improvements in infrastructure and the environment	• Improved and sustainable urban environment for 146,000 people in Pokhara and 6,500 in Manaslu • Improved sanitation systems for about 5,000 households and businesses, including about 2,000 low-income households	• Marginal improvement for the population of Pokhara. Higher level of improvement for Manaslu • 165 new septic tanks constructed, urban drainage and urban roads improved	Government Benefit Monitoring and Evaluation Report Tourism statistics published by the Government	• Pollution of Phewa Lake not improved due to sanitary waste discharge into lake
Purpose Improve the urban environment in Pokhara and Manaslu, upgrade selected tourist-related domestic airports, and strengthen local government capabilities	• Increased numbers of tourists • Longer stays by tourists • More spending by tourists	• Some evidence to support increased number of visitors • Some evidence supports longer length of stays	Tourism statistics published by the Government CAAN Annual Report	• Deteriorated security situation has had adverse impact
Outputs 1. Pokhara Environmental Improvements • Public environment education • Sanitation improvement • Solid waste management • Septage management • Land use plan and urban planning • Drainage improvement • Road improvement • Urban road improvement	• Public awareness program • Improved sanitation facilities at 5,000 locations, including new septic tanks • Town-wide solid waste collection and disposal at landfill • Regular septage collection • Revised land use plan to be implemented by March 1998 • 33 km to be constructed • Road improvements, including 2.7 km access road to waste disposal site • Not included at appraisal	• Public awareness program carried out • 165 new septic tanks constructed • Town-wide collection in place • Regular collection not yet in place • Revised land use plan not yet implemented • 51 km actually constructed • 9.7 km of access road upgraded in suburban area, but final 2 km to access the waste disposal site not completed • Approximately 10 km urban road improvement • Improvements (primarily	Government Benefit, Monitoring and Evaluation Report Loan Review Missions PMU progress reports and communications	• Benefit monitoring and evaluation shows awareness program only marginally successful • Effective and lasting operation depends on adequate number of trained staff

Design Summary	Appraisal Targets	Project Achievements	Monitoring Mechanisms	Key Issues and Recommendations
• Phewa Lake preservation	• Not included at appraisal	fencing) completed		Technical Division established in Pokhara, but understaffed with inexperienced staff
2. Manaslu Ecotourism Development				
• Training/capacity building	• Training and capacity building to enhance the ability of local population to provide improved tourism services and maintenance	• 50 local committees formed, 7 skill development training courses organized, and 5 exposure tours for representatives and residents of project area	KMTNC Annual Reports	
• Access and communication	• Develop trails, heliport, and improved communication facilities	• 2 helipads constructed, trails improved, bridges constructed/restored, and wireless radio sets installed		
• Access to schooling	• Improve infrastructure and access to education	• 10 schools received infrastructure improvement, conservation classes held at 2 schools, sports equipment for 1 school and adult literacy classes held		
• Cultural preservation	• Support local culture through conservation/ preservation of selected monasteries	• 14 community monasteries received assistance from the Project		
• Alternative energy	• Develop kerosene depots and micro-hydro stations	• 4 micro-hydro stations completed and 7 kerosene depots established		
3. Domestic Airport Improvement (Biratnagar, Bharatpur, Jomsom, Lukla, Jumla, Pokhara)	• Airport improvements including runway, taxiway and apron resurfacing, navigation aids, fire/rescue equipment, terminal/control tower construction/improvement, side strip grading, road improvements, water supply, and fencing	• Improvements satisfactorily carried out under the Project, except navigation aids and fire/rescue equipment, which was obtained through separate grant financing	CAAN Annual Reports Loan Review Missions IRAD reports	
4. Institutional Strengthening	• This activity was intended to provide the necessary training and improve capacity to enable the project implementing agencies to manage and maintain infrastructure provided under the Project	• For Pokhara municipality, it is evident that the staffing is inadequate and capability remains weak. For Manaslu Conservation Area, staffing and capability appears adequate. Project management unit (PMU) staff remaining in the Ministry of Culture, Tourism and Civil Aviation (MOCTCA) have increased capability	Government Benefit, Monitoring and Evaluation Report Loan Review Missions	

Design Summary	Appraisal Targets	Project Achievements	Monitoring Mechanisms	Key Issues and Recommendations
Inputs	**Resources and Schedule**	**Resources and Schedule**		
Civil Works	$9.42 million Apr 1996–Mar 2002	13.53 million Apr 1997–Oct 2005	Project Progress Reports	Under civil works, cost increases on access road and urban road component added. However, the access road to the waste treatment facility not complete.
Equipment and Materials	$5.52 million Apr 1996–Mar 2002	$0.80 million Apr 1997–Mar 2004	Government Benefit, Monitoring and Evaluation Report	
Consulting Services	$1.80 million Jan 1996–May 2001	$1.78 million Jan 1996–Dec 2002	Loan Review Missions	For airport upgrading, navigation and firefighting/rescue equipment financed through separate grant aid.
Incremental Administration	$0.83 million Jan 1996–Dec 2001	$0.98 million Jan 1996–Dec 2002		

COST ESTIMATES AND FINANCING PLAN
($ million)

Table A2.1: Project Costs

Category	Appraisal			Actual		
	Foreign Exchange	Local Currency	Total	Foreign Exchange	Local Currency	Total
A. Base Cost						
1. Land[a]	0.00	0.22	0.22	0.00	0.00	0.00
2. Civil Works	1.76	7.66	9.42	2.48	11.05	13.53
3. Equipment and Materials	5.26	0.26	5.52	0.70	0.11	0.80
4. Consulting Services	0.84	0.96	1.80	0.81	0.97	1.78
5. Incremental Administration	0.02	0.81	0.83	0.25	0.73	0.98
Subtotal (A)	**7.88**	**9.91**	**17.79**	**4.24**	**12.87**	**17.10**
B. Contingencies						
1. Physical	0.62	0.78	1.40	0.00	0.00	0.00
2. Price	0.67	2.05	2.72	0.00	0.00	0.00
Subtotal (B)	**1.29**	**2.83**	**4.12**	**0.00**	**0.00**	**0.00**
Total Base Cost	**9.17**	**12.74**	**21.91**	**4.24**	**12.87**	**17.10**
C. Interest and Other Charges	**0.56**	**0.45**	**1.01**	**0.24**	**0.00**	**0.24**
Total Project Cost	**9.73**	**13.19**	**22.92**	**4.48**	**12.87**	**17.34**

[a] Actual land acquisition costs NRs344,900.
Total costs based on MOTCA accounts and exchange rate of NRs71.02 per $.
$6.114 million form the ADB loan was cancelled.
Source: Loan Finance Information System.

Table A2.2 Financing Plan

	Appraisal			Actual		
	Foreign Exchange	Local Currency	Total	Foreign Exchange	Local Currency	Total
Asian Development Bank	9.73	7.47	17.20	4.48	6.74	11.22
Government and Beneficiaries	0.00	5.70	5.70	0.00	6.12	6.12
Total	**9.73**	**13.17**	**22.90**	**4.48**	**12.86**	**17.34**

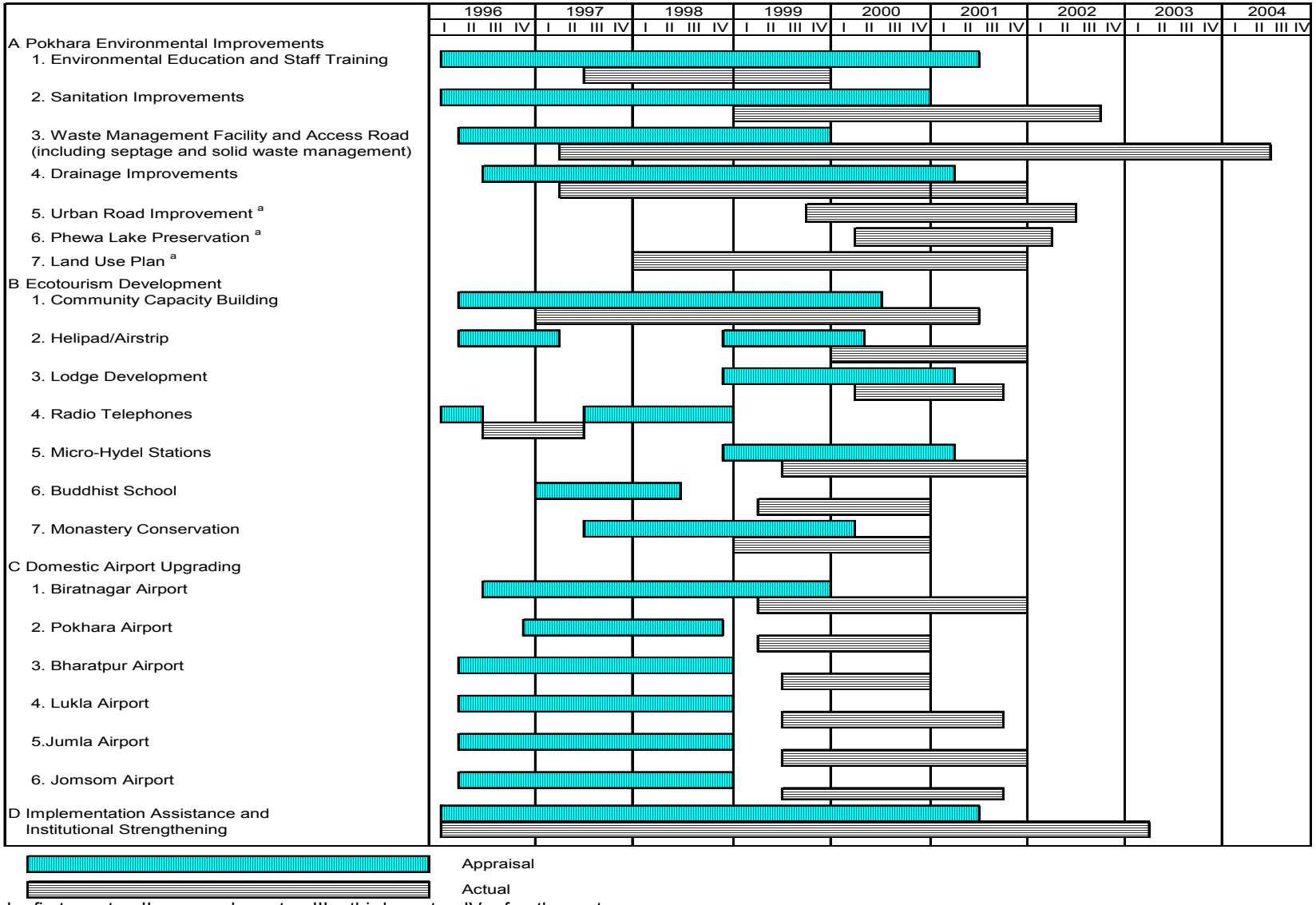
Source: Asian Development Bank loan financial information system.

BREAKDOWN OF ANNUAL DISBURSEMENTS OF ASIAN DEVELOPMENT BANK FUNDS
($'000)

Year	Quarter	Amount	Cumulative
1997	I	0.00	0.00
	II	0.48	0.48
	III	0.000	0.48
	IV	0.06	0.54
1998	I	0.000	0.54
	II	0.08	0.62
	III	0.15	0.77
	IV	0.14	0.91
1999	I	0.19	1.10
	II	0.01	1.11
	III	0.47	1.58
	IV	0.35	1.94
2000	I	0.21	2.15
	II	1.14	3.30
	III	0.68	3.97
	IV	1.42	5.40
2001	I	0.24	5.63
	II	0.92	6.55
	III	1.07	7.62
	IV	0.30	7.93
2002	I	0.99	8.91
	II	0.04	8.95
	III	0.27	9.22
	IV	0.74	9.96
2003	I	0.21	10.17
	II	0.46	10.63
	III	0.00	10.63
	IV	0.29	10.92
2004	I	0.12	11.03
	II	0.12	11.15
	III	0.07	11.22
Total		**11.22**	

Source: Asian Development Bank loan financial information system.

IMPLEMENTATION SCHEDULE



I = first quarter, II = second quarter, III = third quarter, IV = fourth quarter.

STATUS OF COMPLIANCE WITH LOAN COVENANTS

Covenant	Reference in Loan Agreement	Status of Compliance
Project Executing Agencies 1. MOTCA, the line ministry responsible for the tourism sector, shall be the principal Project Executing Agency (hereinafter called PEA) and shall be responsible for overall technical supervision and execution of the Project.	Loan Agreement Schedule 6, para. 1	Complied with.
2. The Borrower's Ministry of Local Development (MLD), in its capacity as the line ministry responsible for municipalities, shall be the Executing Agency for Part A of the Project, which shall be carried out in Pokhara.	Loan Agreement Schedule 6, para. 2	Complied with.
Project Implementing Agencies 3. The Project Implementing Agencies for Parts A, B and C of the Project shall be Pokhara Sub-Metropolis, KMTNC and DCA, respectively.	Loan Agreement Schedule 6, para. 3	Complied with.
4. Each of the Project Implementing Agencies shall be responsible for their respective Project Parts' engineering design, contract documents, prequalification, bidding and award of contracts, construction supervision, recruitment of design and supervision consultants, monitoring and reporting activities, accounting, and liaison with DOT. Pokhara Sub-Metropolis and KMTNC shall also be involved in community liaison, training programs and matters relating to the disbursement and recovery of concessional loans. Pokhara Sub-Metropolis shall liaise with PVTDC and Kaski District Development Committee as required during Project implementation. KMTNC shall coordinate, where appropriate, with nongovernmental organizations (hereinafter called NGOs), including the Rural Self-Reliance Development Center (hereinafter called RSDC), an NGO doing similar work in the Gorkha district under the auspices of the Gorkha Development Project.	Loan Agreement Schedule 6, para. 4	Complied with.
5. A high-level Project Steering Committee (hereinafter called PSC) established under the ongoing Bank-financed Tourism Infrastructure Project shall continue under the Project and shall be chaired by the Secretary, MOTCA. The membership of PSC shall be revised to reflect the Project's components and shall comprise senior representatives from MOF, Ministry of Agriculture, Pokhara Sub-Metropolis, MLD, DCA and KMTNC. Other representatives may be invited on a needs basis. PSC shall provide policy guidance and review the implementation of the Action Plan. PSC shall meet as often as necessary, but at least every 6 months. PSC shall ensure that the semiannual work programs of KMTNC are approved only after it is satisfied that there is no overlap between the proposed program and that of RSDC or any other NGO or agency.	Loan Agreement Schedule 6, para. 5	Complied with.

Covenant	Reference in Loan Agreement	Status of Compliance
Project Management Unit 6. At the central level, the PMU within DOT shall coordinate and manage all activities required for the implementation and management of the Project, including consulting services, and shall report to the Secretary, MOTCA through the Director General, DOT. The PMU, with the assistance of the Project manager, shall liaise with the Bank on all matters of Project implementation. The PMU shall be appropriately strengthened to meet the needs of the Project and provided with staff, and logistic and equipment support. The PMU shall include expertise in urban management services, accounting, economics, statistics, and community development.	Loan Agreement Schedule 6, para. 6	Complied with.
7. The PMU shall establish and maintain accounts and records to facilitate the identification of income and expenditures related to the Project.	Loan Agreement Schedule 6, para. 7	Complied with.
Project Implementing Units 8. Suitably staffed and equipped PIUs shall be established within Pokhara Sub-Metropolis, KMTNC, and DCA to implement the relevant components and subcomponents of the Project. The PIUs shall be headed by managers at senior levels.	Loan Agreement Schedule 6, para. 8	Complied with.
Pokhara Environment Committee 9. PEC shall be established as an advisory committee to ensure that the sanitation facilities improvement subcomponent under Part A of the Project is satisfactorily implemented. PEC shall comprise three members each from Board of Pokhara Sub-Metropolis and the general public in addition to the Member-Secretary of PVTDC and the manager, PSM-PIU. PEC shall be responsible for screening applications for loans for sanitation improvements, disbursement and recovery of loan funds and coordination and monitoring of the implementation of Part A (ii) of the Project. PEC and the public environmental education program shall ensure that the community is involved in the implementation of Part A of the Project.	Loan Agreement Schedule 6, para. 9	Complied with. Provided loans to 165 households of about NRs8.4 million, of which NRs4.0 million has been repaid to date.
Institutional, Policy and Financial Action Plan 10. By 30 September 1997, DCA shall have revised the civil aviation charges, as outlined in the Action Plan, and developed guidelines for improved airport management practices.	Loan Agreement Schedule 6, para. 10 (a)	Complied with delay. New civil aviation charges are in effect.
11. By 31 July 1997, the Borrower shall have (a) declared the Manaslu region in the northern part of Gorkha district a conservation area, and (b) notified and levied an entry fee for tourists entering the Manaslu area.	Loan Agreement Schedule 6, para. 10 (b)	Complied with delay. Manaslu Region in Gorkha District declared as Conservation Area in November 1999.

Covenant	Reference in Loan Agreement	Status of Compliance
12. By 31 July 1997, MOTCA shall have established a planning and project management division in DOT to undertake sector-wide perspective planning and the organization of Project management. The division shall be re-established in Nepal Tourism Board when it is established.	Loan Agreement Schedule 6, para. 10 (c)	Complied with delay.
13. By 30 September 1997, MOTCA shall have developed guidelines, procedures and terms of reference for the Nepal Tourism Board, and shall have established the Nepal Tourism Board after consultation with the Bank.	Loan Agreement Schedule 6, para. 10 (d)	Complied with delay.
14. By 31 October 1997, MOTCA shall have developed and introduced standards and products and services in the tourism sector.	Loan Agreement Schedule 6, para. 10 (e)	Complied with delay
15. By 31 March 1998, Pokhara Sub-Metropolis shall have commenced implementation of the revised Land Use Plan.	Loan Agreement Schedule 6, para. 10 (f)	Not complied with. Land Use Plan developed but not implemented.
16. By 30 June 1999, Pokhara Sub-Metropolis shall have developed a scheme acceptable to the Borrower and the Bank, to fully recover the costs of providing septage and solid waste management services in Pokhara. The scheme shall become effective simultaneously with the commencement of the provision of the septage and solid waste management services.	Loan Agreement Schedule 6, para. 10 (g)	Not complied with.
Operations and Maintenance 17. Pokhara Sub-Metropolis shall be responsible for implementing the solid waste and septage management programs. It shall also be responsible for drainage maintenance along roads other than national highways within its jurisdiction. The PSM-TD shall be established to organize and manage maintenance of urban infrastructure within Pokhara. PM-TD shall be responsible for organizing Pokhara Sub-Metropolis' maintenance functions, developing maintenance plans and budgets, overseeing maintenance work, and monitoring quality. PM-TD shall also be responsible for updating and enforcing the Land Use Plan.	Loan Agreement Schedule 6, para. 11 (a)	Not complied with.
18. KMTNC, with the assistance of consultants referred to in Schedule 5, shall undertake the education and training of host communities in a variety of disciplines including campsite operation, kerosene depot operations, cooking skills, horticulture and forestry management and tourism and conservation awareness under Part B of the Project.	Loan Agreement Schedule 6, para. 11 (b)	Complied with.
19. By 31 December 1996, DCA shall adopt improved airport management practices and shall develop detailed guidelines for improved operations and management of domestic airports and implement them in conjunction with the Project.	Loan Agreement Schedule 6, para. 11 (c)	Complied with delay.

Covenant	Reference in Loan Agreement	Status of Compliance
Environmental Considerations 20. The environmental benefits of the Project shall be enhanced and sustained through the active involvement of local communities. The PMU shall disseminate information on the Project, including the initial environmental examination carried for each Project component, and shall consult with community user groups to ensure that their views are taken into account.	Loan Agreement Schedule 6, para. 12	Partly complied with. Realization and sustainability of environmental benefits in Pokhara at risk due to inadequate action by PSM (paras. 28, 30, 33, and 35 in the main text)
Benefit Monitoring and Evaluation 21. The Borrower shall cause a comprehensive BME exercise to be undertaken for each component of the Project to ensure that the Project facilities are managed efficiently and the benefits maximized. The PMU shall develop the BME system with assistance from the Project management consultants. The PMU shall submit a detailed implementation plan for preparing benchmark information and for monitoring benefits for the Bank's review and concurrence within 6 months after the Effective Date. Annual reports shall be furnished to the Bank through the PMU throughout the Project implementation.	Loan Agreement Schedule 6, para. 13	Complied with.
22. DOT shall be responsible for carrying out the BME activities, including the establishment of benchmarks through initial baseline physical and socioeconomic surveys, data collection and analysis. The surveys shall be repeated at intervals to determine changes in key indicators relating to tourist traffic, length of stay, expenditures, health, welfare, social, economic and physical conditions.	Loan Agreement Schedule 6, para. 14	Not complied with. Survey reports not submitted.
Nepal Tourism Board (NTB) and Civil Aviation Authority of Nepal (CAAN) 23. The Borrower shall ensure that the Nepal Tourism Board will be established, in terms of the Tourism Policy, to replace DOT. The Borrower shall consult with the Bank with respect to the draft rules and regulations of the Nepal Tourism Board prior to its enactment. The Nepal Tourism Board shall comprise representatives of the Borrower and the private sector and shall be an autonomous organization responsible for the coordination of all tourism sector development, including project planning, funding and implementation.	Loan Agreement Schedule 6, para. 15	Complied with.
24. The Borrower shall ensure that CAAN will be established, in terms of the Tourism Policy, to replace DCA. The Borrower shall consult with the Bank with respect to the draft rules and regulations of CAAN prior to its enactment.	Loan Agreement Schedule 6, para. 16	Complied with. CAAN operational since December 1998.
25. After the establishment of the Nepal Tourism Board and CAAN, the responsibilities of DOT and DCA under the Project shall be transferred to the Nepal Tourism	Loan Agreement Schedule 6, para. 17	Partly complied with. Transfer of responsibilities of DOT

Covenant	Reference in Loan Agreement	Status of Compliance
Board and CAAN, respectively. Prior to the assumption of DOT's and DCA's responsibilities under the Project by the Nepal Tourism Board and CAAN, respectively, the Bank shall enter into the Nepal Tourism Board Project Agreement and CAAN Project Agreement with the Nepal Tourism Board and CAAN, respectively, which agreements shall set forth the responsibilities of the Nepal Tourism Board and CAAN under the Project.		and DCA completed. CAAN Project Agreement signed while the Nepal Tourism Board Project. Agreement not signed because of disagreements between NTB and MOTCA responsibilities.
26. In the event that the Bank notifies the Borrower in writing that the respective project agreements in the paragraph above shall not be required by the Bank, then the responsibilities of the Nepal Tourism Board and CAAN shall be as assumed by them as successor organizations of DOT and DCA, respectively, and as set forth in this Loan Agreement. The Bank shall provide the Borrower with such notification as soon as practicable after the Borrower has informed the Bank that the Nepal Tourism Board and CAAN have been established and are fully capable of assuming the responsibilities of DOT and DCA as set forth in this Loan Agreement.	Loan Agreement Schedule 6, para. 18	Complied with.
Land Acquisition 27. The Borrower and MOTCA shall ensure that all land and rights in land required for Parts B and C of the Project are made available in a timely manner. For this purpose, the Borrower shall also ensure that adequate budgetary allocation is made to cover the cost of land acquisition.	Loan Agreement Schedule 6, para. 19	Complied with.
Mid-Term Review 28. A mid-term review shall be undertaken by the Borrower and the Bank within about 2 years of the Effective Date (December 1998) to enable the Borrower and the Bank to adjust the design and implementation arrangements, if necessary. The review shall focus on the status of Project implementation and the sustainability of benefits, including environmental and social impacts, and institutional reform.	Loan Agreement Schedule 6, para. 20	Complied with delay. Midterm review undertaken in August 1999.
Reports 29. The Borrower shall (i) cause MOTCA and the Project Implementing Agencies to maintain separate accounts for their respective Parts of the Project; (ii) have such accounts and related financial statements audited annually, in accordance with appropriate auditing standards consistently applied, by auditors whose qualifications, experience and terms of reference are acceptable to the Bank; (iii) cause MOTCA and the Project Implementing Agencies to furnish to the Bank, as soon as available but in any event not later than 12 months after the end of each related fiscal year, certified copies of such audited accounts and financial statements and the report of the	Loan Agreement Article IV, Section 4.06 (b)	Partly complied with. MOTCA did not submit the audited financial statements for FY2002/2003 and CAAN did not submit the audited financial statements for FY2000/2001 and FY2001/2002.

Covenant	Reference in Loan Agreement	Status of Compliance
auditors relating thereto, all in the English language; and (iv) furnish to the Bank such other information concerning such accounts and financial statements and the audit thereof as the Bank shall from time to time reasonably request.		
30. The Borrower shall furnish, or cause to be furnished, to the Bank all such reports and information as the Bank shall reasonably request concerning (i) the Loan, and the expenditure of the proceeds and maintenance of the service thereof; (ii) the goods and services and other items of expenditure financed out of the proceeds of the Loan; (iii) the Project; (iv) to the extent relevant to the Project, the administration, operations and financial condition of the agencies of the Borrower responsible for carrying out the Project, including MOTCA, the Project Implementing Agencies and the Borrower's Nepal Tourism Board to be established by the Government under the Tourism Policy (hereinafter called Nepal Tourism Board); (v) financial and economic conditions in the territory of the Borrower and the international balance-of-payments position of the Borrower; and (vi) any other matters relating to the purposes of the Loan.	Loan Agreement Article IV, Section 4.07 (a)	Complied with.
31. Without limiting the generality of the foregoing, the Borrower shall furnish, or cause to be furnished, to the Bank quarterly progress reports on the carrying out of the Project and on the operation and management of Project facilities. Such reports shall be submitted in such form and in such detail and within such a period as the Bank shall reasonably request, and shall indicate, among other things, physical progress of works, status of related organizational, financial and capacity building issues, problems encountered during the quarter under review, steps taken or proposed to be taken to remedy these problems, and proposed program of activities and expected progress during the following quarter.	Loan Agreement Article IV, Section 4.07 (b)	Complied with.
32. Promptly after physical completion of the Project, but in any event not later than three (3) months thereafter or such later date as may be agreed for this purpose between the Borrower and the Bank, MOTCA shall prepare and furnish to the Bank a report, in such form and in such detail as the Bank may reasonably request, on the execution and initial operation of the Project, including its implementation, cost, benefits, monitoring and evaluation activities, the performance by the Borrower of its obligations under the Loan Agreement and the accomplishment of the purposes of the Loan.	Loan Agreement Article IV, Section 4.07 (c)	Complied with. Received the Executing Agency's project completion report in August 2003.
Particular Covenants 33. The Borrower shall cause the Project to be carried	Loan Agreement	Complied with.

Covenant	Reference in Loan Agreement	Status of Compliance
out with due diligence and efficiency and in conformity with sound administrative, financial, engineering, environmental, tourism development, civil aviation, public utility, urban development, and conservation and training practices.	Article IV, Section 4.01 (a)	
34. In the carrying out of the Project and operation of the Project facilities, the Borrower shall perform, or cause to be performed, all obligations set forth in Schedule 6 to this Loan Agreement.	Loan Agreement Article IV, Section 4.01 (b)	Complied with.
35. The Borrower shall make available or cause to be made available, promptly as needed, the funds, facilities, services, land and other resources which are required, in addition to the proceeds of the Loan, for the carrying out of the Project and for the operation and maintenance of the Project facilities.	Loan Agreement Article IV, Section 4.02	Complied with.
36. In the carrying out of the Project, the Borrower shall cause competent and qualified consultants and contractors, acceptable to the Borrower and the Bank, to be employed to an extent and upon terms and conditions satisfactory to the Borrower and the Bank.	Loan Agreement Article IV, Section 4.03 (a)	Complied with.
37. The Borrower shall cause the Project to be carried out in accordance with plans, design standards, specifications, work schedules and construction methods acceptable to the Borrower and the Bank. The Borrower shall furnish, or cause to be furnished, to the Bank, promptly after their preparation, such plans, design standards, specifications and work schedules, and any material modifications subsequently made therein, in such detail as the Bank shall reasonably request.	Loan Agreement Article IV, Section 4.03 (b)	Complied with.
38. The Borrower shall ensure that the activities of its departments and agencies with respect to the carrying out of the Project and operation of the Project facilities are conducted and coordinated in accordance with sound administrative policies and procedures.	Loan Agreement Article IV, Section 4.04	Complied with.
39. The Borrower shall make arrangements satisfactory to the Bank for insurance of the Project facilities to such extent and against such risks and in such amounts as shall be consistent with sound practice.	Loan Agreement Article IV, Section 4.05 (a)	Complied with.
40. Without limiting the generality of the foregoing, the Borrower undertakes to insure, or cause to be insured, the goods to be imported for the Project and to be financed out of the proceeds of the Loan against hazards incident to the acquisition, transportation and delivery thereof to the place of use or installation, and for such insurance any indemnity shall be payable in a currency freely usable to replace or repair such goods.	Loan Agreement Article IV, Section 4.05 (b)	Complied with.

Covenant	Reference in Loan Agreement	Status of Compliance
41. The Borrower shall maintain, or cause to be maintained records and accounts adequate to identify the goods and services and other items of expenditure financed out of the proceeds of the Loan, to disclose the use thereof in the Project, to record the progress of the Project (including the cost thereof) and to the extent relevant to the Project, to reflect, in accordance with consistently maintained sound accounting principles, the operations and financial condition of MOTCA and the Project Implementing Agencies.	Loan Agreement Article IV, Section 4.06 (a)	Complied with.
42. The Borrower shall enable the Bank's representatives to inspect the Project, the goods financed out of the proceeds of the Loan, and any relevant records and documents.	Loan Agreement Article IV, Section 4.08	Complied with.
43. The Borrower shall ensure that the Project facilities are operated, maintained and repaired in accordance with sound administrative, financial, engineering, environmental, tourism development, conservation, civil aviation, training and maintenance and operational practices.	Loan Agreement Article IV, Section 4.09	Complied with.
Particular Covenants in the Project Agreement between ADB and CAAN		
44. CAAN shall maintain, or cause to be maintained, records and accounts to identify the goods and services and other items of expenditure financed out of the proceeds of the Loan, to disclose the use thereof in the Project, to record the progress of the Project (including the cost thereof) and to reflect, in accordance with consistently maintained sound accounting principles, its operation and financial condition.	Project Agreement Article II, Section 2.06	Partly complied with. CAAN did not submit audited financial statements for FY2000/2001 and FY2001/2002.
45. CAAN shall furnish to the Bank all such reports and information as the Bank shall reasonably request concerning (i) the Loan and the expenditure of the proceeds thereof; (ii) the goods and services and other items of expenditure financed out of such proceeds; (iii) the Project; (iv) the administration, operation and financial condition of CAAN; and (v) any other matters relating to the purposes of the Loan.	Project Agreement Article II, Section 2.08 (a)	Partly complied with.
46. CAAN shall (i) maintain separate accounts for the Project and for its overall operations; (ii) have such accounts and related financial statements (balance sheet, statement of income and expenses, and related statements) audited annually, in accordance with appropriate auditing standards consistently applied, by independent auditors whose qualifications, experience and terms of reference are acceptable to the Bank; and (iii) furnish to the Bank, promptly after their preparation but in any event not later than 9 months after the close of the fiscal year to which they relate, certified copies of such audited accounts and financial statements and the	Project Agreement Article II, Section 2.09 (a)	Partly complied with. CAAN did not submit audited financial statements for FY2000/2001 and FY2001/2002.

Covenant	Reference in Loan Agreement	Status of Compliance
report of the auditors relating thereto (including the auditor's opinion on the use of the Loan proceeds and compliance with the covenants of the Loan Agreement) all in the English language. CAAN shall furnish to the Bank such further information concerning such accounts and financial statements and the audit thereof as the Bank shall from time to time reasonably request. 47. CAAN shall enable the Bank, upon the Bank's request, to discuss CAAN's financial statements and its financial affairs from time to time with CAAN's auditors, and shall authorize and require any representative of such auditors to participate in any such discussions requested by the Bank, provided that any such discussion shall be conducted only in the presence of an authorized officer of CAAN unless CAAN shall otherwise agree.	Project Agreement Article II, Section 2.09 (b)	Partly complied with.

ADB = Asian Development Bank, BME = benefit monitoring and evaluation, CAAN = Civil Aviation Authority of Nepal, DCA = Department of Civil Aviation, DOT = Department of Tourism, KMTNC = King Mahendra Trust for Nature Conservation, MLD = Ministry of Local Development, MOTCA = Ministry of Tourism and Civil Aviation, NGO = nongovernmental organization, NTB = Nepal Tourism Board, PEA = project executing agency, PEC = Pokhara Environment Committee, PIU = project implementation unit, PMU = project management unit, PSC = project steering committee, PSM = Pokhara Sub-Metropolis, PVTDC = Pokhara Valley Tourism Development Committee, RSDC = Rural Self-Reliance Development Center, TD = technical division.

ECONOMIC ANALYSIS

1. The potential realization of economic benefits varies significantly across project components. All physical works under the Manaslu ecotourism development component were completed on schedule. However, the realization of project impacts is significantly delayed due to political instability in the region. Nevertheless, since 1997, tourist arrivals into the area have increased by 39%. The King Mahendra Trust for Nature Conservation (KMTNC) reports that tourism revenues (excluding permit fees levied by the Government) have increased by 84.6%. Increasing the duration of stay, tourists' daily spending, and reducing deforestation by introducing alternative energy were all objectives of the Project, but no data was available to quantify such benefits.

Table A6.1: Manaslu Tourism Statistics

Year	1997	1998	1999	2000	2001	2002	2003	2004
Tourism Revenue	0	0	0	762,100	741,000	178,000	1,069,000	1,407,000
Tourist visits	491	756	620	617	798	428	645	682

Source: King Mahendra Trust for Nature Conservation and Ministry of Culture, Tourism and Civil Aviation.

2. The Pokhara environmental improvements component has yet to deliver substantial economic benefits. Annual tourist arrivals in Pokhara have decreased by 5.4% (Table A6.2). The appraisal report estimated that the average length of stay in Pokhara in 1994 was 3 days. Current data from the Pokhara Tourist Office suggest that the average length of stay in Pokhara in 2004 was 2 days. No accurate data was available to verify whether the average spend per day for tourists in Pokhara has changed.

Table A6.2: Pokhara Tourist Visits

Year	1997	1998	1999	2000	2001	2002	2003	2004
Tourist Visits	92,717	103,895	105,546	95,095	77,853	50,533	59,435	87,693

Source: Ministry of Culture, Tourism and Civil Aviation.

3. Drainage improvements have significantly reduced flooding in Pokhara. The appraisal report estimated that the annual cost of flood damage, prior to the Project, was $330,000. Road improvements will cause savings in vehicle maintenance and reduce traffic congestion. However, these benefits cannot be quantified accurately.

4. Benefits from improved solid waste and septage management are yet to be realized. Completion of the waste site and septage management facility were significantly delayed. The waste site, although operational since July 2005, has not generated any revenue, and if not managed effectively, will not deliver the planned environmental and economic benefits. The septage management facility and septage cleanout trucks are not being utilized, and the issues and economic costs related to poor septage management are largely unchanged. Several households and businesses have diverted sewerage lines into the newly constructed storm water drains, which will result in significant contamination of Phewa Lake. The septic tank improvement program only reached 165 households (instead of 5,000 estimated at appraisal). The benefits of that subcomponent are negligible. If not remedied soon, the overall investment in environment improvement in Pokhara will largely be wasted.

5. The domestic airport upgrading component was the most successful. Despite initial delays, all airport upgrading components were completed in a timely manner (see

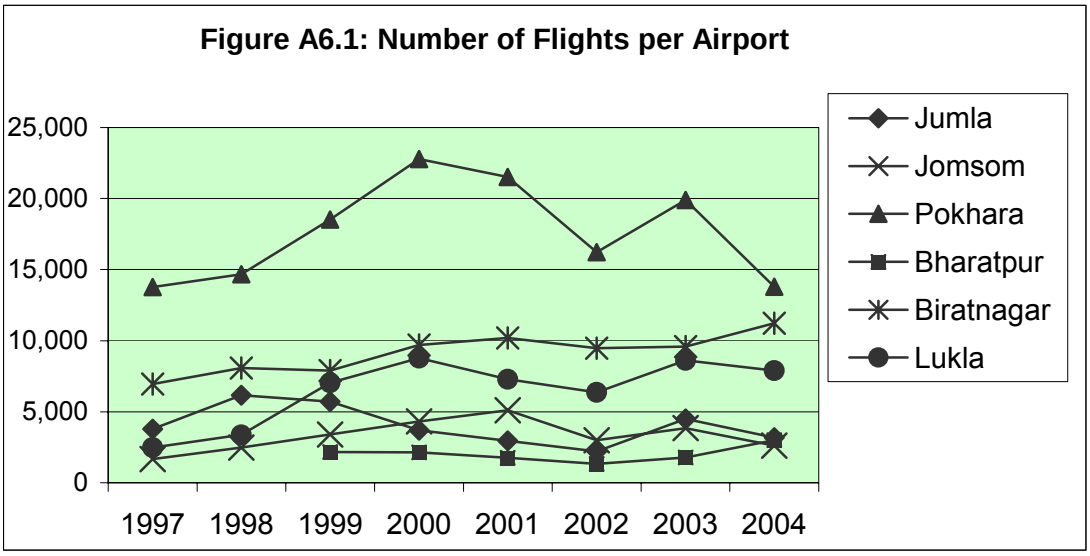
Appendix 4). The performance of the upgraded airports, overall, are positive. The total number of flights to the six airports under the Project has increased by 45% since appraisal. This is most notably driven by the 218% increase in traffic to Lukla. Flights to Pokhara have remained flat, while flights to Jumla have decreased by 16.3%.

6. Passenger volume through the upgraded airports has increased 23% since appraisal. Again, Lukla has demonstrated the most significant improvement, with a 102.7% increase, followed by Jumla at 91.4%. Overall cargo volume transported through the upgraded airports has increased by 211.4% since appraisal. Once again, this increase is largely driven by Lukla. Data and trends of airport usage are in Tables A6.2, A6.3, and A6.4.

7. The appraisal report estimated the benefits of airport upgrading would include increased length of stay, increased spend per day, and reduced cost of transport of essential goods, among other indicators. No data was available order to accurately quantify all these benefits. However, an economic reevaluation was conducted using conservative assumptions.

8. The economic internal rate of return (EIRR) calculation assumes that 10% of the incremental passengers at the upgraded airports are tourists. The average length of stay in the region of the upgraded airport, which does not come at the expense of a stay elsewhere, is assumed to be 5 days. (The average length of stay for visitors, nationally, was 13.51 days in 2004.) The tourism benefit (both direct and indirect) from the incremental tourist stays is assumed to be $10 per day, although the actual average income per visitor per day Nepal-wide was $45.1. Twenty percent of this incremental value is assumed to be attributable to the Project. Financial values were converted to economic values using a standard conversion factor of 0.9. Passenger volume and airport revenue growth assumptions are outlined in the financial analysis (Appendix 7). Based on the above assumptions, the EIRR of the airport upgrading component is calculated to be 18.96%.

9. Values that are not captured in the analysis include the benefit to airlines from increased capacity, reduced aircraft maintenance, and faster flight turnaround. Other benefits—such as reduced injury and loss of life due to accidents; increased access to remote communities for health, education, and social welfare; and savings due to increased efficiency in transport of essential cargo—were not included. The summary EIRR calculations are shown in Table A6.5.

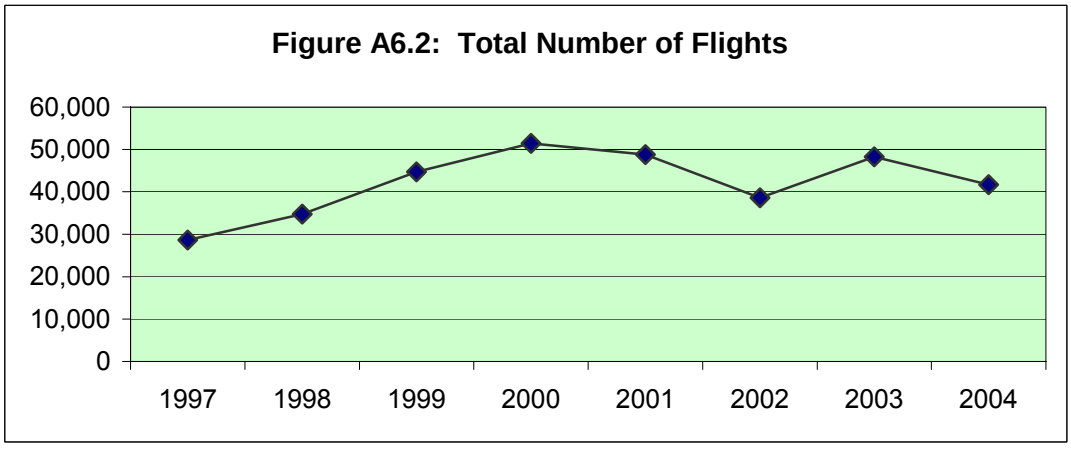


Sources: Civil Aviation Authority of Nepal and Integrated Research Application and Development Consultant's Report.

Table A6.3: Number of Flights per Airport

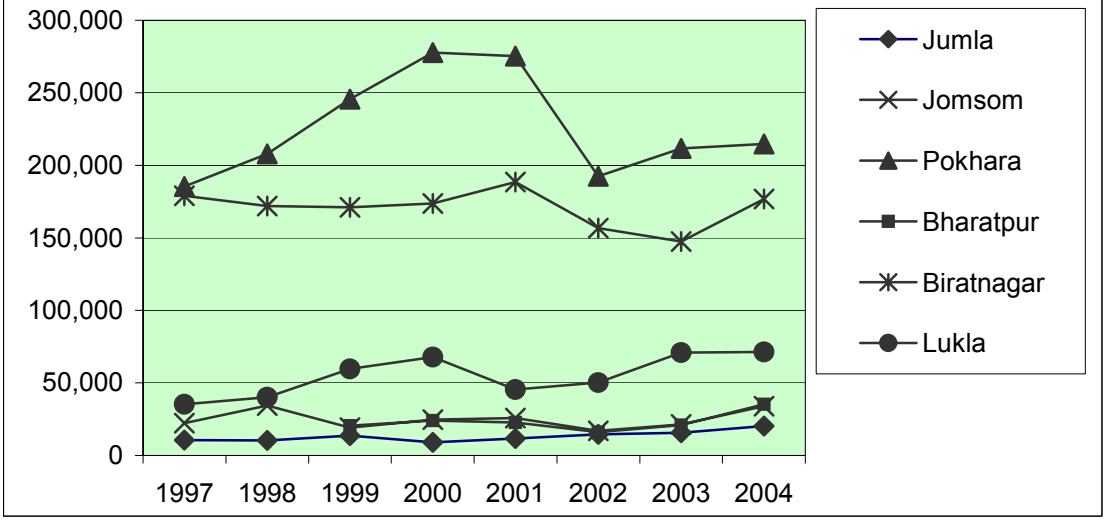
Airport	1997	1998	1999	2000	2001	2002	2003	2004	Percent Increase Since Appraisal
Jumla	3,784	6,170	5,710	3,684	2,946	2,208	4,496	3,168	(16.3)
Jomsom	1,656	2,476	3,406	4,317	5,104	2,988	3,852	2,610	57.6
Pokhara	13,761	14,671	18,512	22,775	21,511	16,216	19,887	13,795	0.2
Bharatpur			2,158	2,132	1,756	1,322	1,776	2,982	38.2
Biratnagar	6,946	8,086	7,890	9,689	10,198	9,472	9,582	11,233	61.7
Lukla	2,482	3,372	7,036	8,774	7,284	6,370	8,616	7,892	218.0
Total	**28,629**	**34,775**	**44,712**	**51,371**	**48,799**	**38,576**	**48,209**	**41,680**	**45.6**

Sources: Civil Aviation Authority of Nepal and Integrated Research Application and Development Consultant's Report.



Sources: Civil Aviation Authority of Nepal and Integrated Research Application and Development Consultant's Report.

Figure A6.3: Number of Passengers per Airport



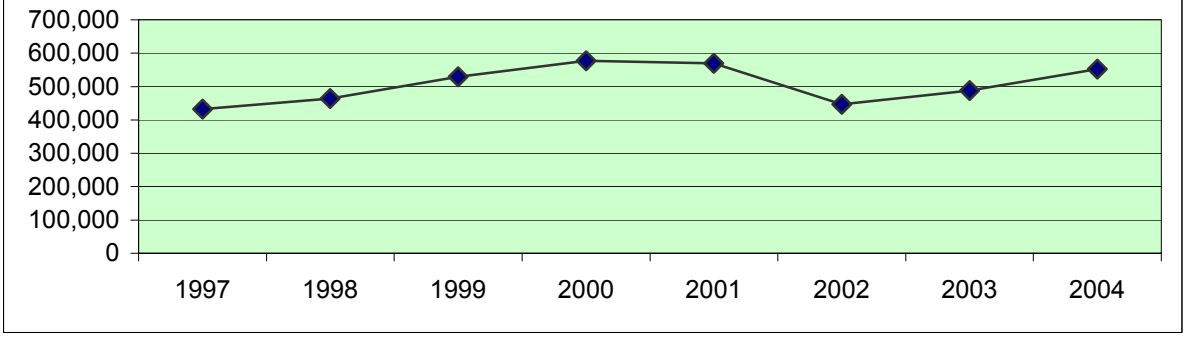
Sources: Civil Aviation Authority of Nepal and Integrated Research Application and Development Consultant's Report.

Table A6.4: Number of Passengers per Airport

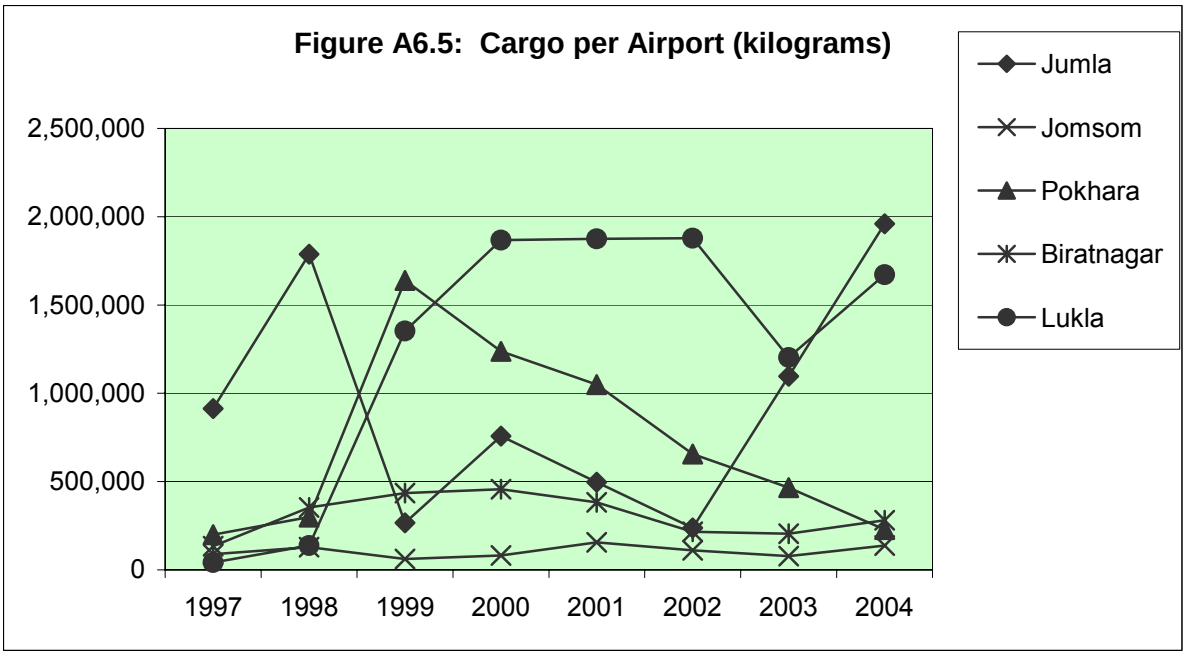
Airport	1997	1998	1999	2000	2001	2002	2003	2004	Percent Increase Since Appraisal
Jumla	10,550	10,309	13,680	8,969	11,740	14,510	15,695	20,193	91.4
Jomsom	22,323	34,440	19,174	24,755	25,682	17,029	21,489	33,836	51.6
Pokhara	185,388	207,874	245,575	277,704	275,383	192,374	211,671	214,645	15.8
Bharatpur			20,496	24,087	22,618	15,995	20,911	35,265	72.1
Biratnagar	17,9007	17,1825	17,1066	173,658	188,517	156,807	147,485	176,839	(1.2)
Lukla	35,243	40,020	59,628	67,969	45,453	50,360	70,959	71,422	102.7
Total	**432,511**	**464,468**	**529,619**	**577,142**	**569,393**	**447,075**	**488,210**	**552,200**	**27.7**

Sources: Civil Aviation Authority of Nepal and Integrated Research Application and Development Consultant's Report.

Figure A6.4: Total Number of Passengers



Sources: Civil Aviation Authority of Nepal and Integrated Research Application and Development Consultant's Report.

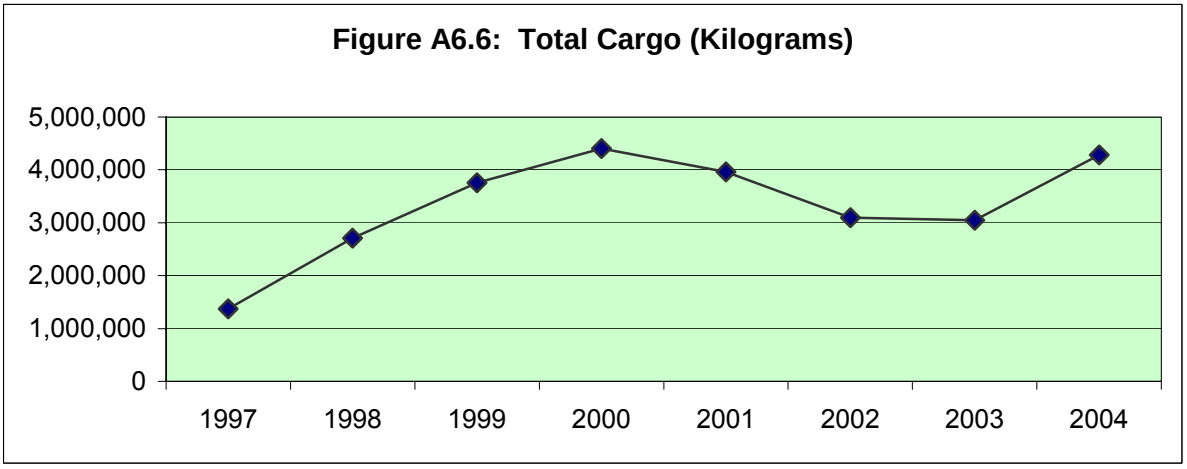


Sources: Civil Aviation Authority of Nepal and Integrated Research Application and Development Consultant's Report.

Table A6.5: Cargo per Airport
(Kilograms)

Airport	1997	1998	1999	2000	2001	2002	2003	2004	Percent Increase Since Appraisal
Jumla	912,300	1,788,427	267,083	756,880	496,707	236,534	1,096,749	1,960,366	1,14.9
Jomsom	88,000	129,405	62,018	81,254	155,901	111,025	77,312	138,198	57.0
Pokhara	198,837	298,717	1,639,027	1,236,459	1,049,459	656,548	465,252	227,645	14.5
Biratnagar	133,451	354,130	434,443	456,645	382,422	214,845	204,079	281,623	111.0
Lukla	42,010	137,910	1,353,340	1,868,247	115,447	301,880	1,203,000	1,672,606	3,881.4
Total	**1,374,598**	**2,708,589**	**3,755,911**	**4,399,485**	**2,199,936**	**1,520,832**	**3,046,392**	**4,280,438**	**211.4**

Sources: Civil Aviation Authority of Nepal and Integrated Research Application and Development Consultant's Report.



Sources: Civil Aviation Authority of Nepal and Integrated Research Application and Development Consultant's Report.

Table A6.6 Economic Internal Rate of Return Calculation

Year	Incremental Passengers	Incremental Airport Revenue	Incremental Tourism Benefit	Capital Cost	Incremental O&M	Incremental Benefit	Terminal Value	Total Incremental Benefit
1999	—	—	—	(170,268)	—	(170,268)		(170,268)
2000	—	10,850	—	(170,268)	3,377	(156,041)		(156,041)
2001	—	31,639	—	(170,268)	(5,923)	(144,553)		(144,553)
2002	—	23,126	—	—	(4,702)	18,424		18,424
2003	—	27,790	—	—	(4,937)	22,853		22,853
2004	—	18,399	—	—	(5,184)	13,215		13,215
2005	5,522	32,454	5,522	—	(5,443)	32,533		32,533
2006	11,651	34,814	11,651	—	(5,715)	40,750		40,750
2007	18,439	37,336	18,439	—	(6,001)	49,774		49,774
2008	25,937	40,032	25,937	—	(6,301)	59,668		59,668
2009	38,968	43,251	38,968	—	(6,616)	75,603		75,603
2010	83,306	48,837	83,306	—	(8,874)	123,270		123,270
2011	130,305	54,759	130,305	—	(11,245)	173,819		173,819
2012	180,123	61,036	180,123	—	(13,734)	227,425		227,425
2013	232,930	67,690	232,930	(180,000)	(16,349)	104,272		104,272
2014	288,906	74,743	288,906	—	(19,093)	344,556		344,556
2015	348,240	82,219	348,240	—	(21,975)	408,484		408,484
2016	411,135	90,144	411,135	—	(25,002)	476,277		476,277
2017	477,803	98,544	477,803	—	(28,179)	548,168		548,168
2018	548,471	107,448	548,471	—	(31,515)	624,404		624,404
2019	623,379	116,887	623,379	—	(35,018)	705,248		705,248
2020	702,782	126,891	702,782	—	(38,697)	790,977		790,977
2021	786,949	137,496	786,949	—	(42,559)	881,887		881,887
2022	800,000	139,141	800,000	—	(42,559)	896,582		896,582
2023	800,000	139,141	800,000	—	(42,559)	896,582		896,582
2024	800,000	139,141	800,000	—	(42,559)	896,582	1,073,134	1,969,716

O&M = operation and maintenance.

EIRR 18.96%

Assumptions:

1. Ten percent of the incremental passengers are tourists.
2. Average length of stay in the area of the upgraded airport, which does not come at the expense of a stay elsewhere, is 5 days.
3. The tourism benefit, per incremental tourist day (both direct and indirect), is $10.
4. Twenty percent of the incremental tourist benefit is attributable to the Project.
5. Financial values have been converted to economic values using a standard conversion factor of 0.9.
6. Passenger volume and airport revenue growth assumptions are outlined in Appendix 7.

Sources: Civil Aviation Authority of Nepal and Integrated Research Application and Development Consultant's Report.

FINANCIAL ANALYSIS

1. The financial internal rate of return (FIRR) for the domestic airports upgrading component was recalculated to assess the financial impact of the Project.[1] The analysis covers 25 years with a base year of 1999, when construction began. Airport revenues are derived primarily from airport taxes; aircraft parking fees, concession rentals, and other sources account for the rest. The growth in passenger volume is used as the basis for estimating revenues. The terminal value of the Project in 2024 is assumed to be an annuity of the projected 2025 income, discounted at 10%. Summary revenue and expenditure data for the upgraded airports are in Table A7.1. The basic data for the financial analysis was provided by Integrated Research Application and Development (IRAD) and the Civil Aviation Authority of Nepal (CAAN).

2. The FIRR of the domestic airport upgrading component is estimated to be 11.82%. Financial projections and calculations of FIRR are summarized in Tables A7.2, A7.3, and A7.4.

3. In the with Project scenario (Table A7.2), passenger volume and annual revenue up to 1996 are based on actual data. It is assumed that passenger volume will grow at 6% per year from 2005 onward, until maximum capacity is reached. The maximum passenger throughput capacity for the six upgraded airports is assumed to be 1.5 million passengers per year. Revenue per passenger is assumed to remain constant at NRs127 (US$1.82). Actual operation and maintenance (O&M) data was only available up to 2002. O&M costs are assumed to increase by 5% per year, up to 2021, when maximum passenger throughput capacity is achieved. It is also assumed that the subsidiary loan from The Government to CAAN has principal of NRs491,981 million (US$7,053), a grace period of 3 years, interest rate of 10.25%, and repayment period of 15 years, beginning 2005.[2] A capital expenditure of NRs200 million is assumed for 2013 for resealing and resurfacing runways.

4. In the without Project scenario (Table A7.3), passenger volume and annual revenue up to 1996 are based on actual data provided by CAAN and IRAD. It is assumed that passenger volume would have grown at approximately the same rate with project scenario during this period. Passenger volume is assumed to increase by 5% per year from 2005 onwards, until an estimated maximum capacity (without improvements) of 700,000 passengers per year is achieved. Revenue per passenger is assumed to remain constant at NRs61.05 (US$0.88), the 1999 level. O&M costs are assumed to increase by 5% per year, up to 2009, when maximum passenger throughput capacity is achieved.

[1] Pokhara is not generating any significant increase in revenue as of 2005. The FIRR of the Manaslu ecotourism development component cannot be calculated based on the data available.

[2] Based on data from IRAD and the 2004 CAAN annual report.

Table A7.1: Summary Financial Data for Upgraded Airports
(NRs '000)

Item	1998	1999	2000	2001	2002	2003	2004
Revenue							
Baratpur	861	1,520	2,242	2,321	1,589	3,169	3,455
Biratnagar	6,503	10,544	14,563	19,897	17,624	18,236	28,644
Jomsom	358	974	2,821	5,129	4,021	7,481	3,676
Lukla	513	1,630	3,184	7,366	6,322	6,930	
Pokhara	8,442	16,898	26,621	35,710	25,042	29,081	26,963
Jumla	325	765	832	1,690	1,329	1,283	1,406
Total revenue	**17,002**	**32,332**	**50,263**	**72,113**	**55,929**	**66,179**	
Compound annual growth rate	*31.23%*						
O&M Expenditures							
Baratpur	801	2,318	2,198	3,886	2,669		
Biratnagar	3,063	8,291	7,983	11,264	12,931		
Jomsom	344	1,287	1,299	2,307	2,374		
Lukla	374	1,087	1,226	2,677	2,298		
Pokhara	1,093	6,190	6,820	10,453	11,434		
Jumla	290	1,110	1,244	1,505	1,260		
Total O&M expenditure	**5,965**	**20,283**	**20,770**	**32,092**	**32,966**		
Operating Income							
Baratpur	60	(798)	44	(1,565)	(1,079)		
Biratnagar	3,440	2,254	6,581	8,633	4,693		
Jomsom	14	(312)	1,522	2,822	1,647		
Lukla	139	543	1,958	4,689	4,024		
Pokhara	7,349	10,707	19,801	25,257	13,608		
Jumla	35	(345)	(412)	185	69		
Total Operating Income	**11,037**	**12,050**	**29,493**	**40,021**	**22,962**		

Compound Annual Growth Rate 20.10%

Sources: Civil Aviation Authority of Nepal and Integrated Research Application and Development Consultant's Report.

Table A7.2: Financial Projections (With Project Scenario)

(NRs '000)

Year	Passengers	Revenue/ passenger	Revenue	Capital Cost	O&M	Loan Inflow	Loan Payments	CAAN's Net Benefit	Terminal Value	Total Benefit
1999	529,619	79.14	41,915	(189,187)	(26,294)	163,994		(9,573)		(9,573)
2000	577,142	100.03	57,731	(189,187)	(23,856)	163,994		8,682		8,682
2001	565,765	141.28	79,929	(189,187)	(35,571)	163,994		19,165		19,165
2002	439,820	137.56	60,503		(35,663)			24,840		24,840
2003	488,210	142.39	69,515		(37,446)			32,070		32,070
2004	552,200	116.16	64,145		(39,318)			24,827		24,827
2005	585,332	140.00	81,946		(41,284)		(65,608)	(24,946)		(24,946)
2006	620,452	140.00	86,863		(43,348)		(65,608)	(22,093)		(22,093)
2007	657,679	140.00	92,075		(45,516)		(65,608)	(19,049)		(19,049)
2008	697,140	140.00	97,600		(47,791)		(65,608)	(15,800)		(15,800)
2009	738,968	140.00	103,456		(50,181)		(65,608)	(12,334)		(12,334)
2010	783,306	140.00	109,663		(52,690)		(65,608)	(8,636)		(8,636)
2011	830,305	140.00	116,243		(55,325)		(65,608)	(4,690)		(4,690)
2012	880,123	140.00	123,217		(58,091)		(65,608)	(482)		(482)
2013	932,930	140.00	130,610	(200,000)	(60,995)		(65,608)	(195,993)		(195,993)
2014	988,906	140.00	138,447		(64,045)		(65,608)	8,793		8,793
2015	1,048,240	140.00	146,754		(67,247)		(65,608)	13,898		13,898
2016	1,111,135	140.00	155,559		(70,610)		(65,608)	19,341		19,341
2017	1,177,803	140.00	164,892		(74,140)		(65,608)	25,144		25,144
2018	1,248,471	140.00	174,786		(77,847)		(65,608)	31,330		31,330
2019	1,323,379	140.00	185,273		(81,740)		(65,608)	37,925		37,925
2020	1,402,782	140.00	196,390		(85,827)			110,563		110,563
2021	1,486,949	140.00	208,173		(90,118)			118,055		118,055
2022	1,500,000	140.00	210,000		(90,118)			119,882		119,882
2023	1,500,000	140.00	210,000		(90,118)			119,882		119,882
2024	1,500,000	140.00	210,000		(90,118)			119,882	1,198,822	1,318,704

CAAN = Civil Aviation Authority of Nepal, O&M = operations and maintenance.

Assumptions:

1. The Government subsidiary loan to the CAAN has principal of NRs491.981 million, grace period of 3 years, interest rate of 10.25%, and repayment period of 15 years.
2. Capital expenditures and disbursements for airport upgrading were distributed equally over the 3-year duration of civil works.
3. Passenger volume grows at a rate of 6% per year from 2005 onwards, until a capacity of 1.5 million is reached.
4. Revenue per passenger will remain constant at NRs127 from 2005 onwards.
5. O&M expense will grow at 5% per year until maximum passenger capacity is reached.
6. Estimated refurbishment expenditures for the six airports in 2013 are NRs200 million.
7. Terminal value is calculated as an annuity of projected 2025 net income, discounted at 10%.
8. Historic nominal values are converted to real 2004 values.

Sources: Civil Aviation Authority of Nepal and Integrated Research Application and Development Consultant's Report.

Table A7.3: Financial Projections (Without Project Scenario)

(NRs '000)

Year	Passengers	Revenue per Passenger	Revenue	Capital Cost	O&M	Loan Inflow	Loan Payments	CAAN's Net Benefit	Terminal Value	Total Benefit
1999	529,619	79.14	41,915		(26,294)			15,621		15,621
2000	577,142	79.14	45,676		(27,609)			18,067		18,067
2001	565,765	79.14	44,775		(28,989)			15,786		15,786
2002	439,820	79.14	34,808		(30,439)			4,369		4,369
2003	488,210	79.14	38,638		(31,961)			6,677		6,677
2004	552,200	79.14	43,702		(33,559)			10,143		10,143
2005	579,810	79.14	45,887		(35,237)			10,650		10,650
2006	608,801	79.14	48,181		(36,998)			11,183		11,183
2007	639,241	79.14	50,590		(38,848)			11,742		11,742
2008	671,203	79.14	53,120		(40,791)			12,329		12,329
2009	700,000	79.14	55,399		(42,830)			12,569		12,569
2010	700,000	79.14	55,399		(42,830)			12,569		12,569
2011	700,000	79.14	55,399		(42,830)			12,569		12,569
2012	700,000	79.14	55,399		(42,830)			12,569		12,569
2013	700,000	79.14	55,399		(42,830)			12,569		12,569
2014	700,000	79.14	55,399		(42,830)			12,569		12,569
2015	700,000	79.14	55,399		(42,830)			12,569		12,569
2016	700,000	79.14	55,399		(42,830)			12,569		12,569
2017	700,000	79.14	55,399		(42,830)			12,569		12,569
2018	700,000	79.14	55,399		(42,830)			12,569		12,569
2019	700,000	79.14	55,399		(42,830)			12,569		12,569
2020	700,000	79.14	55,399		(42,830)			12,569		12,569
2021	700,000	79.14	55,399		(42,830)			12,569		12,569
2022	700,000	79.14	55,399		(42,830)			12,569		12,569
2023	700,000	79.14	55,399		(42,830)			12,569		12,569
2024	700,000	79.14	55,399		(42,830)			12,569	125,688	138,257

CAAN = Civil Aviation Authority of Nepal, O&M = Operations and maintenance.

Assumptions:

1. Passenger volume from 1999 through 2004 would have been similar to the actual figures.
2. Passenger volume grows at a rate of 5% per year from 2005 onwards, until a capacity of 700,000 is reached.
3. Revenue per passenger would have remained unchanged from 1999 onwards.
4. O&M expense grows at 5% per year until maximum capacity is reached.
5. Terminal value is calculated as an annuity of projected 2025 net income, discounted at 10%.
6. Historic nominal values are converted to real 2004 values.

Sources: Civil Aviation Authority of Nepal and Integrated Research Application and Development Consultant's Report.

Table A7.4: Financial Internal Rate of Return Calculation

Year	Incremental Passengers	Incremental Revenue per	Incremental Revenue	Capital Cost	Incremental O&M	Loan Inflow	Loan Payments	Incremental Benefit	Terminal Value	Total Incremental Benefit
1999	—	—	—	(189,187)	-	163,994	—	(25,193)		(25,193)
2000	—	21	12,055	(189,187)	3,753	163,994	—	(9,385)		(9,385)
2001	—	62	35,154	(189,187)	(6,582)	163,994	—	3,379		3,379
2002	—	58	25,695	—	(5,224)	—	—	20,471		20,471
2003	—	63	30,878	—	(5,485)	—	—	25,393		25,393
2004	—	37	20,443	—	(5,760)	—	—	14,684		14,684
2005	5,522	61	36,059	—	(6,047)	—	(65,608)	(35,596)		(35,596)
2006	11,651	61	38,682	—	(6,350)	—	(65,608)	(33,276)		(33,276)
2007	18,439	61	41,485	—	(6,667)	—	(65,608)	(30,791)		(30,791)
2008	25,937	61	44,480	—	(7,001)	—	(65,608)	(28,129)		(28,129)
2009	38,968	61	48,057	—	(7,351)	—	(65,608)	(24,903)		(24,903)
2010	83,306	61	54,264	—	(9,860)	—	(65,608)	(21,204)		(21,204)
2011	130,305	61	60,844	—	(12,494)	—	(65,608)	(17,259)		(17,259)
2012	180,123	61	67,818	—	(15,261)	—	(65,608)	(13,051)		(13,051)
2013	232,930	61	75,211	(200,000)	(18,165)	—	(65,608)	(208,562)		(208,562)
2014	288,906	61	83,048	—	(21,215)	—	(65,608)	(3,775)		(3,775)
2015	348,240	61	91,355	—	(24,417)	—	(65,608)	1,329		1,329
2016	411,135	61	100,160	—	(27,779)	—	(65,608)	6,772		6,772
2017	477,803	61	109,493	—	(31,310)	—	(65,608)	12,575		12,575
2018	548,471	61	119,387	—	(35,017)	—	(65,608)	18,762		18,762
2019	623,379	61	129,874	—	(38,909)	—	(65,608)	25,356		25,356
2020	702,782	61	140,990	—	(42,996)	—	—	97,994		97,994
2021	786,949	61	152,774	—	(47,288)	—	—	105,486		105,486
2022	800,000	61	154,601	—	(47,288)	—	—	107,313		107,313
2023	800,000	61	154,601	—	(47,288)	—	—	107,313		107,313
2024	800,000	61	154,601	—	(47,288)	—	—	107,313	1,073,134	1,180,447

O&M = operations and maintenance.

FIRR 11.82%

Assumptions:

See assumptions under with Project and without Project scenarios.

Sources: Civil Aviation Authority of Nepal and Integrated Research Application and Development Consultant's Report.

ANALYSIS OF INSTITUTIONAL STRENGTHENING, ENVIRONMENTAL, AND OTHER IMPACTS

A. Institutional Strengthening

1. Institutional strengthening was a critical and central component to the success of the Project. At appraisal, it was recognized that the capacity of the Implementing Agencies was weak and needed strengthening, particularly the Pokhara Sub-Metropolis (PSM). Provision was included in the Project for consulting services to assist in institutional strengthening and capacity building. However, PSM failed to take full advantage of this provision. Consequently, at the end of the implementation period, PSM's Technical Division lacked the necessary expertise to properly manage, operate, and maintain the waste management facility. It is under staffed and current staff lack the skills necessary to carry out tasks related to the waste management systems, implementation of the land use plan, and maintenance of drainage facilities in Pokhara. Urgent action is required to correct this deficiency.

B. Drainage Improvements

2. Improvements of urban roads and drainage in Pokhara have reduced flooding. Almost all roadside drains improved under the Project are covered, and discharge into the Seti River and other local streams (such as Phirke) or into Phewa Lake. Only one out of four planned sedimentation basins was constructed at the discharge point at Hallan Chowk near Phewa Lake. The other discharge points continue to deposit sediments in the lake. Another concern is the lack of cleaning and maintenance of the sedimentation basins, which will soon make them ineffective or nonfunctional. In addition, in many places (such as the lakeside and Chipledunga area), septic tank outlets or direct sanitary waste are illegally connected to the covered roadside drains, bypassing septic tanks. This means that they discharge sewage into storm drains and then Phewa Lake or rivers/streams. The washing facility built near the lake does not have any treatment facility. Pokhara Municipality has not started effective collection and safe disposal of septage as of October 2005. Some private sector operators provide septic tank cleanout services but septage is haphazardly disposed of in unidentified locations, probably into local streams. All these activities continue to pollute the lake and rivers/streams. Therefore, it is concluded that the Project has not made a significant difference in abating pollution of the lake and rivers/streams in and around Pokhara.

C. Airport Upgrading

3. Upgrading the airports has not resulted in any significant, adverse environmental impacts as they were small-scale improvements of existing airport facilities. For the people of Jumla, Jomsom, and Lukla, which are remote and devoid of road or other modern means of transport, the improved airport is helping tourism and provides a more convenient and reliable way to connect to the rest of the country. Construction of the drainage channel (Basta Nala) at Biratnagar airport protected the airport from flooding and helped protect agricultural land north of the airport from being flooded during monsoon. However, maintenance of the drainage channel is lacking. Upgrading of Biratnagar and Pokhara airports made it possible for larger aircraft to operate from these facilities.

D. Manaslu Ecotourism Component

4. Although it was not possible to visit the Manaslu Conservation Area,[1] it is expected that provision of kerosene depots and construction of micro-hydro plants will have positively contributed to conservation by saving the forest in the area.

E. Noise

5. Construction activities caused some disturbances (such as noise and dust pollution). For example, construction of roadside drains and improvements of urban roads in Pokhara caused temporary inconvenience to the movement of people and vehicles during implementation. Construction activities in the hills (such micro-hydro, trail upgrading, and airport terminal construction) may have contributed to increased soil erosion and slope instability during construction. However, all these were minor and temporary in nature and are no longer a concern.

F. Land Acquisition

6. Land acquisition was not necessary, except for the construction of the terminal building at Lukla airport and waste disposal facility at Pokhara. The Government formally acquired the land for the Lukla terminal building following approved the land acquisition and compensation procedures. The encroached settlers at Pokhara landfill site were convinced by the municipality and local administration to leave the public land. No resettlement was required under the Project.

[1] Due to prevailing political instability and security concerns in the region.

OVERALL PROJECT RATING

Table A9.1. Assessment of the Pokhara Environmental Improvement Component (Part A)

Criterion	Assessment	Rating (0–3)	Weight (%)	Weighted Rating
Relevance	Relevant	2	20	0.4
Efficacy	Inefficacious	0	25	0.0
Efficiency	Inefficient	0	20	0.0
Sustainability	Less Likely	1	20	0.2
Institutional Development and Other Impacts	Negligible	0	15	0.0
				0.6 Partly Successful

Table A9.2. Assessment of the Ecotourism Component in Manaslu Conservation Area (Part B)

Criterion	Assessment	Rating	Weight (%)	Weighted Rating
Relevance	Relevant	2	20	0.4
Efficacy	Efficacious	2	25	0.5
Efficiency	Efficient	2	20	0.4
Sustainability	Likely	2	20	0.4
Institutional Development and Other Impacts	Moderate	2	15	0.3
				2.0 Successful

Taable A9.3. Assessment of the Domestic Airports Upgrading Component (Part C)

Criterion	Assessment	Rating	Weight (%)	Weighted Rating
Relevance	Relevant	2	20	0.40
Efficacy	Highly Efficacious	3	25	0.75
Efficiency	Efficient	2	20	0.40
Sustainability	Likely	2	20	0.40
Institutional Development and Other Impacts	Moderate	2	15	0.30
				2.25 Successful

Table A9.4. Cost per component

Component	Cost (NRs)	Proportion
Part A	503,548,993	44.02%
Part B	72,853,957	6.37%
Part C	567,561,172	49.61%
Total:	**1,143,964,122**	**100.00%**

Source: Project management unit accounts, Ministry of CTCB

Table A9.5 Overall rating based on proportion of the Project:

Component	Individual Rating	Proportion	Weighted Proportion
Part A	0.6	44.02%	0.26
Part B	2.00	6.37%	0.13
Part C	2.25	49.61%	1.12
		Total	**1.51**
			Partly Successful

Overall rating:	
HS = highly successful	2.5 < HS ≤ 3.0
S = successful	1.6 ≤ S ≤ 2.5
PS = partially successful	0.6 ≤ LS < 1.6
U = unsuccessful	< 0.6

Table A9.6. Rating of each component by criterion:

Component	Relevance	Efficacy	Efficiency	Sustainability	Institutional
Part A	2.00	0.00	0.00	1.00	0.00
Part B	2.00	2.00	2.00	2.00	2.00
Part C	2.00	3.00	2.00	2.00	2.00
Overall	**2.00**	**1.62**	**1.12**	**1.56**	**1.12**
Assessment:	**Relevant**	**Efficacious**	**Less Efficient**	**Likely**	**Little**

Assessment Ratings:
Relevance: 3 = highly relevant, 2 = relevant, 1 = partly relevant, 0 = irrelevant.
Efficacy: 3 = highly efficacious, 2 = efficacious, 1 = less efficacious, 0 = inefficacious
Efficiency: 3 = highly efficient, 2 = efficient, 1 = less efficient, 0 = inefficient.
Sustainability: 3 = most likely, 2 = likely, 1 = less likely, 0 = unlikely.
Institutional Development and Other Impacts: 3 = substantial, 2 = moderate, 1=little, 0 = negligible.

Engineered Reed Bed Treatment System as a Low Cost Sanitation Option for the Philippines

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Introduction

Degradation of water quality in urban areas is mainly attributed to the indiscriminate disposal of domestic wastewater. More than 90% of the sewage generated all over the Philippines is not disposed or treated in an environmentally acceptable manner. Moreover, only one percent of the produced contaminated wastewater is being treated nationwide. This predicament is a constant threat to the local populace, the environment and an immense financial burden to the struggling economy.

The sanitation and sewerage sector in the Philippines, which so far may be considered as underdeveloped, is in great need of technology transfer and financing. Estimates show that the national sanitation coverage declined dramatically from 74.9% in 1991 to 69.4% in 1998[1]. Attempts to provide low-cost technologies for local government units were initiated as early as the 70's through clustered household and cheap collection systems that led to partial treatment through communal septic tanks. Solutions considered these days are mainly in the construction of conventional or centralised sewer treatment plants, with high cost for the construction of collection systems, operating and maintenance costs. These systems are feasible and can be justified only in highly populated cities, but neither in suburban nor rural areas. One possible approach to these areas is the construction of low cost sanitation facilities like an **engineered reed bed treatment system**, with low construction and maintenance costs. Although this innovative technique is accepted worldwide and proven efficient, such a solution is practically unknown in the Philippines until today.

The use of Natural Systems in the treatment of liquid wastes has been getting substantial attention in many environmental conferences and fora.[2] The use of plants, water and soil in a composite unit generally called a wetland has been applied in many areas and applications from domestic to industrial waste sources. Other terms which refer in part or in general to natural treatment systems include; Land Treatment, Phytoremediation, constructed wetland, etc. The realization of the importance of wetlands, which ecologists often refer to as "nature's kidneys" for their water cleansing capacity, has grown since the 1960s. The interest in this new and emerging field of Environmental Studies has led to a deeper understanding of the mechanisms and issues involved in its use. A significant and promising facet of this technology is the low energy requirement in its application.

Project Partners

[1] UNDP Philippines Country Study on Meeting the MDG (March 2002)
[2] Wetlands and Remediation. Second International Conference. Sept. 5-6, 2001. Burlington Vermont

During the last three decades, the German government, through the German Agency for Technical Cooperation (GTZ), has supported economic and social development in the Philippines. One of GTZ's focal sectors is Water, Sanitation and Solid Waste Management. Complemented by the wide experience of several parent sector projects, the GTZ Water Program pioneered the philosophy of ecological sanitation (ecosan), which mainly supports the implementation of innovative options for low-cost rural water supply and sanitation that includes dry sanitation systems, constructed wetlands, decentralized wastewater treatment systems, biogas technology and rainwater harvesting. In general, the advisory services offered by Program on all its intervention levels fall on the context of Integrated Water Resources Management.

GTZ has forged a partnership with competent and experienced academic institutions, namely the University of the Philippines Environmental Engineering Unit and the UFZ Centre for Environmental Research Leipzig-Halle of Germany, to implement the first Vertical Flow Reed Bed System in the City of Bayawan, Negros Oriental Province. This project is currently being implemented through a participatory approach, where the main stakeholders are involved in planning, design, and construction as well as in the operational phase. The plant shall serve as a pilot measure to demonstrate the applicability and efficiency of engineered reed beds as a low-cost alternative technology for wastewater treatment.

GTZ likewise has a standing cooperation agreement with ADB under the "Development of Poor Urban Communities Sector Project (DPUCSP)." Within the framework of DPUCSP, the GTZ Water Program shall promote low-cost technologies for sanitation and wastewater treatment. The potential for upscaling and replicating the technology to other DPUCSP sites is essentially a primary interest of the cooperation.

Description of the Technology

Natural Treatment Systems

A natural treatment system would refer to any unit process, which would involve water, soil, plants, microorganisms and interaction with the atmosphere. If we remove the plants from this equation, then this would refer to any of the conventional biological treatment systems we are familiar with. The addition of plants in this stoichiometry would therefore differentiate it from other systems. In an effort to apply rigidity to the study of this field of Environmental Engineering, different authors have come up with classifications for the different processes under the general label of "natural treatment systems". We can generally classify them according to the following headings, namely (a) Aquatic Treatment Units; (b) Wetland Treatment Units; and (c) Terrestrial Treatment

Natural treatment systems, specifically constructed wetlands, provide a good and robust solution for the rising wastewater problem in the Philippines. Compared to common treatment facilities, wetlands are lower in cost investment, lesser to maintain, and are ideal for densely populated rural or suburban areas.

Engineered Reed Beds

Wetland systems have been used in many applications including treatment of domestic wastewater, septage, highly concentrated organic wastes from food industries, metal processing wastes, and as a polishing step for secondary treatment systems before final

discharge. Engineered Reed Beds are sub-surface flow systems that use reeds in densely planted beds as a treatment system.

In Europe, the concept and application of constructed wetlands is generally different from those that exist in North America and Australasia. In Europe, natural treatment systems such as reed beds are designed to provide secondary treatment for village sized communities of up to 1000 population equivalent.; while in North America, they are designed for tertiary treatment of larger populations. Another difference is that in Europe, the systems are nearly always specifically excavated and planted, whereas in America they are often created from existing natural wetlands.[3]

The use of reeds for the treatment of sewage was first investigated in Germany by Seidel and Kickuth in the 1960's. Since then, about 500 reed bed treatment systems have been constructed in Western Europe since 1984. In general, the experiences gained in the years since, show that BOD (Biochemical Oxygen Demand) removal is 80 to 90%, with typical outlet concentrations of 20 ppm; total N removal is 20 to 30%; and total P removal is 30 to 40%. A general problem is surface flow of the feed caused by the hydraulic load exceeding the permeability of the bed. It is important to note that the pre-engineering of reed bed treatment systems is critical. These systems are not flexible in terms of adjusting to excessive load.

Mechanisms for Engineered Reed Beds

In the case of Engineered Reed Bed Systems, rhizodegradation is the main mechanism for the removal of organic contaminant. Rhizofiltration explains the retention of inorganic contaminants in the reed bed. The reeds which are used for reed bed construction are rhizome bearing macrophytes. These structures in the root system or rhizosphere provide the microenvironment for aerobic and anaerobic degradation of various compounds. Together with the root exudates from the reeds, a unique environment for degradation is produced. The other mechanisms also come into play in varying degrees. These mechanisms give the reed bed system a distinct advantage over other conventional biological systems in the degradation and stabilization of recalcitrant compounds and difficult-to-biodegrade or persistent compounds, which are often also toxic compounds.

The advantages of Engineered Reed Treatment Systems include (a) minimal operating cost due to low energy required; (b) possible treatment solution for the removal of recalcitrant compounds; and (c) possible treatment solution for very small flows, previously untreated.

Practical Applications of Engineered Reed Beds in the Philippines

Detergent Wastewater

A pilot reed bed for research purposes was constructed by the University of the Philippines in Nasugbu, Batangas. Wastewater from a laundry service was treated in this bed. The main contaminant was surfactants. The observed removal efficiency approached 90%. A 5 day retention time was used and measured through tracer studies.

[3] P.F Cooper. The Use of Reed Bed Systems to Treat Domestic Sewage: The European Design and Operations Guidelines for Reed Bed Treatment Systems. CRC Press. 1993

The research also involved the comparison between *Phragmytes karka* and *Phragmytes australis.* It was observed that *Phragmytes karka* performed better in the comparison trials. The removal efficiency and consistency of performance was better for *karka.* [4]

Distillery Slops

An engineered reed bed system for the treatment of alcohol distillery waste is presently operated in Nasugbu, Batangas. The main contaminant of concern in alcohol production is the compound Melanoidin, which results from the Maillard reaction between sugars and amines upon heating. It has a complex polymeric structure whose molecular size is affected by pH and temperature.[5] Melanoidin would then refer to a family of highly colored compounds generated during the alcohol production process. Conventional treatment methods do not provoke the breakdown of this colored substance. Reed bed treatment systems offer a possible treatment method for melanoidin contaminated wastewater. The combined aerobic and anaerobic structure of the rhizosphere of the bed gives it a higher capability to handle the recalcitrant melanoidin.

Housing Resettlement (On-going Project)

The Fishermen's Village is one of the major projects undertaken by the City of Bayawan that aims to provide a decent and low-cost shelter to beneficiaries affected by the Coastal Bay Development Project. The housing relocation site is accessible to the source of livelihood of the fishermen who composed more than 50% of the informal settlers along 4 coastal barangays. A total of 715 households will be resettled in the 7.4-hectare relocation village. An engineered reed bed treatment system is under construction for the said village. This system uses two reed bed systems in series, a vertical reed bed followed by a horizontal flow reed bed. The use of a vertical reed bed will enhance disinfection and removal of nutrients Nitrogen and Phosphorus.

With the implementation of the Philippine Clean Water Act, highly urbanized communities and rural villages are required to connect to available sewerage systems for the treatment of their generated wastewater. Considering the financial constraints for local government units to access or construct conventional treatment systems, the application of engineered reed beds are deemed appropriate.

Benefits and Expected Results

Costs and Energy

Aside from the intrinsic attraction of the "naturalness" or back-to-nature approach of these systems, one major advantage of natural treatment systems is the low operational costs due to the low energy requirements in operating and maintaining the system. Mechanical Aeration is not necessary and is substituted by plant respiration. Initial capital costs for the construction of the system would be comparable with any of the conventional systems. A drawback of natural treatment systems is the need for extensive land area. This may vary from 1 – 5 m^2 per person served. There is also the need to isolate the system from the surrounding environment. This would mean the

[4] Mark T.Q. Mulingbayan. Treatment of Laundry Wastewater using Horizontal Flow Engineered Reed Beds. Masters Thesis. University of the Philippines. College of Engineering. 2005

[5] Ernesto J. del Rosario. Chemical and Microbial Decolorization of molasses-derived melanoidin. Kimika. 9: 65-72 . 1993

need for an impermeable barrier such as plastic or clay lining. Once the system has been built though, the operational costs are substantially lower than conventional systems such as a comparable Activated Sludge Plant.

Sustainable System Operation and Maintenance
The operation and maintenance of engineered reed beds are inherently simple and inexpensive. If the site topography permits, gravity flow through the system affords a no-cost operation of the system. The system is remarkably low maintenance since the reeds are not cut nor trimmed. In cases where the site topography is flat, a pump may be needed to provide a lift to the liquid.

The operation and maintenance of the engineered reed bed encourages the participation of the local community, which could work in 2 models; namely through a Barangay Council or through a Resident's Association.

O&M through a Barangay Council. The community directly benefiting from the reed bed system can assign properly trained staff to take turns in ensuring the proper functioning and maintenance of the treatment facility. Since this task will require only part-time work from the staff, this may easily be absorbed by the current plantilla of the barangay.

O&M through a Residents' Association. A team of trained staff from the residents association may be tasked to manage the operation, maintenance and tariff collection of the treatment facility. The monthly salary of the staff may be sourced from the dues the residents pay on a yearly basis. Alternately, it may also be sourced from an added tariff attached to the water bill or solid waste collection bill of the community.

It is estimated that when the system is properly functioning, the time required for daily inspection would only take half an hour.

Lessons Learned

Treatment of Wastewater using Engineered Reed Bed Systems has been demonstrated in the Philippines (Nasugbu, Batangas) using the Horizontal Flow System and planted with *Phragmytes karka* and *Phragmytes australis*. The efficiency of the system was demonstrated using surfactant contaminated laundry wastewater. In other countries, the use of this system has been demonstrated for domestic wastewater treatment. The application of this system in the Philippines may be more efficient due to higher ambient temperatures, which means faster metabolic rates of microbial systems in the rhizosphere. The first such system will be built in the city of Bayawan, Negros Oriental, for a community of 700 households living in government supported low cost housing.

Appendix

References

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3. Mark T.Q. Mulingbayan. Treatment of Laundry Wastewater using Horizontal Flow Engineered Reed Beds. Masters Thesis. University of the Philippines. College of Engineering. 2005
4. Ernesto J. del Rosario. Chemical and Microbial Decolorization of molasses-derived Melanoidin. Kimika. 9: 65-72 . 1993

Supporting Information

1. Abstract of paper

Mark T.Q. Mulingbayan. Treatment of Laundry Wastewater using Horizontal Flow Engineered Reed Beds. Masters Thesis. University of the Philippines. College of Engineering. 2005

The removal of chemical oxygen demand (COD) and anionic surfactants (as linear alkylbenzene sulfonates, or LAS) from commercial laundry wastewater in horizontal subsurface flow constructed treatment wetlands was investigated in two pilot-scale reedbeds planted with two species of the common reed, *Phragmites australis* and *Phragmites karka*, in four experimental runs at varying hydraulic gradients and theoretical hydraulic retention times (HRT). In one run, a dye tracer test using Rhodamine WT was performed for both reedbeds to compare the theoretical and actual HRT.

The COD and surfactants removal efficiencies of the *P. karka* reedbed ranged from 76.8% to 85.6%, and 90.1% to 91.9%, respectively, slightly better than that of the *P. australis* bed with removal efficiencies of 74.8% to 81.82% for COD and 86.6% to 90.9% for surfactants, for theoretical HRT's of 4 to 5 days.

The dye tracer breakthrough curve generated in one of the runs showed the actual HRT to be shorter than the theoretical hydraulic retention time as derived from hydraulic gradient and estimated permeability using grain size distribution data, due to clogging of the inlet and surface tracking, typical of soil-based reedbeds fed with significant quantities of suspended solids and organic load.

From a maintenance point of view, *P. karka* proved to be the more resilient species, but due to its larger aboveground biomass, takes up more water than P. australis, and may be disadvantageous if water recovery for reuse is a priority.

2. Photo Log of Reed Bed Trials

Figure 3-1 Construction of reedbeds, showing elevations of the floor. The outlet zone is in the foreground.

Figure 3-2 Laser-level equipment used to ensure proper elevations during construction.

Figure 3-3 The reedbeds after HDPE-liner installation, before placement of soil media.

Fig. 4-__ Immediately after planting Dec 2001

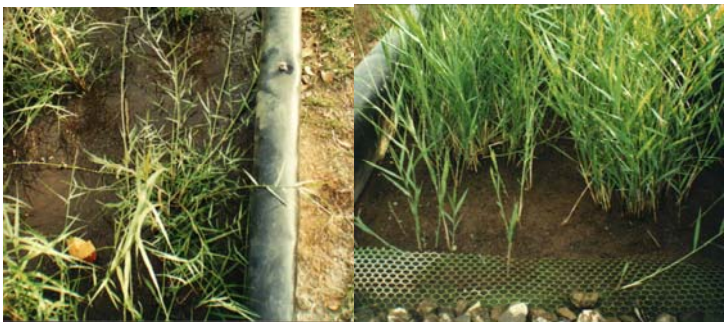

Figure 4-__ Comparative growth spread mechanisms. P. karka (left) sends aboveground stems on the surface which grow shoots, while P. australis (right) sends underground rhizomes and new shoots erupt away from the mother plant.

Fig. 4-____ Between Dec 2001 and Aug 2002

Fig 4-__. August 2002.

Fig. 4-___. November 2002. Reeds fully mature

3. Results of Dye Tracer Studies

The dye tracer test was performed in February2005, midway during the third experimental run. Trace amounts of Rhodamine WT were detected prior to pulse feeding due to a past attempt at a dye tracer trial in the previous month using only 100 mg of RWT dye. These levels were found to be negligible and were expected to be depleted in time. The amount of Rhodamine WT used for the February 2005 trial was 1,000 mg active ingredient per bed.

The breakthrough curve for both beds manifested an early peak followed by a long declining tail, indicating an almost plug flow condition with considerable dispersion, validating reported dye tracer response curve behavior described in numerous literature. (See Figure 4-2)

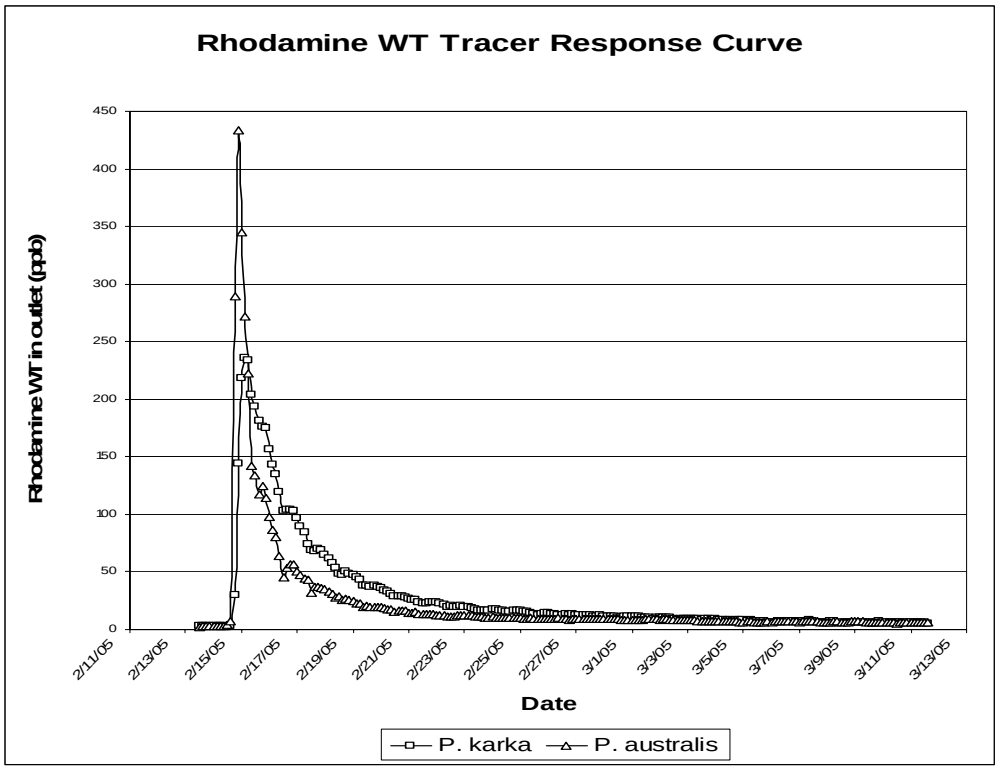

Figure 4-2. Dye Tracer Response Curve

Mechanisms for Contaminant Removal

To explain the effectiveness of using plants in the removal of various contaminants, it is important to know the different possible mechanisms involved for contaminant removal or stabilization[6]. The following mechanisms explain the process of contaminant removal.

1. Phytoextraction

2. Phytostabilization

3. Phytodegradation

4. Phytovolatilization

5. Rhizofiltration – refers to the adsorption or precipitation onto plant roots or absorption into roots of contaminants that are in solution surrounding the root zone, due to biotic or abiotic processes. Plant uptake, concentration, and translocation might occur, depending on the contaminant. Rhizofiltration first results in contaminant containment, in which the contaminants are immobilized or

[6] Introduction to Phytoremediation. USEPA. National Risk Management Research Laboratory, Cincinnati, Ohio 45268. February 2000

accumulated on or within the plant. Contaminants are then removed by physically removing the plant.

6. Rhizodegradation – refers to the breakdown of an organic contaminant in soil through microbial activity that is enhanced by the presence of the root zone.

7. Rhizodegradation is also known as plant assisted degradation, plant-assisted bioremediation, plant aided in-situ biodegradation, and enhanced rhizosphere biodegradation. Root zone biodegradation is the mechanism for rhizodegradation. Root exudates are compounds produced by plants and released from plant roots. They include sugars, amino acids, organic acids, fatty acids, sterols, growth factors, nucleotides, flavanones, enzymes and other compounds. The microbial populations and activity in the rhizosphere can be increased due to the presence of these exudates, and can result in increased organic contaminant biodegradation in the soil. Additionally, the rhizosphere substantially increases the surface area where active microbial degradation can be stimulated. Degradation of the exudates can lead to cometabolism of contaminants in the rhizosphere. Plant roots can affect soil conditions by increasing soil aeration and moderating soil moisture content, thereby creating conditions more favorable for biodegradation by indigenous microorganisms. Thus, increased biodegradation could occur even in the absence of root exudates. One study raised the possibility that transpiration due to alfalfa plants drew methane from a saturated methanogenic zone up into the vadose zone, there the methane was used by methanotrophs that cometabolically degraded TCE.

The principles behind the removal process are the following:

1. The root system of the reeds grows vertically and horizontally, opening up the bed to provide a hydraulic pathway.
2. Within the rhizosphere (the small area surrounding the rhizomes), large populations of common and unique, aerobic and anaerobic bacteria reside, which effect the biological breakdown of the organic components of the wastewater.
3. It has been claimed that oxygen is passed to the rhizosphere via the leaves and stems of the reeds through the hollow rhizomes and out through the roots to provide some of the oxygen needed by the aerobic bacteria. The rate at which this occurs has not yet been determined.
4. Suspended solids in the sewage are aerobically composted in the layer above-ground of straw debris formed from dead leaves and stems.

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The Way Forward
19-20 September 2005, ADB, Manila
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Selections From
PRESIDENTIAL DECREE NO. 1152
[PHILIPPINE ENVIRONMENT CODE][1]

WHEREAS, the broad spectrum of environment has become a matter of vital concern to the government;

WHEREAS, the national leadership has taken a step towards this direction by creating the National Environment Protection Council under Presidential Decree No. 1121;

WHEREAS, it is necessary that the creation of the Council be complemented with the launching of a comprehensive program of environmental protection and management;

WHEREAS, such a program can assume tangible and meaningful significance only by establishing specific environment management policies and prescribing environment quality standards in a Philippine Environment Code.

NOW, THEREFORE, I, Ferdinand E. Marcos, President of the Republic of the Philippines, by virtue of the powers vested in me by the Constitution, do hereby order and decree:

Section 1
Short Title

This decree shall be known and cited as *"The Philippine Environment Code."*

TITLE II
WATER QUALITY MANAGEMENT
Section 14
Purpose

It is the purpose of this Title to prescribe management guidelines aimed to protect and improve the quality of Philippine water resources through:
a. classification of Philippine waters;

b. establishment of water quality standards;

c. protection and improvement of the quality of Philippine water resources; and

d. responsibilities for surveillance and mitigation of pollution incidents.

Chapter I
Classification Standards
Section 15
Classification of Philippine Waters

The National Pollution Control Commission, in coordination with appropriate government agencies, shall classify Philippine waters, according to their best usage. In classifying said waters, the National Pollution Control Commission shall take into account, among others, the following:
a. the existing quality of the body of water at the time of classification;

b. the size, depth, surface area covered, volume, direction, rate of flow, gradient of stream; and

[1] http://www.chanrobles.com/pd1152.htm#PD1152

c. the most beneficial uses of said bodies of water and lands bordering them for residential, agricultural, commercial, industrial, navigational, recreational, and aesthetic purposes.

Section 16
Reclassification of Waters Based on Intended Beneficial Use

Where the public interest so requires, the National Pollution Control Commission, in coordination with appropriate government agencies, shall reclassify a body of water based on the intended beneficial use and take such steps as may be necessary to upgrade the quality of said water. Other government agencies may adopt higher standards for a particular body of water, subject to the approval of the National Pollution Control Commission.

Section 17
Upgrading of Water Quality

Where the quality of water has deteriorated to a degree where its state will adversely affect its best usage, the government agencies concerned shall take such measures as may be necessary to upgrade the quality of such water to meet the prescribed water quality standards.

Section 18
Water Quality Standards

The National Pollution Control Commission shall prescribe quality and effluent standards consistent with the guidelines set by the National Environmental Protection Council and the classification of waters prescribed in the preceding sections, taking into consideration, among others, the following:

a. the standard of water quality or purity may vary according to beneficial uses; and

b. the technology relating to water pollution control.

Chapter II
Protection and Improvement of Water Quality
Section 19
Enforcement and Coordination

The production, utilization, storage and distribution of hazardous, toxic and other substances such as radioactive materials, heavy metals, pesticides, fertilizers, and oils, and disposal, discharge and dumping of untreated wastewater, mine-tailings and other substances that may pollute any body of water of the Philippines resulting from normal operations of industries, water-borne sources, and other human activities, as well as those resulting from accidental spills and discharges shall be regulated by appropriate government agencies pursuant to their respective charters and enabling legislations. In the performance of the above functions, the government agencies concerned shall coordinate with the National Environmental Protection Council and furnish the latter with such information as may be necessary to enable it to attain its objectives under Presidential Decree No. 1121.

Section 20
Clean-up Operations

It shall be the responsibility of the polluter to contain, remove and clean-up water pollution incidents at his own expense. In case of his failure to do so, the government agencies concerned shall undertake containment, removal and clean-up operations and expenses incurred in said operations shall be charged against the persons and/or entities responsible for such pollution.

Section 21
Water Quality Monitoring and Surveillance

The various government agencies concerned with environmental protection shall establish to the greatest extent practicable a water quality surveillance and monitoring network with sufficient stations and sampling schedules to meet the needs of the country. Said water quality surveillance network shall put to maximum use the capabilities of such government agencies. Each agency involved in such network shall report to the National Environment Protection Council the results of these monitoring activities as the need arises.

TITLE IV
NATURAL RESOURCES MANAGEMENT AND CONSERVATION
Section 25
Purposes

The purpose of this Title are:

a. to provide the basics on the management and conservation of the country's natural resources to obtain the optimum benefits therefrom and to preserve the same for the future generations; and

b. to provide general measures through which the aforesaid policy may be carried out effectively.

Chapter VI
Conservation and Utilization of Surface Ground Waters
Section 39
Management Policy

In addition to existing laws, the national government through the National Water Resources Council in coordination with other appropriate government agencies, shall prescribe measures for the conservation and improvement of the quality of Philippine water resources and provide for the prevention, control and abatement of water pollution.

TITLE V
WASTE MANAGEMENT
Section 42
Purposes

The purposes of this Title are:
a. to set guidelines for waste management with a view to ensuring its effectiveness;

b. to encourage, promote and stimulate technological, educational, economic and social efforts to prevent environmental damage and unnecessary loss of valuable resources of the nation through recovery, recycling and re-use of wastes and waste products; and

c. to provide measures to guide and encourage appropriate government agencies in establishing sound, efficient, comprehensive and effective waste management.

Chapter I
Enforcement and Guidelines
Section 43
Waste Management Programs

Preparation and implementation of waste management programs shall be required for all provinces, cities and municipalities. The Department of Local Government and Community

Development shall promulgate guidelines for the formulation and establishment of waste management program.

Every waste management program shall include the following:

a. an orderly system of operation consistent with the needs of the area concerned;

b. a provision that the operation will not create pollution of any kind or will constitute public nuisance;

c. a system for safe and sanitary disposal of waste;

d. a provision that existing plans affecting the development, use and protection of air, water or natural resources shall be considered;

e. schedules and methods of implementing the development, construction and operation of the plan together with the estimated costs; and

f. a provision for the periodic revision of the program to ensure its effective implementation.

Section 44
Responsibility of Local Government

Each province, city or municipality shall provide measures to facilitate collection, transportation, processing and disposal of waste within its jurisdiction in coordination with other government agencies concerned. For this purpose, the national government shall provide the necessary subsidy to local governments upon request made through the National Environmental Protection Council and subject to such terms and conditions as the latter may provide.

Chapter II
Methods of Solid Waste Disposal
Section 45
Solid Waste Disposal

Solid waste disposal shall be by sanitary landfill, incineration, composting, and other methods as may be approved by competent government authority.

Section 46
Sanitary Landfills

Local governments, including private individuals, corporations or organizations may operate or propose to operate one or more sanitary landfills. An entity proposing to operate a sanitary landfill shall submit to the appropriate government agency an operational work plan showing, among other things, a map of the proposed work location, disposal areas for rubbish, garbage, refuse and other waste matter; and the equipment or machinery needed to accomplish its operations. In no case shall land-fill or work locations under this Section be located along any shore or coast-line, or along the banks of rivers and streams, lakes, throughout their entire length, in violation of any existing rules and regulations.

Section 47
Incineration and Composting Plants

The installation and establishment of incineration or composting plants, or the alteration/modification of any part thereof shall be regulated by the local governments concerned

in coordination with the National Pollution Control Commission.

Section 48
Disposal Sites

The location of solid waste disposal sites shall conform with existing zoning, land use standards, and pollution control regulations.

Section 49
Dumping into the Sea and Other Navigable Waters

The dumping or disposal of solid wastes into the sea and any body of water in the Philippines, including shore-lines and river banks, where the wastes are likely to be washed into the water is prohibited. However, dumping of solid wastes or other materials into the sea or any navigable waters shall be permitted in case of immediate or imminent danger to life and property, subject to the rules and regulations of the Philippine Coast Guard and the National Pollution Control Commission.

Government agencies and private entities which are undertaking solid waste management programs shall make consultations with the government agencies concerned with respect to the effects of such dumping to the marine environment and navigation.

Chapter III
Methods of Liquid Waste Disposal
Section 50
Liquid Waste Disposal

Wastewater from manufacturing plants, industries, community, or domestic sources shall be treated either physically, biologically or chemically prior to disposal in accordance with the rules and regulations promulgated by proper government authority.

Section 51
Applicability of Section 49

The provisions of Section 49 hereof shall likewise apply to the dumping or disposal of liquid waste into the sea and other bodies of water.

TITLE VI
MISCELLANEOUS PROVISIONS
Section 52
Population Environment Balance

In the assessment of development projects, the National Environmental Protection Council, hereinafter referred to in this Title as the Council, shall take into consideration their effect on population with a view to achieving a rational and orderly balance between man and his environment.

Section 53
Environment Education

The Department of Education and Culture shall integrate subjects on environmental education in its school curricula at all levels. It shall also endeavor to conduct special community education emphasizing the relationship of man and nature as well as environmental sanitation and practices.

The Council and other government agencies implementing environmental protection laws in coordination with public information agencies of the government shall undertake public

information activities for the purpose of stimulating awareness and encouraging involvement in environmental protection.

Section 54
Environmental Research

The Council shall undertake and/or promote continuing studies and research programs on environmental management and shall, from time to time, determine priority areas of environmental research.

Section 55
Monitoring and Dissemination of Environmental Information of Foreign Origin

The Council shall keep itself informed of current environmental developments by obtaining information and literature from foreign sources through the Department of Foreign Affairs, government agencies and other entities, both domestic and foreign. Such information and literature shall be given the widest dissemination possible.

Section 56
Incentive

To operate the installation and the utilization of pollution control facilities, the following incentives are hereby granted:

a. exemption to the extent of fifty (50) percent of tariff duties and compensating tax for importation of pollution control equipment, devices, spare parts and accessories for a period of five (5) years from the effectivity of this Decree subject to the conditions that will be imposed by the Council;

b. a tax credit equivalent of fifty (50) percent of the value of the compensating tax and tariff duties that would have been paid on the pollution control equipment, devices, spare parts and accessories had these items been imported shall, within a period of seven (7) years from the effectivity of this Decree, be given to the person or firm who or which purchases them from a domestic manufacturer, and another tax credit equivalent to twenty-five (25) percent thereof shall be given to said manufacturer, subject to such conditions as may be imposed by the Council; and

c. deductions equivalent to fifty (50) percent of the expenses actually incurred on research projects undertaken to develop technologies for the manufacture of pollution control equivalent which have been proven effective and commercially reproducible, from the taxable income of the person or firm actually undertaking such projects subject to the conditions that may be imposed by the Council.

The pollution control equipment, devices, spare parts and accessories acquired under this Section shall not be sold, transferred or disposed within five (5) years from the date of acquisition without the prior approval of the Council otherwise the importer or purchaser shall pay twice the amount of the tax exemption or tax credit granted.

Section 57
Financial Assistance/Grant

Financial assistance/grant for the study, design and construction of environmental protection facilities especially for waste disposal in favor of cities, municipalities, small and medium scale industries may be granted on a case-to-case basis subject to such conditions as may be imposed by the Council.

Section 58
Participation of Local Government Units
and Private Individuals

It shall be the responsibility of local government units as well as private individuals to actively participate in the environmental management and protection programs of the government.

Section 59
Preservation of Historic
and Cultural Resources and Heritage

It shall be the duty of every person to help preserve the historic and cultural resources of the country such as sites, structures, artifacts, documents, objects, memorials, and priceless trees.

Section 60
Government Offices Performing
Environmental Protection Functions

Government agencies vested by laws to exercise environmental management powers, shall continue to function as such within their respective jurisdictions. The Council may, however, in the exercise of its powers and functions under Presidential Decree No. 1121, inquire into any action or issue of environmental significance.

Section 64
Effectivity

This Code shall take effect upon its approval.

Done in the City of Manila, this 6th day of June, the year of our Lord, nineteen hundred and seventy-seven.

Approved: June 6, 1977

PRESIDENTIAL DECREE NO. 1151
[PHILIPPINE ENVIRONMENTAL POLICY][1]

WHEREAS, the individual and, at times, conflicting demands of population growth, urbanization, industrial expansion, rapid natural resources utilization and increasing technological advances have resulted in a piece meal approach concept of environmental protection;

WHEREAS, such tunnel-vision concept is not conducive to the attainment of an ideal environmental situation where man and nature can thrive in harmony with one another; and

WHEREAS, there is now an urgent need to formulate an intensive, integrated program of environmental protection that will bring about a concerted effort towards the protection of the entire spectrum of the environment through a requirement of environmental impact assessments and statements;

NOW, THEREFORE, I, Ferdinand E. Marcos, President of the Philippines, by virtue of the powers vested in me by the Constitution, do hereby order and decree:

Section 1
Policy

It is hereby declared a continuing policy of the State:
a. to create, develop, maintain, and improve conditions under which man and nature can thrive in productive and enjoyable harmony with each other;

b. to fulfill the social, economic and other requirements of present and future generations of Filipino; and

c. to insure the attainment of an environmental quality that is conducive to a life of dignity and well-being.

Section 2
Goal

In pursuing this policy, it shall be the responsibility of the Government, in cooperation with concerned private organizations and entities, to use all practicable means, consistent with other essential considerations of national policy, in promoting the general welfare to the end that the Nation may
a. recognize, discharge and fulfill the responsibilities of each generation as trustee and guardian of the environment for succeeding generations;

b. to assure the people of a safe, decent, healthful, productive and aesthetic environment;

c. encourage the widest exploitation of the environment without degrading it, or endangering human life, health and safety or creating conditions adverse to agriculture, commerce and industry;

d. preserve important historic and cultural aspects of the Philippine heritage;

e. attain a rational and orderly balance between population and resource use; and

f. improve the utilization of renewable and non-renewable resources.

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[1] http://www.chanrobles.com/pd1151.htm#PD1151

Section 3
Right to a Healthy Environment

In furtherance of these goals and policies, the Government recognizes the right of the people to a healthy environment. It shall be the duty and responsibility of each individual to contribute to the preservation and enhancement of the Philippine environment.

Section 4
Environmental Impact Statement

Pursuant to the above enunciated policies and goals, all agencies and instrumentalities of the national government, including government-owned or controlled corporations, as well as private corporations, firms and entities shall prepare, file and include in every action, project or undertaking which significantly affects the quality of the environment a detailed statement on:
a. the environmental impact of the proposed action, project or undertaking;

b. any adverse environmental effect which cannot be avoided should the proposal be implemented;

c. alternative to the proposed action;

d. a determination that the short-term uses of the resources of the environment are consistent with the maintenance and enhancement of the long-term productivity of the same; and

e. whenever a proposal involves the use of depletable or nonrenewable resources, a finding must be made that such use and commitment are warranted.

Before an environmental impact statement is issued by a lead agency, all agencies having jurisdiction over, or special expertise on, the subject matter involved shall comment on the draft environmental impact statement made by the lead agency within thirty (30) days from the receipt of the same.

Section 5
Agency Guidelines

The different agencies charged with environmental protection as enumerated in Letter of Instruction No. 422 shall sixty (60) days from the effectivity of this Decree, submit to the National Environmental Protection Council (NEPC), their respective, guidelines, rules and regulations to carry out the provisions of Section 4 hereof on environmental impact assessments and statements.

Section 6
Repealing Clause

All Acts, Presidential Decrees, executive orders, rules and regulations or parts thereof which are inconsistent with the provisions of this Decree are hereby repealed, amended or modified accordingly.

Section 7
Effectivity

This Decree shall take effect immediately.
Approved: June 6, 1977

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ADB	-	Asian Development Bank
AusAID	-	Australian Agency for International Development
BESP	-	Barangay Environmental Sanitation Plan
BLISS	-	Bagong Lipunan (New Society) Improvements of Site Services
BOD	-	Biochemical Oxygen Demand
BWSA	-	Barangay Water Supply and Sanitation Association
CBD	-	Central Business District
COD	-	Chemical Oxygen Demand
CPSO	-	Central Sanitation/Sewerage Program Support Office
DANIDA	-	Danish International Development Agency
DBM	-	Department of Budget and Management
DENR	-	Department of Environment and Natural Resources
DILG	-	Department of Interior and Local Government
DPWH	-	Department of Public Works and Highways
DOF	-	Department of Finance
DOH	-	Department of Health
EIA	-	Environmental Impact Assessment
ECC	-	Environmental Compliance Certificate
IACEP	-	Inter-Agency Committee on Environment Protection
IBRD	-	International Bank for Reconstruction and Development
IRCWD	-	International Reference Center for Waste Disposal
INFRACOM	-	Infrastructure Committee
JICA	-	Japan International Cooperation Agency
LBP	-	Land Bank of the Philippines
LGU	-	Local Government Unit
LWUA	-	Local Water Utilities Administration
MTPDP	-	Medium Term Philippine Development Plan
MWSS	-	Metropolitan Waterworks and Sewerage System
NAWAPCO	-	National Water and Air Pollution Control Commission
NEDA	-	National Economic and Development Authority
NEPC	-	National Environment Protection Council
NGO	-	Non-Government Organization
NBC	-	National Building Code
NPCC	-	National Pollution Control Commission
NSAP	-	National Strategy and Action Plan
NUSS	-	National Urban Sanitation and Sewerage Strategy
NWRB	-	National Water Resources Board
ODA	-	Official Development Assistance
OECF	-	Overseas Economic Cooperation Fund of Japan
PD	-	Presidential Decree
RA	-	Republic Act
UNEP	-	United Nations Environmental Program
UNDP	-	United Nations Development Program
USAID	-	United States Agency for International Development
WD	-	Water District
WDDP	-	Water District Development Project
WHO	-	World Health Organization
WPEP	-	Water Supply and Sanitation Performance Enhancement Project
WSS	-	Water Supply and Sanitation
WSSSMP	-	Water Supply, Sewerage and Sanitation Master Plan

DEFINITION OF TERMS

Drainage	-	Runoff resulting from rain, also referred to as wet weather flow.
Dry System	-	Toilet facility that does not use water for flushing.
Human Excreta	-	Solid (feces) and liquid (urine) waste from humans
Sanitation Facility	-	A facility that handles and disposes human excreta (and, in many cases, sullage) at the point of origin (on-site) or at a remote location (off-site). Can be dry or wet.
Septage	-	Liquid and solid material in septic tanks or other holding tanks for domestic sewage.
Sewerage System	-	Waterborne system for collection, transportation and treatment and disposal of sewerage or wastewater. Considered off-site.
Sullage	-	Liquid wastes resulting for washing, bathing and laundry.
Wastewater or Sewerage	-	Human excreta and sullage, collectively.
Wet System	-	Toilet facility that utilizes water for flushing. Also known as waterborne facility.

1 BACKGROUND

1.1 The Sewerage and Sanitation Sub-sector

The Philippine sewerage and sanitation sub-sector continues to be plagued by problems, which, unless addressed promptly, can be expected to worsen, hindering social and economic progress. Sewerage and sanitation services are, by and large, still inadequate. Development of the sub-sector has been hindered by poor planning, institutional constraints, lack of political will, and insufficient financial resources.

Existing conditions in the sanitation sub-sector are unsatisfactory. Poor sanitation is a major concern for policy makers and citizens alike, due to its adverse impacts on public health and on public resources required for future development. Substandard sanitation has caused environmental degradation and the spread of disease.

- There is a threat of contamination to water sources, especially in urban centers, where rapidly growing populations and unregulated water consumption increase the chances of groundwater contamination from septic tanks, latrines, and poorly maintained facilities.

- The situation is compounded by failure to implement and enforce existing laws and regulations, uncoordinated planning among government agencies, a general lack of funding, and a citizenry largely unable to afford the capital cost of basic infrastructure, or even operating costs for existing facilities.

- There is a glaring lack of septage removal and treatment capacity nationwide. Only 10 percent of household wastewater is treated and disposed properly, while 90 percent remains a potential source of pollution and a threat to public health.

- The need to strengthen national policy, strategy and operational frameworks for the sub-sector has been acknowledged but insufficiently addressed. Other major constraints are inadequate institutional capabilities of Water Districts (WDs) and local government units (LGUs), and limited availability of funds, partly due to poor cost recovery mechanisms and inadequate operations and maintenance practices.

1.2 Study Objectives and Terms of Reference

The Water Supply and Sanitation Performance Enhancement Project (WPEP) is divided into two phases:

Phase I *Situation analysis*, focusing on the collection and presentation of facts about Urban Sanitation and Sewerage Policies and Experiences in the Philippines.

Phase II: *Analytical framework and targeted research program* on effective urban sewerage and sanitation models and practices.

This research study is Phase I of the WPEP, which aims to produce a comprehensive situation analysis of all significant urban sewerage and sanitation policies and experiences in the Philippines since 1970, identifying high impact opportunities for case studies, field trials, and policy refinement. Briefly, the situation analysis includes:

- an introductory overview of the state of the urban sewerage and sanitation sub-sector, including a review of the Philippines Urban Sewerage and Sanitation: National Strategy and Action Plan (1994), and progress in reaching targets, including investment levels and trends, service coverage gap trends, and investment implications;

- a historical review of all official national and local government urban sewerage and sanitation policies and programs, since 1970, including relevant provisions of the Local Government Code (1991), policies of official development assistance (ODA) agencies, and others;

- a historical review of "unofficial" sewerage and sanitation policies and programs since 1970, including commonplace unofficial LGU assistance programs, non-government organization (NGO) activities, and those of other providers;

- complementary analysis of the development logic behind the policies and programs identified, and how these activities were expected to improve service outcomes;

- a compilation of key urban sewerage and sanitation conditions based on field experiences and practices – the real story of what actually got built, what worked and what did not, and its present state – in the Philippines since 1970;

- commentaries on the development impact of major sewerage and sanitation programs and initiatives since 1970, appreciating the difference between development impact and effective implementation, including a commentary on the lag between water supply expansion and sewerage and sanitation improvements;

- information on the experiences of sewerage and sanitation projects funded solely or substantially by urban LGUs, with a commentary on LGU capacity to exercise devolved responsibilities for urban sewerage and sanitation;

a preliminary assessment outlining potential improvements to urban sewerage and sanitation guidelines and practices, including cost sharing.

2 STATE OF THE SEWERAGE AND SANITATION SUB-SECTOR

2.1 Overview

The population of the Philippines, presently estimated at 75.3 million, has been growing at an annual average rate of 2.03 percent. About 36.7 million, nearly 50 percent, live in urban areas. The trend is very rapid population growth in urban areas. Moreover, economic development in most urban areas throughout the country has been expanding steadily in recent years. This concentration of population in urban areas has resulted in greater demand for basic services, including piped water supply and sanitation.

Provision of water supply and sanitation services in the urban areas, both within and outside Metro Manila, has ranked high among Philippine national government priorities. However, local governments, especially in small urban areas, give top priority to water supply and lesser importance to sanitation projects, particularly sewerage, drainage and solid waste disposal. This divergence reflects the reality that setting up sanitation and sewerage facilities requires substantial initial investment as well as commitment by the members of recipient communities to contribute to the operation and maintenance of these facilities once they are in place. In addition, sanitation facilities require careful planning in order to assess the viability of the investment, and such activities are usually accorded a lower priority by local political leaders than projects with more obvious and immediate benefits. In small urban areas, attention to sanitation has been limited mostly to health education programs emphasizing the close relationship between safe water, proper sanitation, hygiene and wellness.

A study conducted on water supply and sanitation systems in selected small municipalities by a multilateral development agency in 1998 found no public sewerage systems in any of those towns. Based on the study's findings, about 60-65 percent of urban households discharged their wastewater into the street drainage system and 25-30 percent into septic tanks from which wastewater seeped into the ground. Drainage systems

that existed in these areas covered only the town centers. Such systems mainly consisted of open earth canals, with few concrete-lined canals. All drainage canals emptied into rivers and creeks that traverse the towns. The study noted that the main problem in all the municipalities was the lack of a sewerage system and the inadequacy of the drainage system. But the urban areas in the study were too small in size to justify installation of comprehensive conventional sewerage/drainage systems. Local governments in each area surveyed responded similarly to the need for adequate drainage/sewerage and effective garbage collection systems. These LGUs contended projects for appropriate disposal of wastewater and solid waste were unaffordable without subsidies from the central government. In addition, charging service fees to urban residents would take time to implement and likely prove difficult, considering residents' limited ability to pay and their priority for purchasing water supply.

The task of providing water supply and sewerage services in Metro Manila and its contiguous areas is the responsibility of the Metropolitan Waterworks and Sewerage Systems (MWSS). In 1995, its service area covered eight cities and 29 municipalities, with a total population of 10.5 million. However, only about 64 percent of the service area population was actually served because of limited water supply and inadequate distribution facilities. The main problem was non-revenue water (58 percent in 1994, way above the standard acceptable level of 25 percent) and accounts receivable (i.e., low collection efficiency). This situation was reportedly due to an aging distribution system (old and leaking pipes) and the number of illegal water users, growing in tandem with the number of illegal squatters. The cost of mitigating these problems and of improving and expanding water supply services sidetracked development of sanitation projects for almost 30 years.

The Local Water Utilities Administration (LWUA) is responsible for the promotion and provision of water supply and sewerage services in urban centers outside Metro Manila through Water Districts. Areas under its responsibility include some 1,500 cities and municipalities. Other urban areas not covered by LWUA are served by systems owned and operated by local government units or private companies, including subdivision owners and developers. Most water supply operators have concentrated on expanding their service coverage and meeting its deficiencies, rather than providing sanitation facilities.

The development of water supply and sewerage facilities in urban centers outside Metro Manila has been constrained by limited financial resources and inadequate institutional capabilities, particularly in financial management, operations and planning. Although urban water supply organizations, including Water Districts, are required by the government to

be financially independent, most are plagued with inadequate financial capability due to the rapid increase in operating costs compared with revenue, poor collection efficiency, and a high percentage of non-revenue water. Water Districts cannot meet their rising costs for operation and maintenance of water supply systems, let alone for expansion and improvement of services, including the provision of off-site sanitation facilities. Their situation is typical of most urban water supply organizations in developing countries. To support the development of the sub-sector, the central government continues to subsidize capital investment requirements, mostly in the form of equity infusions or grants. Facing myriad demands, national government resources have not been sufficient to meet funding requirements, further hampering development of the sewerage and sanitation sub-sector.

2.2 Evolution of Environmental and Liquid Waste-related Management Programs

Historical: Prior to the 1970s

Statutory provisions on environmental issues in the Philippine legal system date back more than 130 years. The Spanish law on waters of 1866 was extended to the Philippines in 1871 with the following provision: "when an industrial establishment was found after the investigation, to have contaminated the waters with substances or properties noxious to the public health, the Governor General could suspend its operations until the owner adopted remedy."

In 1935, the Philippine Constitution declared that "the state in the exercise of its inherent powers may adopt measures to protect the health, the welfare, safety, etc. of the community. The Constitutional guarantees on the right to life, liberty and property are not absolute. Weighed against a greater public interest, these rights have to yield to reasonable regulations."

In 1964, through Republic Act No. 3931, the National Water and Air Pollution Control Commission (NAWAPCO) was formed to maintain reasonable standards of quality for air and water.

Within the Study Period: 1970-2000

In December 1975, Presidential Decree No. 856 established the Code on Sanitation, which dealt in detail with water supply, excreta disposal, sewerage and drainage. Chapter XVII of the Code contained provisions for sewerage collection and disposal, as well as drainage, with implementing rules and regulations.

In 1976, Republic Act No. 3931 was revised by Presidential Decree No 984, and NAWAPCO was replaced by the National Pollution Control Commission (NPCC). In the same year, an Inter-Agency Committee on Environmental Protection (IACEP) under the Department of Environment and Natural Resources (DENR) was created to assess the environmental situation, as well as government policies and programs on environmental protection.

In 1977, IACEP recommended creation of the National Environment Protection Council (NEPC), established under Presidential Decree No. 1121. The Council became responsible for rationalizing the functions of government agencies for an effective, coordinated and integrated system of environmental protection, research and implementation/enforcement of environmental laws.

In the late 1970s, Presidential Decree No. 1151, known as the Philippine Environmental Policy, was promulgated. The law required all agencies and instrumentalities of the national government, including government-owned-and-controlled corporations, as well as private firms and entities, to prepare an environmental statement on their every action, project or undertaking that significantly affects the quality of the environment. Presidential Decree No. 1152, known as the Philippine Environmental Code, established standards for air and water quality, and guidelines for land use, natural resources, groundwater and waste management.

In June 1978, Presidential Decree No. 1586 augmented the environmental statement system by providing sanctions for non-compliance with the environmental impact assessment (EIA) requirement. The scope of the system was also restricted to "environmentally critical projects to be located in environmental critical areas." This Presidential Decree, however, was not implemented until 1982.

In 1993, the Medium Term Philippine Development Plan (MTPDP) covering the period 1993-1998 was developed. It spelled out the development goals and objectives, strategy, policy framework, priority development programs and targets of various sectors. This initiative included a medium term plan for the water supply and sanitation sector.

Post NUSS Period: 1994-2000

Up to 1994, efforts to develop the water supply and sanitation sector focused mainly on the construction of physical facilities, primarily for water supply. In the sanitation sub-sector, more attention was given to strengthening sector policy, strategy, operational frameworks, and

institutional capabilities. It was then deemed necessary that specificmeasures be identified through an in-depth assessment of implementation experiences, including private sector participation in water supply provision, and an analysis of emerging issues and concerns. Hence, the decision to update the medium term plan, and to formulate a sector investment plan, now referred to as the 1994 National Urban Sewerage and Sanitation Strategy Plan (NUSS). The purpose of the sanitation program was to create a more effective institutional framework to guide policy and institutional reforms; and to propose an appropriate development strategy and investment plan to improve sewerage and sanitation coverage nationally.

In March 1994, the National Economic Development Authority (NEDA) adopted Resolution No. 5 based on the NUSS plan, giving high priority to improved sanitation and sewerage in urban areas. The resolution also included the following propositions:

- ensure that on-site sanitation facilities are readily adaptable to future sewerage systems;
- all new housing developments, central business districts (CBDs) and high income areas shall have low cost (simplified) sewerage systems;
- industrial wastes and collected municipal wastes shall be treated in accordance with DENR standards;
- services shall be based on demand and on willingness-to-pay criteria;
- utilization of external sources of assistance;
- LGUs will be responsible for implementing sanitation and sewerage projects and programs;
- the national government shall assist LGUs, through LWUA-Central Program Support Office (CPSO), in institutional development, training, financial management, planning, and program management.

> To assist LGUs in carrying out sanitation and sewerage projects, the Department of Finance (DOF) made loans available through the Land Bank of the Philippines (LBP). Due to budgetary constraints, LWUA's role was reprogrammed to that of an advisor to LBP for this new Water District Development Project (WDDP).

There were originally six pilot project sites for WDDP: the cities of Cagayan de Oro, Cotabato, Dagupan, Davao, and General Santos, plus the municipality of Calamba. However, General Santos City backed out from the project, leaving only five sites to proceed with the project in 1996. Due to delays in meeting loan requirements, negotiations dragged on until 1998, a local election year. After those elections, no firm commitments or interest came forth for the project, and local officials had other priorities. Moreover, the impact of the regional financial crisis that began in mid-1997 contributed to LGU decisions to drop the project.

WDDP was later restructured into a broad-based environmental fund for sanitation, sewerage, drainage and the Barangay Environmental Sanitation Plan (BESP) to assist LGUs to pursue demand-driven sub-projects. The restructuring required the creation of the Project Management Office at LBP. In July 1999, the revived WDDP commenced with two LGUs signing subsidiary loan agreements. To date, four LGUs are participating in the program, constructing off-site sanitation through formal drainage systems with dry weather flow interceptors and sewerage facilities.

3 SUB-SECTOR REVIEW

3.1 Introduction

The following review of the sanitation and sewerage sub-sector in the Philippines is based on examination of the current situation's institutional, legal, technical, financial and ecological aspects. The purpose of this section is to summarize existing practices and experiences, and to identify barriers and constraints to improved sanitation management.

The analysis examines the sanitation and sewerage sub-sector nationwide, in the context of the classification system for urban communities used in the Philippines. The study identified 68 Highly Urbanized Cities (HUCs), Independent Component Cities (ICCs) and Component Cities (CCs), and this study concentrates on these large urban centers, which have been found to have correspondingly large sanitation and wastewater management problems. **Table 3.1** summarizes the subject areas studied.

Table 3.1

Study Subject Areas

Type	Number (Percent)	Population	Income (P'000/yr)
Highly Urbanized City (HUC)	**23 (35%)**	**200,000+**	**120,000 or more**
Component City (CC)[1]	**38 (59%)**	**25,000 - 200,000**	**<4,000 - 120,000 or more**
Independent Component City (ICC)[1]	**4 (6%)**	**25,000 - 200,000**	**<4,000 - 120,000 or more**

Source: DILG 1991 and DOF (1995)
Notes:
[1] ICC – Independent Component City CC- Component City

In 1998, 2.3 million households, or 19 percent of all Philippine households, did not have access to sanitary toilet facilities, defined as a flush toilet or closed pit latrine. As indicated in the National Demographic and Health Survey (NDHS), 92.3 percent of the urban population had access to sanitary toilets, compared to 69.8 percent in the rural communities. It is also estimated that only about 7 percent of the overall population is connected to a sewer system (see **Figure 3.1)**. Access to sanitary toilet facilities remains problematic, particularly outside urban areas, where one of six households has no toilet facility. **Table 3.2** shows the distribution of household facilities.

Table 3.2

Distribution of Households with Sanitation Facility

Sanitation Facility	Residence		
	Urban (%)	**Rural (%)**	**Total (%)**
Flush Toilet[1]	87.4	60.2	73.7
Closed Pit Latrine[2]	4.9	9.6	7.3
Open Pit Latrine[3]	2.4	9.7	6.1
Drop Type/ Overhang[4]	1.4	2.9	2.1
No Facilities/ Field[5]	3.6	17.0	10.3
Other/ Missing	0.3	0.6	0.5

Source: NDHS, 1998
NSO

[1] Flush toiler (water-sealed) - type of toilet where after water is flushed or poured into the bowl, a small amount of water is left in the bowl and seals the bottom of the bowl from the pipe leading to the depository.

[2] Sanitary pit or privy (closed pit)- non-water carriage type where pit is dug to a depth of 1.5 – 3.0 m, large enough to hold wastes for several years.

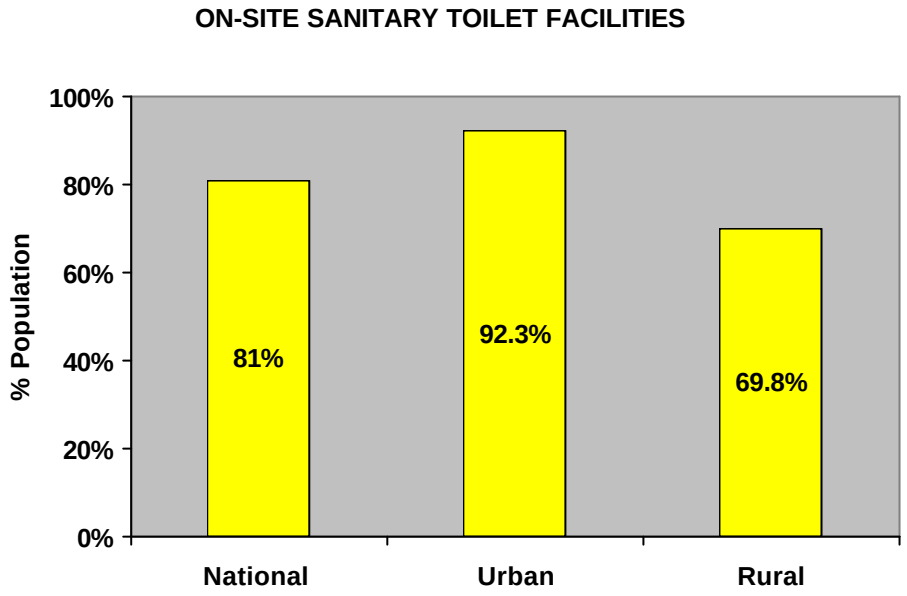
[3] Open pit- a scant type of toilet over a pit with no provision for fly prevention.

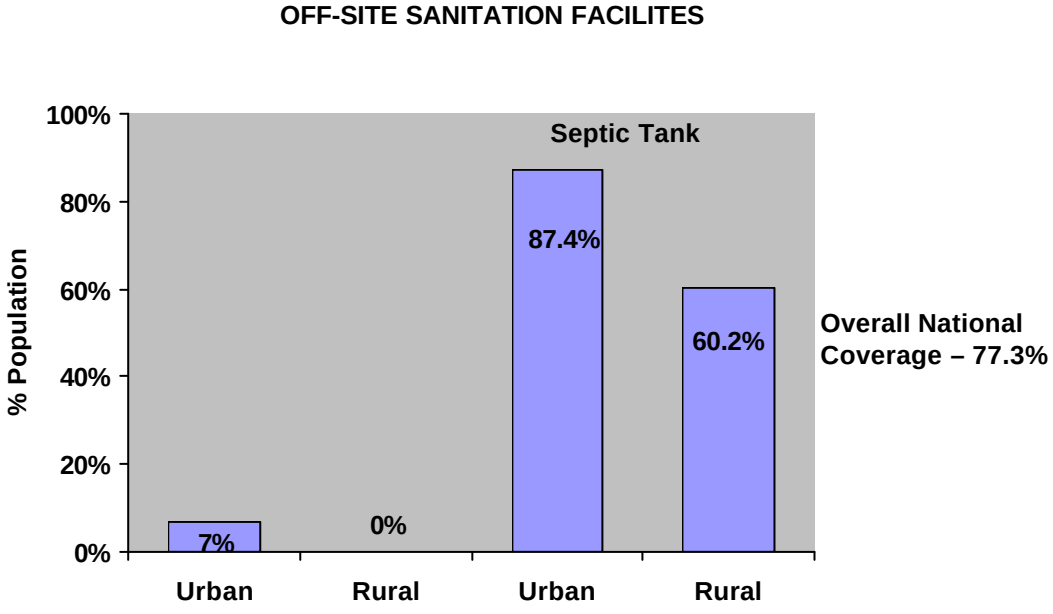
[4] Drop type- a type with enclosure or with roofing but no pit;
Overhang type- a toilet constructed over a body of water (either sea or river).

[5] No toilet facility/field- In households without toilet facilities, members may defecate along the railway, in nearby bodies of water, in a field, etc.

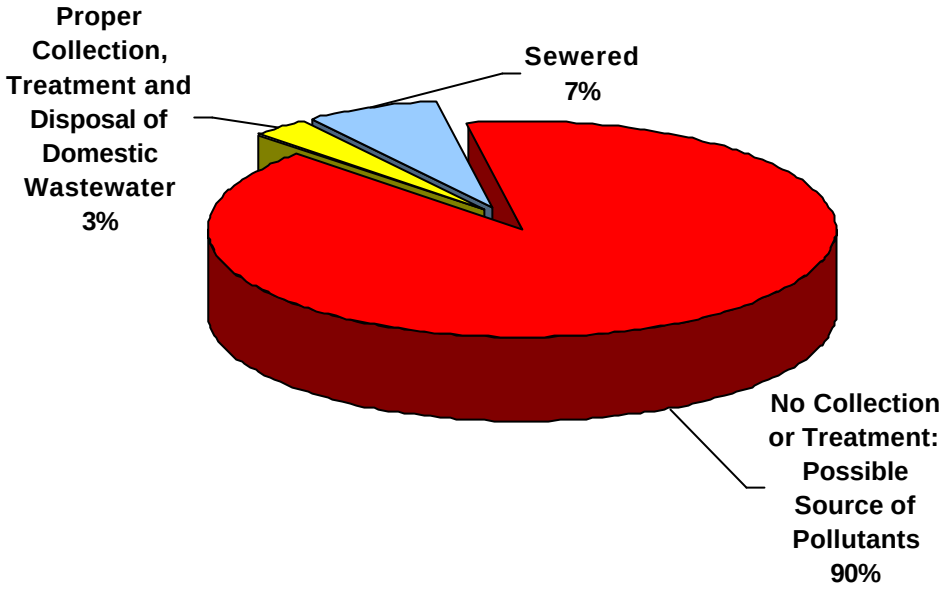
On the basis of the 1998 NDHS data and estimates to present a baseline situation for off-site sanitation facilities, **Figure 3.1** was developed. From the charts presented, it should be noted that provision of on-site sanitation remains a problem for 19 percent of households.

Figure 3.1
NATIONAL SEWERAGE AND SANITATION SITUATION





OFF-SITE SANITATION EFFECTIVENESS



On-Site – the human waste is deposited and treated where the toilet facility is located.
Off-Site – the human waste is transported for treatment.

An emerging problem is increased wastewater generated due to increasing water supply demand and provision and inadequate treatment of it. Overall, 77.3 percent of households have some provision for treatment of household wastewater. However, sewer systems reach only a miniscule portion of households, 7 percent in urban areas and none in rural areas. Other households that have sewerage treatment—and 23.7 percent have none—rely on septic tanks. These systems can be effective but many are improperly constructed, poorly maintained and inadequately serviced. They are rarely desludged or provided with adequate absorption fields. Septage tends to leach into surrounding areas, threatening groundwater contamination. The lack of tank trucks for emptying septic systems and treatment facilities to dispose of septage leads to illegal dumping in drainage systems, the ground or bodies of water, exacerbating problems from other indiscriminately discharged sewerage such as industrial wastes. Overall, only 3 percent of septage receives adequate treatment and disposal, and 90 percent of household wastewater remains a source of pollution and a threat to public health.

The next sections will examine the legal and institutional backdrop that contributed to the lack of dynamism in the sewerage sub-sector.

3.2 Legislation and Policies

The national legislative framework governing sanitation and sewerage in the Philippines is based on separate provisions contained in several pieces of legislation and policy pronouncements. Environmental and sanitation legislation, regulations and codes were compiled for the NUSS in 1994. That compilation plus legislation and policies enacted after the NUSS, including recommendations not acted upon to date, is summarized in **Table 3.3**.

Table 3.3

Summary of Sewerage and Sanitation-Related Policies

Legislation	Sub-sector Related Statement	Responsible Enforcing (E) and Implementing (I) Agency	Problems With Implementation
National Plumbing Code through PD1096 January 1959	Guidelines, criteria and standards for the design and construction of sanitation and sewerage facilities	DPWH (E/I)	Wastewater disposal rules not fully enforced; absorption fields not required for Imhoff and septic tank effluent disposal
An Act Creating the National Water and Air Pollution Control Commission, RA2931 June 1964	Prohibits depositing into the waters or air any substances that shall cause pollution	NAWAPCO (E/I)	Clear IRR, but not implemented/ enforced Not fully enforced
Department of Health Circular, PD 522, IRR No 220 Series of 1974	Sewage from house plumbing systems shall be connected to a public sewerage system, if available, or to a septic tank	DOH (E) DPW (I)	
The Code on Sanitation of the	Guidelines on sewerage collection and disposal, excreta disposal and drainage, with IRR		Not diligently enforced or monitored – homes

Philippines, PD 856 December 1975		DOH (E) DPW (I)	unconnected despite available sewer systems; septic tanks built illegally, etc.
	Requires subdivisions, hospitals, public buildings to provide sewerage and treatment facilities		Not enforced
Revising Republic Act 3931 known as the Pollution Control Law, PD 984 August 1976		NPCC (E/I)	
Creating the National Environmental Protection Council, PD 1121 April 1977	Establishes emphasis on environmental protection and awareness by amending and enforcing laws; requires environmental impact assessments, and monitoring for environmental protection	NEPC (E/I)	Not strictly enforced; compliance on provision of appropriate sanitation and sewerage facilities is not met
	Requires Environmental Assessment for any project or undertaking		EA system does not strictly enforce sanitation and sewerage provisions
	Polluter responsible to contain, remove and clean up certain pollution incidents		Only enforced on big polluters (i.e. industries)
Formulation of a Philippine Environmental Policy, PD1151 June 1977	Requires connection to sewerage system where available and provision of individual septic tanks when sewerage is not available	DENR (E/I)	Connection to available sewerage system not enforced
Philippine Environmental			

Code, PD 1152 June 1977	Projects should obtain Environmental Compliance Certificate	DENR (E/I)	
Rules implementing the subdivision and condominium buyer's protective decree September 1981	Requires certificate prior to implementation; sets water quality standards for industrial and municipal wastewater	MHS (E/I)	Project review is not strict on sanitation and sewerage provisions Not monitored
Revising the Provisions of PD 1151 in relation to the Environmental Impact Statement June 1982	Devolves provision of basic services and facilities to LGUs, including sanitation, sewerage and flood control		
Revised Effluent Regulations March 1990	National policy, strategy and action plan for urban sewerage and sanitation	DENR (E/I)	Low priority for sanitation projects
Local Government Code IRR Rule V 1991	Increases role of LGUs in the provision of sanitation facilities	DENR (E/I)	LGUs not keen on sanitation and sewerage projects
National Policy on Urban Sewerage and Sanitation, NEDA Board Resolution No 5 Series of 1994		DILG (E) LGUs (I)	Deals mainly with water

NEDA Board Resolution No 4 Series of 1994, and Board Resolution No 6 Series of 1996		NEDA (E) LGUs (I) NEDA (E) LGUs (I)	

The profile of the water supply and sanitation sector has improved in recent years, partly due to government and external support agencies' efforts. Another key factor is that beneficiary communities have recognized the need for improvements, accepted their responsibilities, and offered the cooperation vital for successful, effective implementation of projects.

Major sanitation and sewerage initiatives are:

- 1988-2000 Water Supply, Sewerage and Sanitation Master Plan (WSSSMP): This plan emphasized the commitment of the national government to provide for the basic needs of the population, especially in depressed areas. WSSSMP was the result of an extensive inter-agency undertaking that involved DPWH, DILG, NEDA, MWSS, LWUA and NWRB. WSSSMP set the framework and agenda for organized, unified action by policy makers and program implementers, at all levels of the government, to execute and manage water supply, sewerage and sanitation programs and projects throughout the country. WSSSMP was also intended to serve as an example and reference for the private sector and non-government organizations actually or potentially involved in the development of the sub-sector. Objectives of WSSSMP were to: (a) provide safe water supply to the majority of the population in a cost-effective manner; and (b) institutionalize the delivery of water supply services. In 1994, WSSSMP was updated as a result of the enactment of the 1991 Local Government Code, the conclusion of the 1988-1992 Medium Term Philippine Development Plan, and findings and recommendations of several other sector studies.

- Republic Act No. 6957 of 1990 entitled "An Act Authorizing the Financing, Construction, Operation and Maintenance of Infrastructure Projects by the Private Sector and for Other Purposes," manifested the government's policy of greater private sector participation (PSP) in the water sector.

However, according to NSAP and WSSSPS, reasons for the lack of successful PSP include:

- absence of a framework to allow LGUs to decide on the most appropriate form of PSP;
- lack of effective and credible regulation of the water and sanitation sector, including tariff setting, economic and service standards for operators, extraction of groundwater, and discharges into the environment;
- low levels of awareness or institutional capacity to initiate, develop and finance projects;
- undeveloped risk identification, risk management, and risk sharing processes between government and private sector entities;
- unclear guidelines regarding project guarantees to private sector participants;
- no established process for evaluation and review of different PSP methods to achieve planned outcomes;
- insufficient incentives to attract PSP and institute efficiency initiatives;
- slow processing of unsolicited private sector proposals, such as build-operate-transfer (BOT) initiatives, in part due to bidders' requests for financial guarantees, contrary to national government policy.

- Local Government Code of 1991: The Code set the tone for increased local government responsibility for provision of basic services and facilities. Under the Code, responsibility for providing basic services was transferred from the central government to the provinces, cities, municipalities and barangays. Each local government unit was required to provide a minimum set of services and facilities in accordance with national policies, guidelines and standards.

- 1993-1998 Medium-Term Philippine Development Plan (MTPDP): The Water Resources section of the plan indicated that in 1992 about 66 percent of the population (or roughly 42.6 million people) had access to potable water supply, compared with 61 percent or 34.4 million in 1986. In Metro Manila, about 61 percent of total households had direct service connections, while the rest were either indirectly served or supplied by providers outside the MWSS network. In other urban areas, only about 47 percent of households had comparable access to water. Key measurable targets in the MTPDP included increasing to 79 percent (57.1 million people) the portion of the population served with adequate potable water; construction of sewerage facilities in Metro Manila and

other highly urbanized areas; and building 1.8 million toilet facilities nationwide.

- National Urban Sewerage and Sanitation Strategy Plan of the Philippines of 1994 (NUSS): The plan recommended the adoption of a national strategy and program for the provision of adequate sanitation and sewerage facilities in urban areas. Under the strategy, multiple functions were performed at the national level, even though actual service provision took place at the local level, and cut across the interests and areas of responsibility of several agencies. The plan proposed the Central Sanitation/Sewerage Program Support Office (CPSO) to aid LGUs, assisted by an inter-agency advisory committee (IAC) including representatives of DBM, DENR, DILG, DOF, DOH, DPWH, LWUA, MWSS and NEDA.

- NEDA Board Resolution No 5 Series of 1994: This act approved the recommendation of the NEDA Infrastructure Committee (INFRACOM) on national policy, strategy and action plans for urban sewerage and sanitation. The resolution provided for the creation of CPSO, housed within LWUA, under the jurisdiction of LWUA Board. LGUs were designated as primary implementers of sanitation/sewerage programs, with the national government providing assistance to develop LGU capabilities in certain areas.

- Water Supply, Sewerage and Sanitation Sector Databank: A national water resources databank was established at NWRB, with the following initial activities: (a) creating the Philippine Groundwater Databank (LWUA/NWRB) in 1993, financed by UNDP; (b) formulating the Water and Sanitation Monitoring System (WASAM) in 1994, with assistance from UNICEF, to gather specific indicators in the WSS sector for use in planning purposes; and (c) developing the Water Supply, Sewerage and Sanitation Sector Database (commenced in January 1995) through a technical assistance grant from the Danish Consultant Trust Fund (administered by the World Bank). The database was later transferred to NWRB.

- External Assistance: Several multilateral and bilateral agencies have provided assistance for water, sanitation and sewerage development. These include Asian Development Bank, the World Bank, UNDP, UNICEF, Australia's AusAID, Japan's OECF, USAID, Denmark's DANIDA, the government of France, and the German Agency for Technical Cooperation. ADB, for example, has provided several loans and technical assistance grants for water supply, sanitation and urban development projects, mostly combination water supply/sanitation projects. One example is the 1999 ADB Sector Strategy for Urban Water Supply and Sanitation, which aimed to increase water supply coverage, especially for the urban poor; reduce system wastage and leakage; strengthen cost recovery and financial management; and

improve financial self-sufficiency through improved billing, collection and rate setting. The strategy emphasized improving the capabilities of municipalities in administration, community management, financial management, and operation and maintenance; integrating water supply development with drainage, wastewater management, and solid waste management; and facilitating community participation and management to achieve long-term service sustainability.

Box 3.1 Summary of Legal Barriers and Constraints to Improved Sanitation and Sewerage

The Philippines has sufficient sewerage and sanitation legislation and policies but they are not properly enforced and implemented. In the country's development plans, more emphasis was given to water supply provision than sanitation. At present, the sub-sector needs strengthening in the following areas:

- Fill gaps in legislation applicable to LGUs
- Facilitate interagency coordination at the national and local levels
- Design a national framework for implementing "polluter pays" policies
- Develop a monitoring system to ensure strict implementation and enforcement of policies at both the national and local levels

3.3 Institutional Structure

3.3.1 Introduction

This review of the institutional framework for management of sanitation was drawn from institutional, legal, technical, and financial assessments available on demand from the Water Supply and Sanitation Program Management Office of DILG, 5th Floor, Francisco Gold Condominium, EDSA, Quezon City, Philippines. The main agencies involved in the management of the sub-sector and their functions are summarized in **Table 3.4** below.

Table 3.4

Summary of Existing Institutional Structure

For Sanitation and Sewerage

Function	Responsible Institution/Agency
Policy Making	DENR, DOH, NEDA
Policy Formulation, Technical Standard and Guidelines	LWUA/ DPWH

Public Awareness	DENR, MWSS
Technical Assistance	LWUA, MWSS, DENR
Enforcement	
Environmental Code	DENR via EMB, Regional Offices, PENROS, CENROS
Sanitation Code	DOH via Municipal/City Health Offices
Plumbing Code	DPWH
Local Government Code	DILG
Service Delivery	LGUs – Private Sector, NGOs, WDs, Other Government Agencies (i.e. PTA, LLDA, DOTC, PEZA, etc.)
Training	LGA, DAP, DENR, LWUA, MWSS, NGOs

3.3.2 Policy Making and Policy Formulation

The main policy making bodies for wastewater management are the Department of Environment and Natural Resources (DENR), the Department of Health (DOH), and the National Economic and Development Authority (NEDA). DENR regulates discharges from commercial and municipal sewage treatment plants. It also has primary authority to protect water resources. DOH regulates premises with new or existing sanitation installations. DENR and DOH are the primary regulators of the sanitation sector, and carry out reforms in sanitation and pollution regulations and law enforcement. NEDA is responsible for coordinating long-term planning and programming.

3.3.3 Enforcement

The four main laws affecting sanitation and sewerage are the Environmental Code, the Sanitation Code, the Plumbing Code and the Local Government Code. Responsibility for enforcement of these codes lies, respectively, with DENR, DOH, DPWH and DILG. These codes all place responsibility for sanitation and sewerage activities with LGUs. Nevertheless, enforcement of these codes remains inadequate in the area of wastewater management. There are two main problems that need to be addressed. First, implementing rules and regulations for some parts of the codes are weak, so enforcing agencies and implementing institutions do not have sufficient guidance on what is expected by the law. Second, insufficient priority and resources have been given to enforcement of sanitation and sewerage laws. For example, the responsibility of the Environmental Quality Division of the DENR regional offices along with the PENROs and CENROs is the enforcement of the Environmental Code, covering the full range of environmental issues. These departments have very limited personnel, and few staff members are specially trained in sanitation and sewerage management issues.

At the local level, most LGUs have passed ordinances for more effective sanitation and sewerage management. Most also have local littering, disposal, health, and sanitation laws. Nevertheless, enforcement of these

ordinances, especially in sanitation and sewage management, remains weak.

3.3.4 Service Provision and Delivery

Under present institutional arrangements, various government and quasi-government agencies are responsible for the provision and delivery of urban sanitation and sewerage services. Agencies involved in the delivery of sewerage and sanitation infrastructure include DOH for on-site sanitation facilities, DPWH for off-site sanitation facilities, LGUs for locally initiated projects, the BOT Center for privatized facilities, NGOs such as UWEP and ITN for promotion of low-cost sanitation facilities, etc.

The Local Government Code states that sanitation service management is the responsibility of LGUs in line with existing legislation. However, in the absence of clear implementing rules and regulations and sufficient guidance, LGUs, especially in smaller cities and municipalities, fulfill this function on a largely ad hoc basis, without strategic planning or adequate efforts to implement laws and determine overall expenditures for sanitation and sewerage-related management.

Groups outside official institutions have taken initiatives in the sub-sector to address urgent issues affecting their activities and areas of concern. These players were moved to action due to the absence of any agency or organization that would commit to provide sanitation and sewerage services. Without grant funds or cost sharing from the national government, LGUs cannot implement such expensive projects, even though they have official responsibility for them.

Here are some examples of stakeholder actions to address urgent issues in the sector:

Table 3.5

Initiatives by Stakeholders

	Implementing Organization/ Agency	Trigger	Action Plan and Expectations
1.	Philippine Tourism Authority (PTA)	? Declining tourist arrivals due to beach pollution in Boracay	? Sewerage project to intercept wastewater for treatment and disposal. Tourist arrivals and revenues increased; surface and groundwater quality improved.

2.	Laguna Lake Development Authority (LLDA)	? Pollution reduced fishing industry revenues; lake fish killed	? Wastewater inter-ceptor conveyance systems and treatment facilities to improve lake water quality.
3.	Pasig River Rehabilitation Commission (PRRC)	? Pollution of Pasig River	? Wastewater inter-ceptor conveyance pipeline and treatment facilities for residents along river in cooperation with government cleanup.
4.	Urban Waste Expertise Program (UWEP)	? Rapidly deteriorating coastal and surface water quality in Tingloy, Batangas	? Assist LGUs to provide low-cost liquid waste management options.
5.	International Training Network (ITN)	? High cost of effective on-site sanitation technologies	? Promotion of innovative low-cost sanitation facilities.

Box 3.2 Summary of Institutional Barriers and Constraints to Improved Sanitation and Sewerage

- **Absence of a national body responsible for sanitation and wastewater management**
- **Inadequate enforcement of existing legislation at national and local levels**

- **Fragmented sanitation and wastewater management by LGUs, leading to poor accountability**
- **Limited capacity of LGUs to manage private sector operations**
- **No incentives to improve sanitation services**
- **Inadequate training, public information campaigns, and advocacy**

3.4 Technical

This technical review of existing sanitation and sewerage facilities in the Philippines examined the sub-sector's situation and practices in different classes of urban areas. The greatest levels of wastewater generation occur in highly urbanized cities. The challenge in providing adequate sanitation services is much greater in HUCs and larger city components than in smaller areas, and hence, was the focus of this analysis.

3.4.1 On-Site Sanitation Technologies

The 1998 Annual Poverty Indicators Survey (APIS) of the National Statistics Office (NSO) reported that in high and low income groups, water sealed is the predominant type of toilet facility (see **Figure 3.2**). The proportion of families with water sealed toilets is higher among the highest 60 percent income group at 82.7 percent, compared with lower percent income group at 49.5 percent. More than a quarter of families in the lowest 40 percent income group still use closed pit (16.3 percent) or open pit (10.5 percent) toilet facilities. Among the regions, the National Capital Region

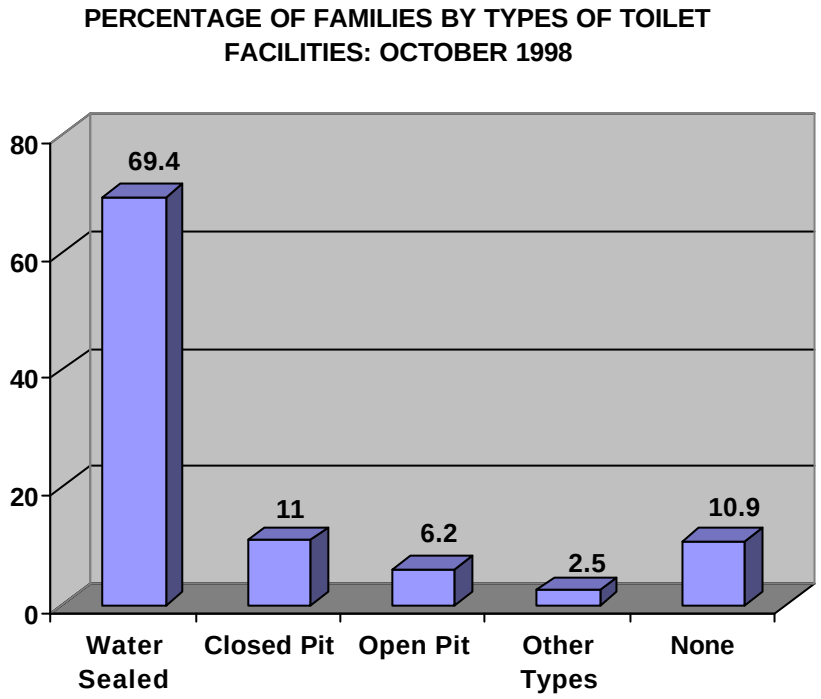
has the highest proportion of families with water sealed toilet facilities. Nine out of ten families in this region use water sealed toilet facilities. The lowest percentage with water sealed toilet facility is in the Autonomous Region of Muslim Mindanao (ARMM), where only one in ten families has this kind of toilet facility.

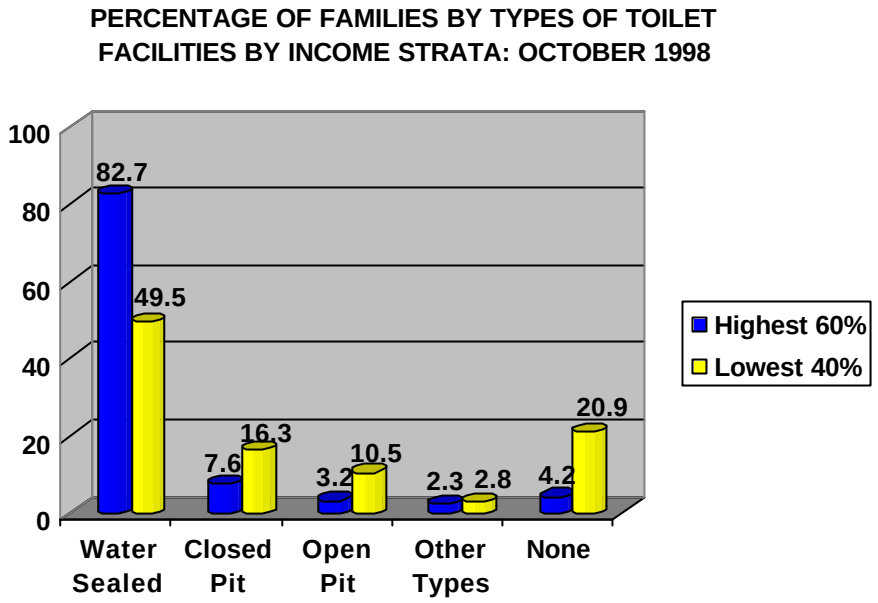
Although new sanitation technologies, such as compost toilets, are being promoted by some NGOs (i.e. ITN and WASTE), people are still reluctant to change to these low-cost and environment-friendly technologies. People would rather "wait and see" the success of these demonstration projects. Recognizing this attitude, demonstration projects should be undertaken to support promotional campaigns.

The choice of appropriate sanitation technology also must consider a socially and environmentally acceptable level of service along with significant health and economic benefits. On-site sanitation technologies that have been used and are applicable in rural and urban areas are tabulated and evaluated in **Table 3.6**.

Figure 3.2

Survey on Type of Toilet Used





Source: Annual Poverty Indicators Survey (APIS), 1998 National Statistics Office (NSO)

Table 3.6

Available Sanitation Technologies

Technology	Description	Advantages	Disadvantages
Aquaprivy	Squatting plate situated immediately above a small septic tank that discharges its effluent to an adjacent soakway.	Easy to construct with maximum use of indigenous materials.	Can cause intense odor release, fly and mosquito nuisance. Watertight feature makes it expensive.
Ventilated Improved Pit Latrine	System includes pit, vent pipe, latrine pedestal or squatting plate, and enclosing shed.	Low construction and operation costs, simple and easy to construct with maximum use of indigenous materials. Minimal nuisance, low water requirement, and good potential for upgrading.	Unsuitable for high density urban areas (in excess of 200/ha). May pollute groundwater.
Composting Toilet	Waterless pit system similar to sanitation	Minimal water requirement, can be	Suitable only for low density areas; must

	pit. Ash and biodegradable organic matters added to pit to absorb odor and moisture.	used in areas where water supply is limited; humus produced is safe, stable and can be recycled as fertilizer.	have sufficient ash and biodegradable materials; high degree of user care and motivation is required for satisfactory operation.
Sanitation Privy	Earthen pit of at least 1 m^2, concrete/ impervious floor, water sealed bowl, and suitable enclosure.	Low construction and operation costs, simple and easy to construct with maximum use of indigenous materials.	Can cause intense odor release, fly and mosquito nuisance.
Water Sealed Toilet Bowl	Similar to pit or septic tank toilet systems but equipped with a P-trap or water seal to reduce odor escaping from the pit. Also prevents insect and rodent infestation.	Low water requirement, minimal nuisance and risk to public health.	Difficult to construct, can be expensive in rural areas.
Pail System/ Vault Toilet	Portable container such as a pail is used to store waste, and periodically disposed properly.	Low construction cost, can use any available, suitable container.	High operating cost due to collection and disposal of night soil; can cause public health danger if the night soil is not collected regularly and disposed properly.
Septic Tanks	Most common off-site sanitation facility in the Philippines. Uses water to transport the waste to a tank where solids settle and digest, and the liquid passes to a soakway.	Can achieve 40 percent BOD reduction and 65 percent suspended solids removal if properly designed.	Practice of discharging effluent into open drains significantly contributes to environmental pollution and degradation. Needs a lot of space for soil absorption field, resulting in high construction cost.

Septic tanks are the predominant system for disposal of household wastewater in conjunction with cistern type or flush toilets where there is

adequate water supply. Sullage (from the kitchen, laundry or bath) may also be discharged into septic tanks; sometimes, household wastewater is discharged directly into the house yard or storm drains.

Septic tanks are small, rectangular chambers in which sewage is retained for settling and sludge digestion. Septic tank effluents contain pathogenic organisms and can cause diseases. The National Building Code and the National Plumbing Code require on-site leaching or absorption to dispose of septage.

For various reasons, such as unsuitable soils, but more often due to lack of space for soil absorption fields due to high land costs, most septic tank systems in the Philippines have been constructed without soil absorption fields. Instead, septic tank effluent is often directly emptied into street and storm drains, significantly contributing to environmental pollution and degradation.

The proliferation of squatter and slum areas with minimal sanitation facilities has exacerbated the problem of untreated wastewater discharged into the urban environment. Clearly, there should also be action plans for sanitation requirements in these areas.

Communal toilet facilities have been proposed for slum and squatter areas. However, suitable land is difficult to locate, especially in densely populated areas. Beneficiaries also need to be organized to sustain operation and maintenance of the facility, with additional support through training and information dissemination programs. The “users pay” concept pioneered in Dagupan City has been successfully replicated in many LGUs. Communal toilets operated on this basis are generally well kept, since funds are generated for their operation and maintenance.

Communal septic tanks are also used in some subdivisions or housing projects (i.e. BLISS). Most of these housing projects are for middle- or high-income groups but are not strictly regulated in terms of sanitation and building requirements.

3.4.2 Sewerage

Metro Manila

One of the mandates of MWSS is to provide sewerage services to the 13 cities and 24 municipalities in Metro Manila, Rizal and part of Cavite. Its service area comprises 203,400 hectares with a population of 11.7 million. Prior to privatization in 1997, MWSS was supplying inadequate potable water service, while sewage collection and treatment was even less

satisfactory, covering a mere 7 percent of the population. MWSS placed great reliance on the use of individual septic tanks.

Numerous reports examining Metro Manila – i.e. JICA Report, Sogreah Report, the MSSP project, and the MWSS Master Plan Study – included similar recommendations for sewerage programs. The reports proposed installation of dry weather flow interceptors in the short term to divert septic tank effluent and sullage then being discharged in *esteros* or creeks to a sewage treatment plant.

Proposed sanitation programs were complementary to eventual construction of a conventional sewerage system. Proper septic tank management was recommended to reduce pollution, including expansion of desludging activities through acquisition of more vacuum tankers and better septage management strategies. Marine and land disposal of effluent was proposed until the sewage treatment plants were constructed.

Privatization of MWSS requires the concessionaires to offer sanitation service to customers not connected to the sewerage system, along with the associated responsibilities of construction, maintenance and operation in the immediate term.

- Maynilad (West Zone Concessionaire) will rehabilitate and upgrade existing sewerage systems, expand the sewerage network and improve the management of sanitation services. Two treatment plants will be

constructed in phases over five years, along with expansion of central sewerage system service, rehabilitation of the Central Malate sewerage and lift station, and a septage treatment plant in Dagat-dagatan. Maynilad will ensure that sewerage treatment plants comply with national regulations and will evaluate alternative methods of sludge disposal, such as agricultural reuse, composting, drying with reuse of digesting gas, and sanitary landfill.

- Manila Water (East Zone Concessionaire) will implement sanitation programs in densely populated areas. Components of the Manila Sewerage Project include septage collection, a barge loading station, and rehabilitation of the Ayala sewage treatment pit.

Other agencies are also concerned with the environmental and sanitation situation in Metro Manila. Recently, the Pasig River Rehabilitation Sector Development Program proposed procurement of vacuum trucks for septic tank maintenance and construction of a septage treatment plant. This sanitation service will serve about 185,000 households that have no coverage from MWSS.

Other Urban Areas

Off-site sanitation and sewerage systems of varied types and capacities exist in five cities and municipalities outside Metro Manila: Baguio City, Cebu City, Zamboanga City, Davao City and Cauayan, Isabela. These facilities are described briefly in **Table 3.7**.

TABLE 3.7
Inventory of Sewerage Facilities

LOCATION (OPERATOR)	DATE CONSTRUCTED	TYPE AND DESCRIPTION OF FACILITIES	ISSUES/ OBSERVATIONS
ZAMBOANGA CITY (WD)	Not available	- Conventional sewage collection pipelines - Marine outfall - No treatment, except for some screening (Operational)	Services a small part of the city. No expansion to date due to high investment cost.
DAVAO CITY (PSP)	1974	- Sewer lines with 1,161 service connections - Sewerage treatment plant (Operational)	Serves only two residential subdivisions in the city.
BAGUIO CITY (LGU)	1928 – US 1994 – JICA grant	- 8,600 m^3/day capacity Sewerage Treatment Plant (oxidation ditch) - 18.52 km conventional collection pipelines with 526 inspection manholes, 72 interconnection points from old sewer lines - River outfall (Operational)	Serves 63 out of 129 barangays in the city; only 42 percent of the service area is connected to the sewerage system.
CEBU CITY (LGU)	1988	- 1 km conventional sewer pipelines with 2 service connections - 5,000 m^3/day capacity sewerage treatment plant (aerated lagoon) (Operational)	Built to serve the whole reclamation area but serves only a bottling plant and a major mall/ supermarket. Funding is inadequate for operation and maintenance. Limited sewer line length cannot accommodate many users.
CAUAYAN, ISABELA (LGU)	1989 – WB FRWSSP	- 6.5 km of small bore sewer pipelines with 43 flushing points, 70 manholes, about 800 connections - 210 m^3/day capacity waste stabilization pond treatment	Covers a fraction of the area. No expansion to date due to high cost of investment.

		facility (Operational)	
METRO MANILA (MWSS)	1980	- Conventional sewer pipelines with 90,000 sewage boosters, pumps, lift stations, and connections (1996) - Sewerage treatment plant (Operational)	Services only 13 percent of the MWSS concession areas. Poor maintenance; most sewer lines leak.

The facilities mentioned in **Table 3.7** and new sewerage facilities constructed by middle- and high-end subdivision developers have increased sewerage coverage, but the actual impact of these facilities is negligible. Service coverage expansion during the past 30 years has been overtaken by rapid urbanization and population growth, with increased deterioration and degradation of receiving waters.

Case 1: Baguio City Conventional Sewerage System with Communal Septic Tanks – one LGU, two systems

Baguio City's sewerage system serves the central business district and adjoining areas, covering 63 out of the city's 129 barangays. The city government is continuing to bring the system closer to the prospective users by expanding the service area coverage.

The sewerage system is connected to an 8,600-m^3/day activated sludge sewerage treatment plant. During the first semester of 1996, the average inflow volume was 5,156 m^3/day. Within the service area, 41.75 percent of the potential users were already connected to the system, while 55.27 percent still utilized septic tanks. The remaining 2.98 percent without on-site sanitary facilities were referred to the Sanitation Division of the local health department for its appropriate action.

City Ordinance No. 098-95 was passed by the City Council to maximize connections to the sewerage system. One provision of the ordinance compels households and businesses within the service area to connect to the system. This provision supports Section 234, RA 1378, known as the National Plumbing Code.

The revenue code of the city (CO No. 01-95) provides the schedule of the sewerage fees. User fees are fixed and computed at about 19 percent of the Baguio Water District's prevailing water rate. Revenue generated will be sufficient to sustain the operational cost of the system with 85 percent of the rated capacity paying sewerage fees. In addition, users pay a sewer collection permit fee upon connection to the system.

The sewerage system was expanded to the remaining 66 barangays – areas beyond the reach of sewer lines or low-lying areas where pumping

becomes very expensive – through the provision of communal septic tanks. The communal septic tanks are regularly desludged, and septage is brought to the wastewater treatment facility.

Case 2: Cabanatuan City and Puerto Galera Dry Weather Flow (DWF) Treatment and Disposal – innovative steps in the provision of off-site sanitation

It is clear that LGUs cannot afford sewerage projects by themselves due to the high capital investment required. Although there may be will on the part of LGUs to mitigate pollution, project implementation assistance and financing help are essential. Thus, a step-by-step, scaled-up approach to sewerage projects is essential.

Cabanatuan City's Experience

In 1999, the city government of Cabanatuan prepared a Feasibility Study for the Comprehensive Drainage System of Cabanatuan City (the sub-project) to be financed by a P300 million loan under the Water District Development Project-Urban Sewerage, Sanitation and Drainage (WDDP-USSD) component of the World Bank through the Land Bank of the Philippines (LBP). The sub-project's main objective is to eliminate flooding

in the Central Business District (CBD) and adjoining barangays – which occurs practically every year and is often heavy and prolonged – by replacing the existing undersized, dilapidated and mostly silted drainage system. The existing system also receives wastewater from septic tank overflow including sullages. Thus, the storm drainage system functions as a combined system. Provision of a new storm water drainage system is an initial clean-up step to eliminate stagnating wastewater within the immediate vicinity of households.

In order to properly mitigate the impact of the project on the environment and to avoid further degradation of receiving water bodies, a supplemental study was undertaken to evaluate the present condition of the receiving water bodies, specifically their capacity to accommodate storm water discharges during the rainy season and the negative impact on water quality, particularly during the dry season. The study was required prior to the issuance of the Environmental Compliance Certificate (ECC) and the World Bank's Environmental Clearance for construction of the drainage project.

The study found that, even without the new project, receiving water bodies were already contaminated. Water quality analysis showed BOD coliform count and other parameters exceeding DENR standards. Triggered by the environmental degradation of city water resources, the Mayor opted to

include a dry weather flow interceptor and treatment prior to disposal as part of the new system. This DWF infrastructure would, as a first stage intervention, improve water quality in the receiving rivers and creeks.

Puerto Galera's Experience

Due to the good drainage topography of Puerto Galera, street drainage systems in the urban centers function well. However, the municipal drainage system also collects septic tank effluents and sullages from households, which are discharged directly into the Verde Island Passage. Alarmed by deteriorating water quality and its impact on marine life, the Puerto Galera municipal government decided to provide treatment facilities at system outfalls adjacent to the urban center. The treatment facilities include sedimentation tanks and filtration tanks.

Since treatment began, marine water quality has improved and fish habitation is again observable. The LGU supports the project with an ordinance to protect the bay from indiscriminate waste disposal. In fact, the LGU is also planning to construct a similar facility for other outfalls concurrent with its planned expansion of the water supply system.

Case 3: Zamboanga City's Pilot Sewerage Facility – Water District woes

Zamboanga Water District attempted to construct a sewerage treatment facility and integrate its management with its water supply facility. The pilot project serves a small part of the city. Wastewater is collected via sewerage pipelines and pumped for disposal through a marine outfall. Except from screening, there is no treatment prior to disposal.

This demonstration project experienced problems with tariff acceptability, adequate financing, operation and maintenance requirements, and leadership priorities, as experienced in Metro Manila and elsewhere. The demonstration project was never expanded. Most Water Districts are not in favor of financing the capital expenditure for sewerage facilities.

Case 4: Private Sector Participation with LGUs

Boracay's Experience

Boracay is an island in Malay municipality renowned for its beaches that derives its main income from tourism. Triggered by the threat of pollution, the Philippine Tourism Authority (PTA) intervened and constructed a sewerage facility through a P100 million loan, payable in ten years, from Japanese aid agency OECF. The system was scheduled to be in service through a private operator by 2001. Legislation was passed allowing PTA to charge an Environmental Management Fee to visitors (P25 for foreigners, P10 for Philippine citizens). User fees will also be charged to business establishments and households. The sewerage system was

planned to serve about 70 percent of the island's population, as well as its main tourist areas.

Other Experiences

Some developers of subdivisions, Export Processing Zones, and other land intended for tenancy are now incorporating sewerage systems as a component, particularly those targeting the high-income market. Operation and maintenance are either supplied by private operators through management contracts or provided in-house using specially trained staff. Tariffs (following the "polluter pays" principle) from all connected establishments are collected monthly to cover the amortization and operating costs of the sewerage system, which usually includes collection, treatment and disposal facilities. Examples of such private systems are found in Mactan Export Processing Zone, Philippine Export Processing Zone in Cavite, Ayala Center, and Ortigas Center.

Due to the magnitude of investment required for sewerage systems and the low interest in connecting to them, no NGOs are interested in conventional sewerage systems. They promote alternative low-cost off-site sanitation options, such as the small-scale wastewater management system in Tingloy, Batangas, to be initiated by Urban Waste Expertise Program (UWPEP) of Holland.

Most sewerage facilities in the Philippines have been designed as conventional systems. Although applicable and relatively inexpensive, community-based small bore sewer systems have not been tried extensively. This technology and other available options are discussed in **Table 3.8**.

Table 3.8

Available Sewerage Technologies

Technology	Description	Advantages	Disadvantages
Sewage Collection			
Combined Sewer	Drainage and sewerage system that uses a single conduit for collection and transport of domestic wastewater and storm water runoff.	Less difficult to construct since only one pipeline needs to be laid. Minimal land requirement.	Not economically feasible to treat entire wet weather flow. Flow in excess of the interceptor cap is

			stored or usually discharged to receiving water body. Combined sewer overflow exerts severe environmental impact during wet periods.
Conventional Gravity Sewer	Collects effluent into a gravity reticulation system and transports to sewage treatment site away from urban/developed areas.	No need to construct septic tanks. No problem of combined sewer overflow. Provides greatest user convenience since all excreta and pathogens are transported away from developed areas.	Very high construction costs, as conventional sewers tend to be built deep and large. Operation and maintenance also difficult and expensive.
Simplified Sewerage	Developed in Brazil, resembles conventional system with reduced design criteria since conventional system design is generally quite conservative.	Same as conventional sewage system. Less costly due to reduced size.	Sewer lines tend to be constructed deeper and larger. Operation and maintenance difficult and expensive.
Small Bore Sewerage/ Common Effluent Drainage	Collects septic tank effluent into a gravity pipe system similar to conventional gravity sewer system.	Requires fewer manholes and uses smaller pipes at shallower depths than conventional sewer. Less land required for sewage treatment because most organic loading is removed in individual septic tanks.	Sewer lines tend to be constructed deeper and larger. Operation and maintenance difficult and expensive.
Condominal Sewer System	Also developed in Brazil, utilizes 100mm sewer line installed in backyards. Wastewater for entire block discharges to single point connection then to reticulation system to sewage treatment site.	Total length of the pipe is significantly reduced and laid at shallow depths, leading to additional construction cost savings.	Users are required to maintain sewer lines located on their property. Sound cooperation between sewerage agency, community leaders, and users a must.
Wastewater Treatment			
Subdivision Scale Septic Tank	Communal septic tank or communal upflow anaerobic sludge blanket unit with overflow into a drainage ditch; or communal package treatment plant (variation of activated sludge) discharging to nearby waterway.	Small scale, low cost (except for package treatment plant)	Requires community participation and commitment.

Primary Treatment	Minimum treatment required for effluent discharged to receiving water bodies via outfall. Limited reduction of organic pollution, still high OD.	Low cost treatment process that can remove 35 percent of BOD.	Significantly pollutes receiving body of water.
Treatment Using Aquatic (Duckweed) Plants	Duckweed plants (Lemnaceae) have voracious appetite for wastewater nutrients	Treated effluent is suitable for industrial or urban re-use, recharge of surface and groundwater, crop irrigation, or discharge to lakes and streams.	Needs very large land area. Very high initial capital investment.
Conventional Sewage Treatment	Wastewater treated in two stages; primary treatment followed by secondary treatment.	Can be economical for handling large volumes of wastewater in areas where land cost are high. Meets BOD and suspended solids criteria in DENR guidelines.	Very high initial cost for equipment (generally imported). Operators must be highly skilled both in maintenance of equipment and process. High power consumption.
Anaerobic Treatment	Uses upflow anaerobic sludge reactor that can remove 60-80 percent of BOD and COD.	Reasonable BOD and suspended solids removal; well stabilized sludge may be used as soil conditioner.	Less than secondary level treatment; very low removals of organic matter and some chemicals.
Waste Stabilization Ponds	Decomposable organic waste are stabilized by microorganisms and disease-causing agents reduced significantly due to long detention periods in antagonistic environment. Biological activity may be anaerobic, facultative, or aerobic.	Most economical method of sewage treatment where land is available at relatively low cost. Low operation and maintenance costs.	Large land requirement.

3.4.3 Special Waste

The Toxic and Hazardous and Nuclear Wastes Control Act of 1990 (Republic Act 6969) made the first step toward adequate treatment and

disposal of hazardous waste. The Act sets a framework for the control of these wastes but is only starting to be implemented by DENR.

Lack of effective enforcement of the legislation and appropriate penalties for violators renders it an ineffective deterrent; waste generators still dispose their effluents as cheaply as possible. While most industries are required to treat effluent prior to discharge into receiving waters, factories provide primary treatment only, and no secondary treatment facility accepts these effluents for further treatment. There are still no large plants capable of treating and disposing toxic and hazardous liquid wastes. Moreover, the absence of effective monitoring of effluent discharges allows unscrupulous waste generators to dispose toxic and hazardous liquid wastes in municipal drainage systems or water bodies.

Box 3.3 Summary of Technical Barriers and Constraints to Improved Sanitation and Sewerage

- **Lack of incentives for appropriate technologies**
- **Persistent use of technologies that do not significantly reduce pollution in street drains and receiving waters**
- **Lack of incentives to connect to existing sewerage systems**
- **Inadequate septage desludging and too few vacuum vehicles to collect septage**
- **Inadequate septage/wastewater treatment facilities**
- **Lack of treatment provision for special wastes**
- **High cost of conventional sewerage systems**
- **Lack of local experience in sanitation and sewerage management**
- **Limited information available at local level on sanitation and low-cost sewerage technologies**

3.5 Financial

3.5.1 Investments in Sanitation and Sewerage since 1970

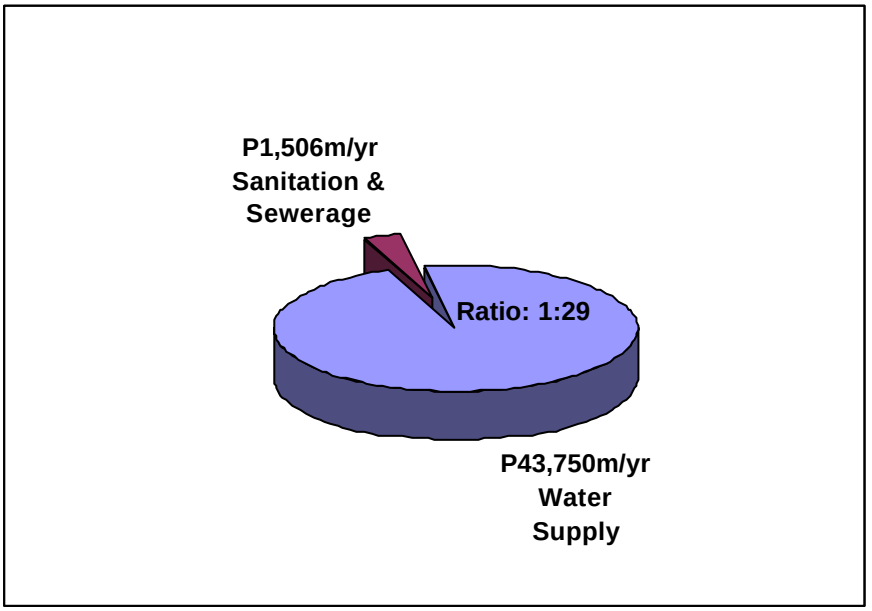
In the absence of consolidated data on investments in sanitation and sewerage management since 1970, research was undertaken to compile information on completed and ongoing sub-sector projects. In most cases, spending for water supply projects dwarfs investment in sanitation and sewerage. Comparing the investment in water supply and the sanitation and sewerage sub-sector is instructive, given that the volume of water supply delivered is directly proportional to wastewater generated.

Based on the available data, a summary of investments made in the sub-sector since 1970 is estimated, assuming an allowance of about 25 percent for projects that were implemented by other government and private organizations (PTA's Sewerage for Boracay Environmental Infrastructure Project, projects implemented by land developers, NGOs, etc.). Investment in the sub-sector was estimated at P1.5 billion per year. This figure is 29 times less than the estimated P43.8 billion average annual investment for water supply projects. In other words, for every 97 pesos spent on water supply projects, only 3 pesos were spent on sanitation and sewerage projects.

Figure 3.3

Investment in Water Supply versus

Sanitation and Sewerage



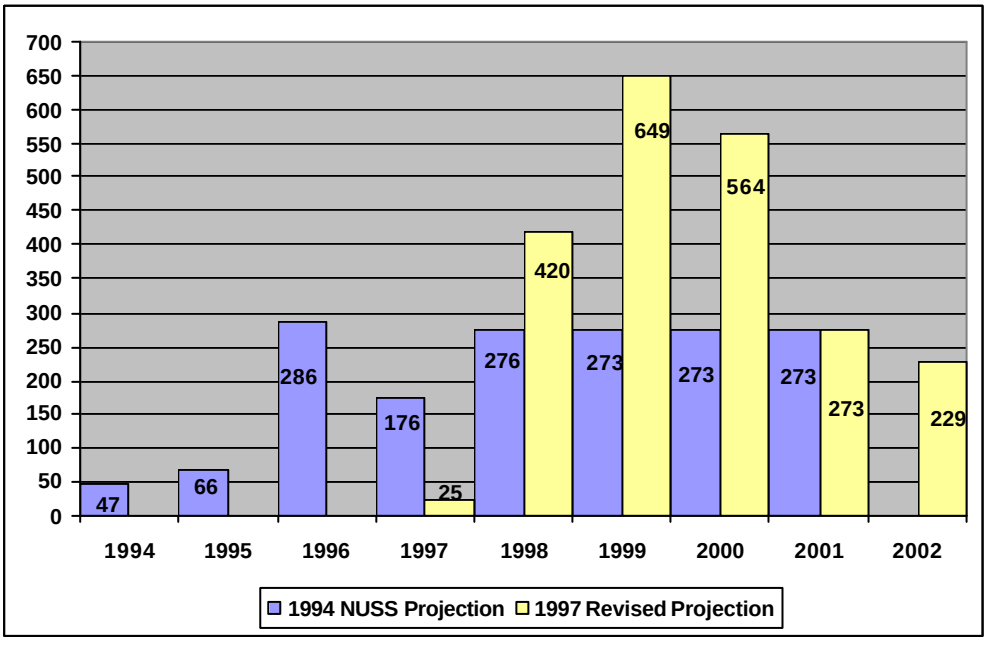
SECTOR	PERIOD	NO. OF YEARS	AVE. ANNUAL INVESTMENT (MILLION PESOS)	PERCENT
Water Supply	1974-2000	26	43,749.95	96.67
Sanitation & Sewerage	1970-2000	30	1,505.82	3.33
TOTAL INVESTMENT FOR BOTH SECTORS			45,255.77	100.00

3.5.2 NUSS Implementation Plan

The 1992 NUSS prepared an implementation plan for five pilot HUCs as demonstration project sites for sanitation and sewerage investment of P1.771 billion. Following snags in project implementation and the withdrawal and replacement of some sites, feasibility studies of the five pilot LGUs were completed in December 1996, and the budget portfolio was realigned. Subsequently, the Philippine national government negotiated with the World Bank for an appropriate loan, approved in October 1997 with a projected financing plan amounting to P2.161 billion. The project became officially known as the Water District Development Project (WDDP). The sewerage component became the Urban Sewerage, Sanitation and Drainage Facility of the World Bank, with Land Bank of the Philippines as implementing agency.

Figure 3.5 presents the WDDP spending plan, as originally conceived and as revised in 1997.

Figure 3.4
WDDP 10-year Implementation Plan



Source: NUSS, 1994

WDDP Staff Appraisal Report, July 1997

LBP initiated loan negotiations with LGUs in 1998. During the period, local elections loomed and no firm commitments to the project were obtained. Every selected LGU backed out of the project due to financial difficulties triggered by the Asian economic crisis, plus changes in local leadership and their project priorities.

The World Bank and LBP restructured WDDP and offered LGUs another opportunity to participate. The restructured project now caters to lower or feeder investments in sanitation and sewerage, such as the Barangay Environmental Sanitation Plan (BESP). The project began with two participating LGUs in August 2000. To date, there are four participating LGUs with an estimated loan amount (based on the Subsidiary Loan Agreement) of P590 million, about 27 percent of the planned 1997-2002 investment budget.

WDDP is financing sanitation and sewerage projects in the urbanized centers of Cabanatuan City, San Fernando City, Panabo Davao del Norte, and various municipalities of Palawan Province. The proposed sanitation investment is expected to improve public health and living conditions for more than 50,000 households.

WDDP's Project Management Office in LBP found that most LGUs were not aware of the implications and potential benefits of the project. WDDP needs LGUs to "champion" the implementation of sanitation-related investments, which have been given low priority in the past. Consequently, continuing presentations by PMO/LBP have drawn funding queries from more LGUs, building a long pipeline of prospective participants.

Another finding is the lack of willingness to pay for sewerage disposal, particularly among households. For this reason, only areas within the LGU with sensitive businesses that will be affected by domestic wastewater, such as tourist resort areas, protected areas and endangered resources, immediately favor provision of sanitation and sewerage infrastructures. Without these triggers, LGUs are less interested. They cite the following reasons:

- constituents are not accustomed to paying fees for domestic waste disposal;
- constituents believe that off-site treatment is the responsibility of the LGU;
- lack of awareness of economic, public health and environmental benefits;
- high tariffs;
- current financial difficulties.

Initially, the lack of willingness-to-pay is equally distributed among rich and poor households. However, willingness-to-pay surveys conducted in three

of the 1994 WDDP pilot sewerage project areas revealed that, after a briefing and distribution of Information, Education and Communication (IEC) materials, a majority of the populace in those target urban centers agreed to connect and pay. These commitments led to the endorsement of the project by City Councils. Middle- and high-income groups are mostly in urban centers, so it is imperative that these groups give their approval. It is also sensible, since they have businesses to protect and can benefit from increased land values. Low-income groups in these areas are mainly in slums and squatter colonies. Communal toilet facilities, which would be connected to the system, were proposed for them on a "user pays" basis.

Other Sources

In addition to the WDDP-USSD, additional funding for LGU sanitation and sewerage infrastructure has been initiated by Japan's Overseas Economic Cooperation Fund (OECF). The program is called the Local Government Unit Support Credit Program (LGUSCP) with LBP as the conduit bank. OECF has lent the national government P3 billion for loans to LGUs. This funding can be utilized for housing, health, water supply, flood control, sanitation, sewerage, solid waste and forestry projects.

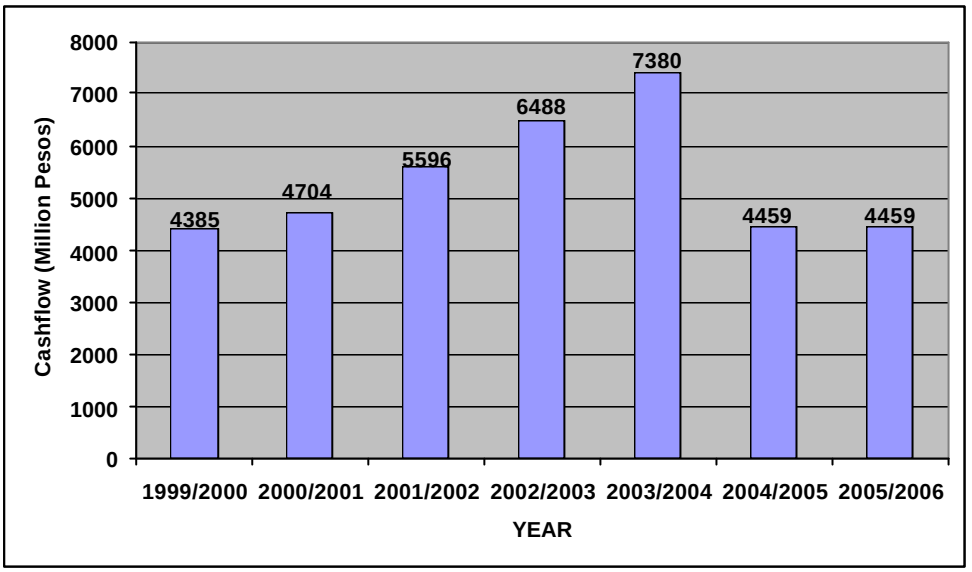
Other sources of funds that could be accessed by LGUs for sanitation and sewerage include their own internal funds and commercial bank loans.

3.5.3 The National Strategy and Action Plan (NSAP) for the Water Supply and Sanitation Sector

A medium-term investment plan for sanitation and sewerage sub-sector was prepared for NEDA in 1999. The Water Supply and Sanitation Sector Strategy Plan was financed by Asian Development Bank and was prepared by Australian Water Technologies in association with Brockman Tym International and Global Works International.

The Medium-Term Investment Plan covering 1999-2006 is presented in **Figure 3.6**. Sanitation project costs for LGUs were taken into account in devising the investment plan, as LGUs are able to secure loans for sanitation and sewerage projects as necessary (or according to demand).

Figure 3.5
Projected NSAP Investment Plan



Source: MTPIP
NSAP, 1999

3.5.4 Review of Investment Costs of Various Sanitation and Sewerage Technologies

While the 1994 NUSS thoroughly reviewed the costs of various sanitation and sewerage technologies, the investment costs for these technologies were updated in the 1999 NSAP. These cost parameters, which can be used for planning purposes, were used to update the Medium Term Investment Plan. Likewise, investment costs for various sanitation and sewerage technologies presented in the NUSS were updated to 1999 prices.

Box 3.4 Summary of Financial Barriers and Constraints to Improved Sanitation and Sewerage

- **limited funds at the local level to finance sanitation and sewerage infrastructure**
- **lack of financial support at the national level to provide incentives for sewerage projects**
- **limited willingness to pay for sewerage service by households**
- **inadequate provision of capital and revenue for sewerage/sanitation facilities**
- **low interest from potential private sector participants**

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 Lessons Learned and Conclusions

An assessment of current conditions and feasible improvements in the urban sewerage and sanitation sub-sector should be conducted, preferably involving all levels of government. This assessment would concentrate on large urban/commercial centers that, because of their size, generally are major contributors to sewerage and sanitation problems in the country. An assessment should also be undertaken in smaller urban municipalities that, due to their limited scale, do not have proper sewage disposal facilities.

Prioritization of capital funding must be based on sound technical and operational solutions. A strategy that will create the framework for longer-term achievement of goals – improved public health and greater economic development – should be formulated. Funds to meet capital and operating costs can be sourced from government revenues, user fees (all users: industrial, commercial, residential), trust funds or sinking funds, indirect taxation, or by donations and grants from domestic and external sources, such as private sector companies, NGOs, and multilateral development agencies. However, assistance from the private sector is likely only where a profitable return on the investment can be projected.

Sewerage management projects, even those employing alternative technology options, are very expensive. Individual users cannot be expected to shoulder the full cost of sewerage systems. The cost of urban sewerage and sanitation programs must be shared among households, business and other users, communities, local government units and the national government. The latter, directly and indirectly, benefits from the implementation of these sub-sector programs.

The Philippine national government has been unwilling to subsidize sewerage projects. But if it intends to pursue health and environmental improvements, it is not enough to declare that sewerage and sanitation projects have the highest priority; environmental preservation has been on the government's priority list for a long time. It is also imperative for the national government to provide grants or subsidies to share the cost of such projects. In other countries, the push for environmental projects was accompanied by substantial financing assistance from the national government. It is essential for the Philippine government to be an active financing partner for sanitation and sewerage projects in urban areas.

Pre-selection of cities has proven to be inappropriate, as the experience of the original NUSS/WDDP pilot sites demonstrates. Interest and commitment generated from cities through demand-driven approaches should be key factors in deciding where to undertake very costly sanitation improvement projects.

The recommendations of the National Urban Sewerage and Sanitation Strategy and its accompanying feasibility studies need to be addressed. The success of the restructured WDDP as a sanitation-cum-drainage project validates the concept of staged implementation for urban sanitation improvements, as recommended in the NUSS. This strategy is similar to those recommended in the 1999 NSAP.

Sewerage projects must also consider users' ability and willingness to pay. If tariffs are based on full cost recovery plus operation and maintenance costs – as national government guidelines require – many poor households will not be able to afford a sewer connection. Moreover, hierarchical approaches to project selection, rather than demand-driven approaches based on stakeholder input and support for the project, can make potential users unwilling to pay, regardless of income level.

The next important question is: what can be done? Here are some suggestions:

- **Immediately formulate a medium-term investment plan for the sanitation sector alone**, not as a component of a water supply and sanitation investment plan. Environmental funds available for the sub-sector from the World Bank through the WDDP and the LGUSCP of OECF (see **Chapter 3.5.2**) could be a starting point to stimulate LGUs to plan sanitation and sewerage projects. The medium-term plan should be supported by a national government enabling law (i.e., department order or decree) and guidance to LGUs for wastewater management.

- **Amend some existing laws and regulations.** Suggestions in the NUSS should be reconsidered (see **Section 3.5.2**). Political leadership both at the national and local levels will be required for success.

- **Strengthen institutional effectiveness** through new policies or following existing policies more rigorously, including improved enforcement and implementation guidelines.

- **Clarify roles and responsibilities, and establish clear accountabilities** for sewerage and sanitation sub-sector policies and projects. There should be a more clear delineation of functions and responsibilities among government agencies. More importantly, there should be clear accountabilities, i.e., who is accountable for what, where and when. Accountability extends not only to physical projects, but, critically, to finances: where funds go; which projects are to be financed; who will disburse and follow the funds (incoming and outgoing); and who will take charge of reporting on physical and financial progress. Financial issues are important and valid concerns.

- **Create an advocacy group for IEC and promotion** of the sub-sector. The group would encourage all sectors to enforce wastewater management regulations. The advocacy group would lobby and initiate IECs on the national and LGU levels to increase awareness regarding domestic wastewater management.

- **Implement community awareness programs** about the present situation, problems faced, future challenges, and possible solutions that can be successfully undertaken with the help of the target beneficiaries. Experience demonstrates IEC programs build support for projects.

- **Enact municipal government resolutions** that: (a) require all households applying for connections to water supply systems have appropriate water-sealed toilets with septic tanks and wastewater disposal; (b) authorize LGU officials to endorse water supply operators to temporarily cut off service to customers that fail to comply with and/or violate sanitation ordinances; and (c) compel all users to pay appropriate fees for sewerage and garbage collection services. (These steps should have already been taken for industrial, commercial and other large scale users.)

- **Develop appropriate and suitable low-cost sanitation and sewerage technologies** that match costs with willingness to pay and ability to pay. These technological options may be demonstrated through community-scale pilot projects.

4.2 Recommendations

With the lessons learned and the conclusions from the situation assessment of the sub-sector, the following steps are recommended:

- Develop a viable framework for sanitation and wastewater management, including institutions with the responsibility and accountability to manage sanitation and sewerage at both the national and local levels, delineating the roles of the service providers (i.e. Water District, LGU, private sector, and other agencies) within their areas of responsibility.

- Develop policies and guidelines for effective enforcement and implementation of regulations and legislation, including cost-sharing provisions.

- Document lessons learned – what went wrong? what went well? – in successful and unsuccessful projects.

- Provide LGUs with appropriate standards, guidelines and low-cost technology options to assist their decision-making.

- Initiate demonstration sub-projects in LGUs to highlight effective urban sewerage and sanitation models and practices, taking into account earlier findings and conclusions, for effective replication in other LGUs.

Each component is designed to complement and reinforce the others. Thus, the sub-sector assessment activities and outputs have direct effect on the outputs of the other components, and vice versa.

Using Capacity Factors for Multicriteria Decision Making in Sanitation Options

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1. Introduction and Problem Definition

Current responses to deficient municipal sanitation system (MSS) in lower income countries (LICs) by national governments and international agencies such as the World Bank (WB) and United Nations Development Programme (UNDP) focus on three primary factors to reduce this deficiency in service capacity: (a) policies, (b) programs, and (c) technologies. The weakness of previous interventions is the lack of a comprehensive focus on *capacity building* over the lifecycle of the infrastructure for these services. Worse are solutions that focus narrowly on building physical infrastructure that are at times inappropriate to the context of its environment. Consequently, the net is cast too close to the symptom of the problem, rather than striking at all its root causes. In fact deficiencies in municipal sanitation service capacity, either in quality or quantity, are symptoms of more deeply rooted factors endemic to sanitation systems. This paper identifies seven capacity factors that must be addressed in order to provide sustained access to municipal sanitation infrastructure. These capacity factors are; institutional, human resource, technical, economic/financial, environmental/natural resource, social/cultural, and service capacity (Louis and Bouabid, 2003). These capacity factors combine to assure service capacity in higher income countries (HICs) but their interaction in lower income countries (LICs) results in a deficiency in service capacity. Hence a failure to explicitly accommodate them in planning for MSS in the LIC will result in services that cannot sustain the demands of the local context in which they are built.

2. Description of Approach

This research postulates that there are seven such capacity requirements that determine the long term success or failure of a municipal sanitation system. When they are present in sufficient amounts and interact appropriately, they determine the long term success of the municipal sanitation system at sustaining the demand for services. These capacity requirements are the following and illustrated in Figure 1: (1) institutional capacity, (2) human resources capacity, (3) industrial capacity, (4) economic/financial capacity, (5) environmental/natural resources capacity, (6) social/cultural capacity, and (7) service capacity.

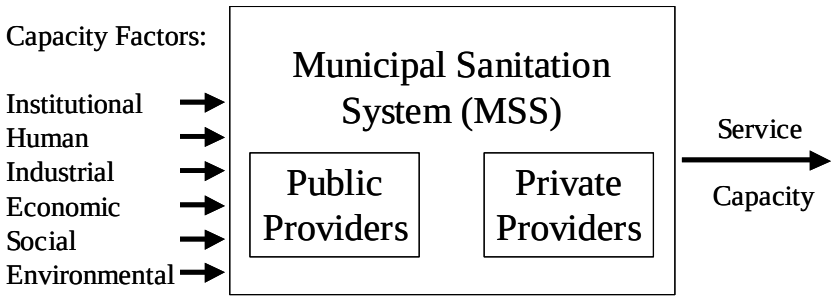

Figure 1: MSS Systems Diagram

Institutional Capacity refers to the body of laws and regulations, administrative agencies and procedures for the governance of MSS. In MICs such as the United States, MSS function in the context of well-established institutions at the national, regional and local levels. These are structurally decoupled from the political process of changes to the executive, legislative or judicial branches of government. However, in LICs such stability is not assured and the political process exerts direct and sometimes contradictory effects on the goals of MSS (Oro, 2000).

Human Resources Capacity refers to the stock of professionals, skilled labor, and unskilled labor available to MSS. MSS planning in LIC, must reflect the existing mix of expertise and grow in technical complexity as the skilled and professional pools increase. Investments in overly complex systems are costly, never recovered, and inappropriate to the conditions set by local capacity factors (Gupta and Van Beukering, 2000a).

Social Capacity refers to the socio-cultural values that underlie the way sanitation in general is perceived in society and the way MSS delivery is perceived as a practice by stakeholders. For example, in many parts of Asia, organic waste has traditionally been seen as a resource and has been used as animal feed, to fertilize land, and as a source of fuel for cooking. Accordingly, these perceptions greatly affect public participation in service activities for both suppliers and users of the service. Documented MSS planning through consultations with communities and NGOs are few but have been proven to be highly effective (Wright, 1997).

Industrial Capacity refers to the supply chain that supports the hardware and service needs of the MSS industry. This includes such services as the maintenance and repair of vehicles and equipment along with such hardware as machinery, tools, and spare parts. Where these hardware and services are not available locally, they have to be imported at higher cost, which may compromise the availability of the service. In the LIC, an informal sector often provides low quality supplementary services (Gupta and Van Beukering, 2000b). However, this informal sector is incapable of meeting the demand for sanitation services on its own, with the result that the barrios and shantytowns in urban areas are degraded by filth and related unsanitary conditions.

Economic and Financial Capacity refers to the markets for MSS, financing mechanisms (bonds, credit ratings etc.), and availability of cash to fund ongoing system operations. Capital investments usually come from general taxes or overseas development assistance (ODAs). Hence, economic resources for MSS are often variable and sporadic. Private businesses often subsist on government contracts that also depend on these same resources. Private financing mechanisms are generally not available for MSS in LIC (Blight & Mbade, 1998a).

Environmental and Natural Resources Capacity refers to the natural sources and sinks of the sanitation services systems. These are the surface and groundwater supplies for DWS, land and surface water discharges for WST and land and air quality for MSW landfilling and burning. As urban populations in the LIC increase, more of these resources will be consumed for MSS, even as they are competitively required to meet the other demands of development.

Service Capacity refers to the resultant service volume supplied by the providers of a sanitation service in a designated area. More detailed discussion on the different capacity factors are found in Appendix 1.

An assimilation of capacity requirement needs can be achieved through the identification of relevant criteria that have strong correlations to specific capacity requirements. In this fashion, the options for meeting the needs are in appropriate context of all the requirements that affect

service capacity. Table 1 summarizes the links between capacity requirements and project criteria. The following section details their relationships.

Table 1: Capacity Requirements Link to Criteria

	Capacity Requirements						
Criteria	Institutional	Human	Industrial	Environmental	Social	Economic	Service
Investment Cost	X					X	X
O&M Cost	X					X	X
Price/unit (Affordability)					x	X	X
Employment level		x	x		x	X	X
Local resource use	X	x	x	X	x	X	X
Market development			x			X	X
Pollution Impact				X		X	X
Health impact		x			x	X	X
Benefits to the poor					x	X	X
Capacity potential						X	X
Technical feasibility		x				X	X
Inter-service impact	X			X			X

Investment cost, O&M cost, and price/unit directly correlate with financial capacity, which refers to the markets for MSS, financing mechanisms (bonds, credit ratings etc.), and availability of cash to fund ongoing system operations. Financial capacity for investment recovery is critical to ensure project success and sustainability. Capital investments, typically derived from general taxes or overseas development assistance (ODA), are likewise critically affected by the public institutional framework governing these processes and must be taken into account in project selection.

The criterion for employment level is linked to the need to enhance human and industrial capacity, as well as economic capacity. Human resources capacity refers to the stock of professionals, skilled labor, and unskilled labor available for MSS projects classified in Table 4. In LICs, labor-intensive processes are usually preferable in order to generate jobs in the community. Increased employment in the region anticipates increased spending by consumers, which can potentially boost local economy.

Local resource mobilization aims to maximize the use of the available supply of resources indigenous in the area without sacrificing the sustainability of these resources. This also refers to available technical capabilities in the community to actually run the sanitation facility. The criteria relates to making the most out of local resources in order to reduce dependencies from external support. Accessible local resources for all the capacity requirements: institutional, human, industrial, environmental, social, economic, and service resources should be accounted.

Market development primarily concerns economic capacity and industrial capacity. Industrial capacity refers to the supply chain that supports the technology and service needs of the MSS industry. Where the supply chain for this technology and supported services are not available locally, they have to be imported at higher cost, which may compromise the availability of the service. Hence an adequate support system for MSS should also be developed locally. Studies also argue that adequate provision of sanitation services is a prerequisite for enabling socio-economic development. Certain industrial sectors will benefit from the input as well as output of the sanitation processes.

Pollution impacts affects environmental and natural resources capacity, which refers to the natural sources and sinks of the sanitation services systems. These include the surface and groundwater supplies for DWS, land and surface water discharges for WST and land and air quality for MSW landfilling and burning. These impacts to the environment have corresponding economic costs in terms of clean-up costs, health costs, and the like.

The Environmental and Planning Management (EPM) Source Book by the United Nations Environmental Program (UNEP) additionally suggests the criterion, benefits to the poor. This type of criterion is suggested by the United Nations as one of the crucial goals for LICs to combat poverty alleviation and improve social capacity.[i] As discussed earlier the hardest hit by deficiencies and shortages of the sanitation services are the poor.

Capacity potential and technical feasibility refer to the sustainability and life of the project or facility. These criteria concern the technical aspect of the project that obviously determines the price tag. Hence, the financial capacities in order to afford certain technologies can be limitations. Furthermore, the criteria must take into account the human capacity of possessing and expanding the capability of managing and maintaining the capacity over the lifetime of the project.

3. Results and Proof of Concept: Town X Case Study

Although the case study features solid waste, the process involved can readily be applicable to water or wastewater cases. Appendix 2 details the case study for the options analysis of solid waste alternatives for Town X. Due to intellectual property and confidentiality agreements, the town used in the study would like to remain anonymous. A multi-criteria decision making methodology was employed, grounded on the capacity factors described above. Table 2 lists these criteria according to capacity factors. An adhoc committee was formed to determine this list and use it to evaluate solid waste alternatives.

Table 2: List of Criteria for Town X MSW, 2002

Capacity Factors	Criteria
Institutional	Prohibition/ Support from laws and regulation
Human/Organizational	Job/ employment level
Industrial	Local resource mobilization
Environmental	Pollution impact Impact to wild-life habitat Impact to cultivable areas
Economic	Impact to other economic sectors (Market development) Investment cost Operational cost Impact to property values Affordability
Social	Health Impact

	Impact to urban poor Consensus (acceptability in community) Utilization Convenience
Service/ Inter-service	Capacity/ Capacity Expansion Potential DWS Impact WST Impact Short-term/ Long-term dimension Technical feasibility

4. Lessons Learned

Waste transfer topped environmental, social, and economic categories. However, undue reliance on other municipality made waste transfer an unpopular alternative for the committee since there is no long-term guarantee for the availability of the final sink. Although waste transfer scored high in the environmental category, environmental costs were still being incurred by somebody else's "backyard". Economically it was simply cheapest and socially it was easiest to perpetuate the status quo.

Composting was institutionally preferred by the central Government and the Department of Natural Resources. It had the most potential to mobilize local resources, generate employment, and develop the local economy. It scored highest with service capacity offering a long-term solution, flexible capacity, and more technical feasibility for LICs. Furthermore, the committee expressed partiality to the criterions where composting scored highest namely, 1) benefit to urban poor, 2) market development potential, and 3) long-term dimension. This tipped the scale to composting, gaining heavier points for these weights.

Brainstorming sessions from the ad hoc committee not only yielded good descriptions and illustrations of impacts but also fostered participation and solidarity. The adoption of the seven capacity factors also enabled the early identification of potential problems and formulation of intervention in different areas of the project implementation. An immediate benefit of using the analysis was in leveraging more support from the National Government, private sector, and other collaborative organizations.

Appendix 1: Definition of Capacity Factors/ Requirements

Institutional Capacity

Institutional capacity refers to the body of laws and regulations, administrative agencies and procedures for the governance of MSS. In HICs, MSS function in the context of well-established institutions at the national, regional and local levels. These are structurally decoupled from the political process of changes to the executive, legislative or judicial branches of government. However, in LICs such stability is not assured and the political process exerts direct and sometimes contradictory effects on the goals of MSS.[2]

Traditionally, management of municipal services is a responsibility of government at national and other levels of political administration and is therefore commonly performed by public officials. The ministries customarily involved are Public Works, Health, Environment and Natural Resources, Local Government, Social Welfare, and Community Development.[3] Generally at the national levels, there is a body charged with responsibility for formulating policies, planning, coordinating activities, monitoring and evaluating projects and programs. The responsibility is placed under one lead ministry. The policies are implemented through national service boards or corporations in charge of the services.[4] However, in the transition from governance at the national level to implementation at the local level, systematic planning for sanitation services is typically neglected.[5] Generally, the sanitation service operation is manned by crew of unlicensed laborers under the authority of the local government.[5] Furthermore, since daily management does not lie within the jurisdiction of a single local policy-maker, appropriate planning for local conditions is virtually impossible. This absence of system planning is compounded the lack of laws, regulations, and administrative structures and procedures necessary to assign responsibility and accountability for MSS delivery.[3]

Human Capacity

Human Resources Capacity refers to the stock of professionals, skilled labor, and unskilled labor available to MSS. MSS planning in LIC, must reflect the existing mix of expertise and grow in technical and administrative complexity as the skilled and professional pools increase.

MSS may be broken into four classes in order to analyze their human resource requirements. Table 3 summarizes this classification. Based on this classification, the human resources capacity requirements may be analyzed qualitatively as shown in Table 4.

Table 3: Classification of MSS Systems

Class	Name	Description
I	No Service	- no infrastructure

		- no service provider - no formal or informal service
II	Uncontrolled Unofficial Service	- no infrastructure - no formal service provider - informal service - *uncertified local provider* - *pirated* - neighborhood level
III	Uncontrolled Official Service	- no infrastructure - formal service provider - *administrative* - *operations* - informal service provider - multi-neighborhood: community level
IVa	Controlled Official Service - Distributed Local Systems	- infrastructure - formal service provider - informal service provider - consolidated communities - *distributed local systems*
IVb	Controlled Official Service -Centralized Regional Systems	- infrastructure - formal service provider - informal service provider - consolidated communities - *centralized regional systems*

Table 4: Human Resources Capacity Requirements for MSS Systems

MSS System Class	Human Resources Group					
	Professional		Skilled Labor		Unskilled Labor	
	Tech	Admin	Tech	Admin	Literate	Illiterate
I	Low	Low	Low	Low	Low	High
II	Low	Low	Low	Low	Med	High
III	Low	Low	Med	Med	High	High
IVa	Med	Med	Med	High	High	Med
IVb	High	High	High	High	Med	Low

The bulk of demand for MSS in urban settlements in LIC is from favelas, shantytowns and other informal settlements that throng the central area. Whereas centralized infrastructure and administration can meet the needs of cities in higher income cities, such systems are inappropriate for the conditions that determine demand in LIC. It is imperative that MSS planning for LIC reflect this reality. A failure to do so will result in the common case of LIC that make investments in large centralized systems that are costly, improperly operated, and unable to sustain service for the bulk of local demand. [6]

In LIC, the relatively few professionals and experts in MSS, primarily from the civil or chemical engineering professions (see Table 5) function in the managerial and consultant positions.[7] Supervisory and blue-collar jobs in these industries come from low-income

populations. Waste management as a field of study in particular is relatively scarce in LICs due to the lack of skills, expertise and interest in the field.[6] As a profession or trade it is further viewed as an inferior occupation, the work dirty and unimportant.[6] For example in India, people of lower caste levels undertake waste activities.[6] Since these activities are labor intensive and involve livelihood performed by the low-income marginalized people in the metropolis, informal sectors thrive in MSS. By sorting and collecting waste materials, providing and distributing water, or cleaning septic tanks, the informal sector accounts for 1-2% of the workforce in large cities.[8]

Table 5: Engineering Workforce in Selected Countries

Country	Year	Total No. of Engineers	Engineers/ 1,000 Population
High-Income			
USA[a]	1995	3,839,000	14.30
Canada[b]	1997	165,758	5.60
Middle-Income			
Estonia[c]	1998	16,800	11.85
Philippines[d]	1995	38,919	0.57
Low-Income			
India[e]	1990	3,494,544	3.76
Pakistan[f]	1993	13,000	0.08

a) US Bureau of Census, 1995
b) National Survey of the Canadian Engineering Profession in 1997: Summary of Findings
c) Statistical Yearbook of Estonia 2000
d) Commission on Higher Education (CHED), Philippines
e) Institute of Applied Manpower Research, I.P. Estate, Mahatma Gandhi Marg, New Delhi
f) Institution of Engineers Pakistan

Industrial Capacity

Industrial Capacity refers to the supply chain that supports the technology and service needs of the MSS industry. This includes such services as the maintenance and repair of vehicles and equipment along with such hardware as machinery, tools, and spare parts. Technology-intensive centralized municipal sanitation service providers, such as automated water treatment plants or anaerobic digesters for sewage treatment, are dependent on chemical supplies and require consistent scheduled maintenance for continuous reliable service. Where the supply chain for these services is not available at a low opportunity cost, the services are inappropriate for the industrial capacity of the location.[7] In such cases, it is not economically efficient to use those technologies to provide the service. Instead, a system that is less technology-intensive should be selected with the understanding that the region will evolve to a more sophisticated system when the supporting capacity requirements, are in place at a feasible cost.[9]

Economic and Financial Capacity

Economic Capacity refers to the markets for MSS, financing mechanisms (bonds, credit ratings etc.), and availability of cash to fund ongoing system operations. The term market includes public and private service providers, provisions for rate setting, fees and collection mechanisms to offset costs. The success of these markets is closely tied to institutional capacity requirements for the regulation of the natural monopolies that emerge in the provision of sanitation services.[10] This is most pertinent in view of the trend toward privatization of MSS in both LIC and HIC.[11,12] For example, the city of Manila contracted out 100% of waste collection and privatized its water and sewer service.[13] Trinidad and Tobago has a majority of its waste collection contracted out to private companies.[14] Alongside the formal private sector in LIC is the informal sector, which often provides supplementary services. Though this research includes contributions from the informal sector in its assessment of service capacity, extending the analysis of markets to include informal transactions, was beyond the scope of this work.

The traditional approach to MSS infrastructure financing in HIC is through government grants and municipal bonds.[15] At present a sizable portion of municipal budgets in LICs is spent on sanitation services, as much as 50% of municipal expenditures are allocated for solid waste management.[6] However, even with these levels of expenditure, services are far from desirable with an average of only 50% of the generated solid waste collected in cities.[16] Thus, in the case of LIC, capital investments for MSS usually come from general taxes, government-funded international loans, and overseas development assistance (ODA).

These three sources are inappropriate for financing MSS capital improvement and operations. General taxes provide a variable and politically-dependent source of financing to MSS providers that may not reflect actual system costs and financing need. In addition, general taxes are unable to send a signal to service consumers of the price of the MSS they receive. Thus, users have no price incentive to limit consumption and those with access to services are driven to overconsume. Government-funded international loans, from agencies like the World Bank and regional development banks, provide relatively low interest financing over long repayment periods. However, these funds place a burden on the MSS provider to generate earnings and/or contribute to GDP at a rate that exceeds the rate of interest on the loan. In fact, the rate of growth of its contribution to GDP will always be the net of the true performance and the loan interest rate. This is a high expectation for new system in an LIC with limited management and institutional resources. The likelihood is great that the MSS will be unable to meet this expectation, leaving the system and government backers with a net drain on the national income as they must allocate earnings to service the foreign debt.

Overseas development assistances, in the form of direct grants or subsidies on capital imports are sporadic in timing, amount, and volatile from currency exchange. ODA may also come with preconditions, such as spending for institutional change or environmental protections that are outside the jurisdiction of the MSS provider. Furthermore, since ODA involves the national government, its use by MSS providers will inevitably entail political involvement in the management of the MSS. Such involvement detracts from the MSS provider's goal of efficiently delivering safe, reliable municipal sanitation services.

Consumer's economic capacity is also becoming increasingly critical for planning sanitation systems. Willingness-to-pay surveys have been undertaken to assess the viability of user fees.[17] Many systems have been unsuccessful due to the inability of consumers to afford the type of service provided, which in turn undermines funding for capital investment, and operation and maintenance.

Environmental Capacity

Environmental Capacity refers to the carrying capacity of the air, water and soil media to absorb the environmental impacts of existing and planned sanitation services. For example, non-attainment areas for criteria air pollutants would most likely be denied permits for new waste incinerators. However, in the municipality of Town X, which is the subject of the case study for this thesis, air quality already laden with pollutants from thousands of motorcycles with uncontrolled two-stroke engines, is subjected to the emissions of hundreds of open fires, lit to burn uncollected MSW.

Natural Resources Capacity refers to the stock of natural sources required for the sanitation services. Thus it refers to the volume and quality of surface and groundwater for drinking water supply, the availability of land and the flow rate of receiving waters for effluents from wastewater treatment plants, the height of the water table for septic tanks and pit latrine systems, the acreage and soil type of land for landfills and composting facilities, as well as the energy capacity to support sanitation activities. As urban populations in the LIC increase, more of these resources will be consumed for MSS, even as they are competitively required to meet the other demands of development.

Social Capacity

Social capacity refers to the ability of the affected community to organize around a shared perception of the need for MSS, to formulate a common demand for service from municipal authorities, and to participate in community-based provision of MSS where appropriate. Though the affected community may not speak with one voice on social issues, the first step in building social capacity for MSS is the ability of the affected community to forgo its differences in order to achieve the greater good, in this case, MSS. The town of Town X, Nelson County – Virginia, is a multi-racial community that is also stratified by median household income.[18] Faced with a failing groundwater supply for their private wells, residents were able overcome racial and economic differences to collaborate in building the infrastructure for connections to the public water service provided by the County. In the condomial system in Northeast Brazil, individual households cooperate to manage a shared sewer infrastructure.[10]

Social capacity also refers to the absence of direct institutional opposition to the community organization necessary for providing municipal sanitation services in lower-income communities. Such organization requires the participation of an active leader or group of leaders who can motivate the community to organize, plan, implement, and manage the service. Community organization for MSS also requires the dissemination of

information through public meetings, pamphlets, the Press and other communications media. In many societies, institutional forces actively suppress some or all of these activities – influential community leaders, community organization for action, and community-based information dissemination. Under military rule in Brazil in the 1970s and early 1980s, the favelas - or shanty towns – of Sao Paulo Brazil, were denied and prevented from developing water service by the state water utility SABESP. With the withdrawal of military rule in the mid to late 1980s, the community organized to develop a management system and pressure SABESP to provide water service to their communities. [10]

Cultural Capacity refers to the cultural values that underlie a community's preferences for a particular type of access to the MSS. Many of the difficulties in implementing sanitation system arise from the fact that sanitation improvements are an intervention in the domestic domain. Its use requires a change in people's most private habits. For example, in cultures where there is a strong preference for privacy in matters of personal hygiene, community latrines or bath houses will not be acceptable. In cultures where waste management is determined by social class, caste or by gender, centralized facilities that do not reflect these cultural preferences will fall into disuse and disrepair. [10,19,20]

Service Capacity

Service capacity refers to the annual service volume supplied by the providers of a sanitation service in a designated area. In LICs, information on service providers, by type and capacity, is poor either because there is no service provider or the provider is from the informal sector and wishes to remain undocumented.[21] Where there are official facilities, these are assumed to operate at maximum capacity because the actual daily throughput is undocumented or unknown. Capital improvements of service facilities are irregular due to weak institutional, human resource, and financial capacity requirements. Indeed, capital improvements are often made in response to crises in service delivery. The combined effect of these factors is that cities in LICs commonly face mounting deficits between the supply of and demand for municipal sanitation services. Traditionally, supply-driven approaches predominate planning and are focused exclusively on providing infrastructure and technology to close the supply gap. In many instances, engineers and planners exclude the other capacity requirements (institutional, human resources, industrial/technical, economic/financial, environmental/natural resources, and social/cultural) as social and human sciences that are either irrelevant or outside the scope of the mathematical planning model and the engineered solution. As the phenomenon of megacities grows and the problems of deficient municipal sanitation services to the people of these cities multiply, planners have begun to consider interdisciplinary approaches to MSS planning in their search for sustained solutions.[22,23]

Appendix 2: Options Analysis

Town X has become an important link between the industrial and tourism areas. It also serves as one of the key residential catchments for the main city and those employed by the industrial centers with as much as 84% of its land allocated to residential areas. Town X has a size of 4,397.79 hectares divided into 73 political units.

Capacity Factors

A Succinct Description of the Capacity Factors for Town X is detailed in Table **6**.

Table 6: Capacity Requirements Appraisal for Town X MSW, 2002

Capacity Requirement	Assessment
Institutional	Municipal government – run. Relevant Laws: 1) Environmental protection laws 2) Solid waste code 3) Water code 4) Clean air act No active implementation and regulation.
Human/ Organizational	No professional staff. Small skilled crew for garbage truck maintenance. High unskilled labor force (mostly illiterate) for collection task and street sweeping. Some waste pickers.
Industrial	Rely on foreign imports (for garbage trucks, bins, and spare parts) and local engineering consultants.
Economic	Minor private sector participation. Some informal recycling market. No fees.
Environmental	Heavily impacted air, water, and land. No LF space.
Social/cultural	High personal hygiene, dissatisfied with no service.
Service	20% of total demand (75,792MT/yr)

Goal-Criteria Elicitation

The adhoc committee undertook first round evaluations of alternatives. To reiterate, the adhoc committee consisted of representatives from the different divisions of the Municipality of Town X.

The vision of Town X embodied the ultimate goal of the committee – To achieve sustainable development. This vision of Town X stated in the following passage:

> *We, under the guidance of Almighty God, and equipped with political will, envision a progressive, well developed, self-reliant, peaceful, healthy, and environment friendly city through sustained developments.*

The capacity appraisal along with other suggestions from various stakeholders guided the criteria identification. The results are listed in Table **7**.

Table 7: List of Criteria for Town X MSW, 2002

Perspectives	Criteria
Institutional	Prohibition/ Support from laws and regulation
Human/Organizational	Job/ employment level
Industrial	Local resource mobilization
Environmental	Pollution impact Impact to wild-life habitat Impact to cultivable areas
Economic	Impact to other economic sectors (Market development) Investment cost Operational cost Impact to property values Affordability
Social	Health Impact Impact to urban poor Consensus (acceptability in community) Utilization Convenience
Service/ Inter-service	Capacity/ Capacity Expansion Potential DWS Impact WST Impact Short-term/ Long-term dimension Technical feasibility

Options Analysis

Current technologies provide for several proven methods to manage and dispose of solid waste. Town X decided to adopt the approach of a multi-tiered hierarchy of an integrated solid waste management program. Figure 2 gives an overview of current options available. These options are as follows:

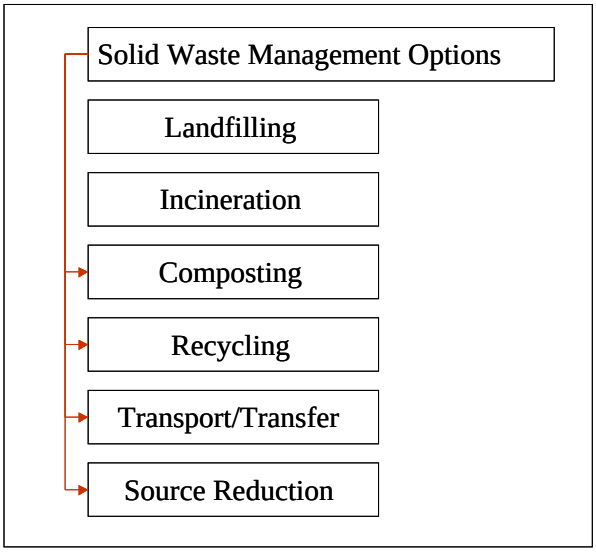

Figure 2: Alternatives for MSW

Table 8. Long-term Alternatives for Town X MSW, 2002

MSW Alternatives	Description
Landfilling	Landfilling is widely used in industrialized countries for long-term storage of solid waste. Current regulations for the design, operation, and closure of landfills fall under severe restrictions governing landfill lining systems, leachate collection and disposal, and landfill gas collection and treatment.
Incineration	Incineration is another technology widely used in industrialized countries which combust waste and on occasions produces energy. Uncertain emission risks from these facilities are currently being debated, hence the unpopularity of this technology.
Composting	Composting is the process where components of the solid waste stream is separated and then allowed through controlled natural processes, to decompose. The resultant "stabilized" materials are then utilized for land conditioning. Odor impacts and market problems are potential issues of the composting alternative. Caution is advised for co-composting of animal and plant waste, which have already failed in the US.
Recycling	Recycling has become an important program for solid waste management that has helped bring the issues of solid waste to public discussion and involvement. Four primary categories of recycling are common: commingled recovery, when recyclable and compostible materials are removed from the waste stream after collection and disposal, source separation when recyclable and compostible materials are separated prior to collection.
Transport/ Transfer	The transportation and transfer is the movement of waste and disposal to other municipality housing final disposal facilities such as landfills. The transfer of solid waste between municipalities can be a dangerous issue in the future where "not in my backyard" and "you pollute, you clean" mentalities are starting to take root.
Source Reduction	Source reduction and prevention is the practice of minimizing or avoiding discards. It can be achieved through using less material in making a product, making products more durable, making products easily repairable, or by making products easily recyclable. Reduction of waste increases the life span of disposal sites.

Table **9** lists the long-term, medium-term, and short-term alternatives considered by the Solid Waste Group of Town X. The long-term alternatives were presented to the adhoc committee for initial evaluation. The next sections illustrate the MCDM process that followed.

Table 9. Alternatives with IRP Components for Town X MSW, 2002

	Long-term	Medium-term	Short-term
Landfilling	Develop landfill	NA	NA
Incineration	Set up incineration plant	NA	NA
Composting	Set-up large-scale Composting Facility	Implement household composting	NA
Recycling	NA	Implement waste segregation program	NA
Transport/ Transfer	Purchase more garbage trucks	NA	Rehabilitate out of order garbage trucks
Source Reduction	NA	Implement source reduction program	NA

The committee convened to evaluate the alternatives in accordance with the established criteria. Consensus had to be reached as opposed to averaging scores per evaluator. Each alternative was given a nominal score (high, medium, low) for its performance with each criteria, detailed in Table **10**. The discussion method details are described in Appendix 3.

Table 10. Evaluation of Alternatives of Town X MSW by Committee, 2002.

Capacity Requirement	Criteria	Long-term Alternatives			
		Landfill	*Incineration*	*Composting*	*Transfer*
Institutional	Law/ Regulation support	Medium	Low	High	Low
Environment	Pollution impact	High	High	Medium	Low
	Impact to wild-life habitat	NA	NA	NA	NA
	Impact to cultivable areas	NA	NA	NA	NA
Human	Job/ employment level	Medium	Low	High	Medium
Industrial	Local resource mobilization	Low	Low	High	Medium
Economic	Market development	Low	Low	High	Low
	Investment cost	High	High	Medium	Low
	Operational cost	Medium	High	Medium	Low
	Impact to property values	High	High	High	Low
Social	Health Impact	Medium	High	Medium	Low
	Benefits to urban poor	Low	Low	High	Low
	Consensus	NA	NA	NA	NA
	Utilization	NA	NA	NA	NA
	Convenience	High	High	Low	High
	Affordability	High	High	Medium	Low
Service/ Inter-service	Capacity Potential	Low	High	Medium	Low
	DWS Impact	High	Medium	Medium	High
	WST Impact	Medium	Low	Medium	High

	Short/Long-term dimension	High	High	High	Low
	Technical feasibility	Medium	Low	High	High

Composting scored best overall (see Table **11**) for both the total and average scores, followed closely by waste transfer. Landfilling trailed in third with incineration having the lowest overall scores. The following details the performance of the alternatives per capacity requirements.

Composting scored best in the institutional requirement due to its preference by Solid Waste Code. Incineration was badly perceived since the adoption of the Clean Air Act that made the incineration of waste extremely prohibitive. Waste transfer was viewed politically unstable since it involves the jurisdiction of other municipalities for both transport and disposal. Landfilling was acceptable but only under stringent specifications, which required more documentation and paperwork in the design and development stage.

Waste transfer scored best in the environmental requirement since ultimately this involves the transfer of environmental impacts of the final sink, somewhere else. Composting scored better relatively to landfilling. Landfilling was viewed skeptically due to server land scarcity as well as its potentially negative environmental effects. Incineration was also viewed negatively environmentally, discouraged by the Clean Air Act.

Composting scored best for the human requirements since this alternative is expected to employ relatively more blue-collar workers for the manual separation tasks anticipated in the operations. Landfilling and waste transfer scored better than incineration, which was viewed to require highly skilled engineers to operate and maintain the facility.

Composting scored best for the industrial requirements. Composting is expected to use more local resources by employing waste pickers and integrating the informal recycling operators in the facility. Landfilling and incineration required imported equipment and expertise, while waste transfer sustained the status quo and so was given an acceptable score.

Waste transfer scored best the economics category. Incineration and landfilling were considered relatively more expensive from composting and waste transfer options. Although markets from crop growing and gardening activities were projected, waste transfer was perceived cheaper than composting and benign to property values since limited land is required.

Waste transfer again scored best in the social category with lesser health impact, more convenience, and still affordable. The composting alternative anticipates in the future, a rigorous source separation program at the household level. Thus, scoring low in inconvenience. Health impact for both incineration and landfilling are considered high.

For the service requirements, composting won. It has been selected as the most technically feasible due to the waste composition of Town X, having biodegradable waste

as much as 66% of the total waste stream. It was felt that the current system lacks the technical capabilities to undertake incineration and landfilling technologies predominant in HICs while composting has been advocated more for LICs. Waste transfer scored poorly due to the unsustainability of the alternative for the long-term as well as dependency with other municipality's landfill capacity. Nominal scores were numerically translated, compiled, and summarized in Table 11 and Figure 3.

Table 11. Evaluation of Alternatives of Town X MSW Computations, 2002

Capacity Requirements	Criteria	High Score	Low Score	Land-fill	Incinera-tion	Compost-ing	Transfer
Institutional	Law/Regulation Support	3	1	2	1	3	1
*C_ave**				2	1	3	1
Environmental	Pollution impact	1	3	1	1	2	3
	Impact to wild-life habitat						
	Impact to cultivable areas						
*C_ave**				1	1	2	3
Human	Job/ employment level	3	1	2	1	3	2
*C_ave**				2	1	3	2
Industrial	Local resource mobilization	3	1	1	1	3	2
*C_ave**				1	1	3	2
Economic	Market development	3	1	1	1	3	1
	Investment cost	1	3	1	1	2	3
	Operational cost	1	3	2	1	2	3
	Impact to property values	1	3	1	1	1	3
*C_ave**				1.25	1	2	2.5
Social	Health Impact	1	3	2	1	2	3
	Benefits to urban poor	3	1	1	1	3	1
	Consensus						
	Utilization						
	Convenience	3	1	3	3	1	3
	Affordability	3	1	2	1	2	3
*C_ave**				2.0	1.5	2	2.5
Service/	Capacity Potential	3	1	1	1	2	3
Interservice	DWS Impact	1	3	3	2	2	1
	WST Impact	1	3	2	3	2	1
	Short/Long-term dimension	3	1	3	3	3	1
	Technical feasibility	3	1	2	1	3	3
*C_ave**				2.2	2	2.4	1.8
			Sum	**30.0**	**24.0**	**39.0**	**37.0**
			Ave	**1.76**	**1.41**	**2.29**	**2.18**

Note: *C_ave – average score of impacts contained within the perspective category**

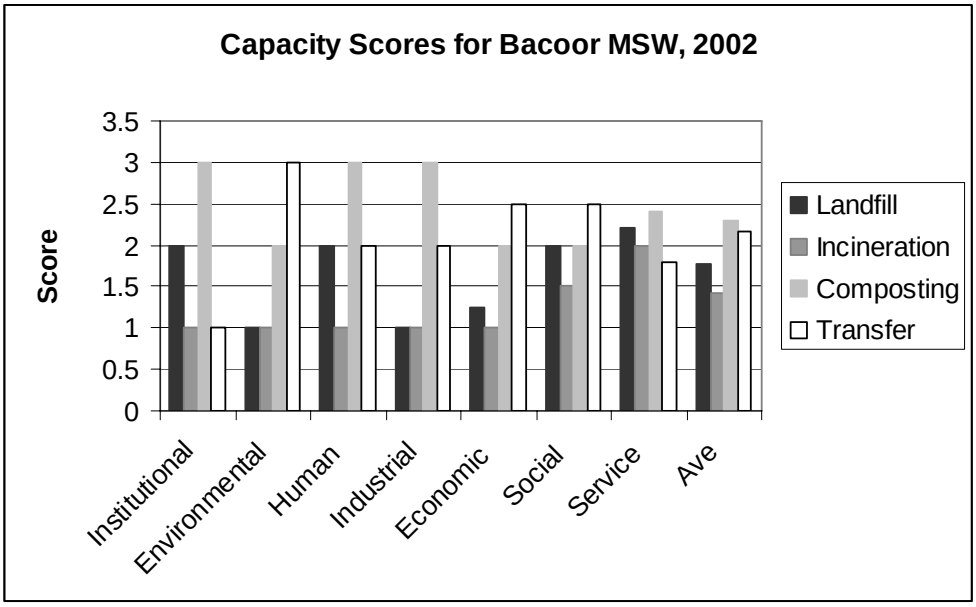

Figure 3. Category Scores for Town X MSW, 2002

Since waste transfer and composting had close scores. Further analysis of the two alternatives based on the capacity requirements was undertaken. Composting topped institutional, human, industrial, and service capacity requirements, 4 out of 7 of the capacity requirements.

Waste transfer topped environmental, social, and economic categories. However, the unsustainability of waste transfer for the long-term and reliance on another municipality made it an unpopular alternative for the committee since they were dependent on a final sink that did not guarantee continuity. And although it scored high in the environmental category, environmental costs were still being incurred by somebody else's "backyard". Economically it was simply cheapest and socially it was easiest to perpetuate the status quo.

Composting was institutionally preferred by the central Government and the Department of Natural Resources. It had the most potential to mobilize local resources, generate employment, and develop the local economy. It scored highest with service capacity offering a long-term solution, flexible capacity, and more technical feasibility for LICs. Furthermore, the committee expressed partiality to the criterions where composting scored highest namely, 1) benefit to urban poor, 2) market development potential, and 3) long-term dimension. This tipped the scale to composting, gaining heavier points for these weights.

Recommendation

In summary, a multi-tiered approach was adopted. The bulk, biodegradable waste, shall undergo composting, while recyclable materials go through recycling. This process is undertaken in a Materials Composting and Recovery Facility (MCRF). The household composting, source separation and reduction program is implemented not only to encourage sustainable waste practices but also to support the operations of the MCRF.

Waste transfer/transport operations still need to be carried out to address residual waste. This assumes that a remote final disposal site such as a landfill will be available for the residuals. The recommendation is detailed below:

I. A short-term component to increase waste-transfer capacity by rehabilitating inoperative trucks
   - Rehabilitation of 3-5 trucks (rear loader/side loader) with 14-m^3 capacity for collection of additional 1,500 tpy.

II. A medium-term component to develop a household segregation and composting program
   - Organization of a Community Mobilization and Environmental Education Program (CMEEP) for general environmental education and specific program information.
   - Information drive concerning source separation program: compostible vs. non-compostible waste.
   - Implementation of two-bin system for household, communal, and commercial waste.
   - Implementation of a hierarchical collection fee system (source separated collection fee should be lower than previous standard garbage collection fee)
   - Facilitation, training, and installation of household composting.
   - Estimated additional capacity of 25,000 tpy.

III. A long-term component to develop a Material Composting and Recovery Facility (MCRF) for composting waste and recyclables
   - Composting has been selected as the most practical alternative.
   - The development of the MCRF will be housed in 5.3 hectares of land with a capacity of 43,200 tpy.

Figure 1: Land for the MCRF in Town X, January 2002

Appendix 3: Discussion Method

1. Discussion Group

In a discussion group, a small group of individuals (from five to eight) who are knowledgeable about a particular subject discuss the topic among themselves. Participants make no formal presentations; they exchange ideas through conversation.[i]

Included in the group are representatives from the following divisions of the Town X:

- Planning Division
- Health Division
- Environmental Division
- Social Works Division
- Trade and Industry Division
- MSW Group

2. Purpose

- To identify criteria for options analysis
- To evaluate options in accordance with the established criteria
- To reach a consensus in the decision-making process

3. Participant Responsibilities

- To attend multiple sessions for the MSW issue
- To participate in the activities of the discussion group
- To support the decision-making results of the discussion group

4. Procedure

A. Identify Participants

Identify suitable discussion participants and invite a small group to a meeting at an agreed place and time. The Board of Supervisors appointed the participants from the various divisions.

B. Launch the Official Opening of the Group Discussion

• Begin by introductions: invite participants to introduce themselves.

• Explain clearly the purpose of the discussion. There is no right or wrong answer but what are needed are each participant's views.

• Points, counterpoints, rebuttal, and general discussion are all appropriate. However, discussion is to deal with the main issues. All team members should be considerate and willing to discuss issues.

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[i] Hannsmann, Ralph, Scholz, Roland W., Crott, Helmut W., Mieg, Harald, A., "Education in Environmental Planning: Effects of Group Discussion, Expert Information, and Case Study Participation on Judgment Accuracy", *Natural and Social Science Interface*, Swiss Federal Institute of Technology, Zurich, November, 2001.

C. Criteria Identification

• The eight capacity requirements were presented to the participants.

• Participants were asked to write down their suggested criteria for the options analysis.

• The collected criteria from each participant were presented to all categorized by capacity requirements.

• Consensus was achieved by agreeing to employ all suggested criteria (see Table A5-12).

• The criteria identification activity took up one session.

Table A5-12. List of Criteria for Town X MSW, 2002.

Perspectives	Criteria
Institutional	Prohibition/ Support from laws and regulation
Human/Organizational	Job/ employment level
Industrial	Local resource mobilization
Environmental	Pollution impact Impact to wild-life habitat Impact to cultivable areas
Economic	Impact to other economic sectors (Market development) Investment cost Operational cost Impact to property values Affordability
Social	Health Impact Impact to urban poor Consensus (acceptability in community) Utilization Convenience
Service/ Inter-service	Capacity/ Capacity Expansion Potential DWS Impact WWS Impact Short-term/ Long-term dimension Technical feasibility

D. Options Analysis

• The pre-determined alternatives were presented to the participants.

• The participants evaluated the alternatives in accordance with the established criteria. Each alternative was given a nominal score (high, medium, low) for its performance with each criteria.

• Consensus had to be reached as opposed to averaging scores per evaluator. Hence, prolonged discussion was necessary between participants to agree on a score (see Table A5-13. Evaluation of Alternatives of Town X MSW by Committee, 2002.).

• Several criterions had to be dropped because the criterion was vague, not easily evaluated, or unknown. These criterions were impact to wildlife, impact to cultivable areas, consensus (acceptability), and utilization.

• The nominal scores were translated to numerical scores and tabulated.

• The options analysis activity took up two sessions.

Table A5-13. Evaluation of Alternatives of Town X MSW by Committee, 2002.

Capacity Requirement	Criteria	Long-term Alternatives			
		Landfill	*Incineration*	*Composting*	*Transfer*
Institutional	Law/ Regulation support	Medium	Low	High	Low
Environment	Pollution impact	High	High	Medium	Low
	Impact to wild-life habitat	NA	NA	NA	NA
	Impact to cultivable areas	NA	NA	NA	NA
Human	Job/ employment level	Medium	Low	High	Medium
Industrial	Local resource mobilization	Low	Low	High	Medium
Economic	Market development	Low	Low	High	Low
	Investment cost	High	High	Medium	Low
	Operational cost	Medium	High	Medium	Low
	Impact to property values	High	High	High	Low

Table A5-13. Evaluation of Alternatives of Town X MSW by Committee, 2002.…continued

Capacity Requirement	Criteria	Long-term Alternatives			
		Landfill	*Incineration*	*Composting*	*Transfer*
Social	Health Impact	Medium	High	Medium	Low
	Benefits to urban poor	Low	Low	High	Low
	Consensus	NA	NA	NA	NA
	Utilization	NA	NA	NA	NA
	Convenience	High	High	Low	High
	Affordability	High	High	Medium	Low
Service/ Inter-service	Capacity Potential	Low	High	Medium	Low
	DWS Impact	High	Medium	Medium	High
	WWS Impact	Medium	Low	Medium	High
	Short/Long-term dimension	High	High	High	Low
	Technical feasibility	Medium	Low	High	High

E. Summary of Results and Conclusion

• The main purpose and objectives of the discussion group was reiterated. The results were reviewed and presented to the Board of Supervisors.

Composting scored best for both the total and average scores, followed closely by waste transfer. Landfilling trailed in third with incineration having the lowest overall scores.

• Participants walked away feeling that they not only participated in a good learning experience, but also that they learned something about the content and about themselves as well.

• The sessions were brought to a close.

5. Materials

A range of materials including documents and pictures to introduce topics for discussion, were used. Handouts on the capacity requirements and the alternatives were given. Paper and pens were provided for the participants. A blackboard was used for presenting and discussing issues for all to see.

6. Tips on Leading a Good Discussion

• Create a safe climate. Group discussions require that leaders create a climate in which each participant feels safe and secure to voice opinions, questions and uncertainties without the threat of embarrassment or ridicule. This ensures a richer exchange of dialogue and opinion.

• Keep the conversation moving. Good discussion groups must have balance and broad participation. No one perspective or participant can be allowed to dominate the discussion, even though there may be some specific directions in which a lesson ultimately must go. Occasionally, a leader may need to prompt students who tend to sit on the sidelines to get more involved. Listening sheets, visuals, and other teaching-learning aids could help the process of discussion by adding visual support.

• Keep the discussion on topic. Chasing rabbits is one of the greatest risks of group discussions. In order to keep the discussion on track, leaders can periodically summarize the topic, clarify goals and set guidelines, such as time limits for speakers.

• Help facilitate clear communication. Good leaders help participants be better listeners, hearing the message and intent as well as the words. Good leaders may recognize that what may seem like agitation is merely a person's inability to adequately express a thought. In instances like this, the leader can help learners reshape their thoughts and help them communicate more clearly.

• Deal with group difficulties. Sometimes discussion topics may be volatile and sensitive. One participant may be very passionate and very rigid about the subject, exhibiting that he or she will not bend on a subject through verbal or nonverbal communication. Help this learner listen to and be tolerant of people who have different opinions.

• Serve as co-learner. One particular benefit of the discussion approach is that leaders can be participant as much as a teacher. Although leaders should retain control, learners have the sense of being on the same plain with the leader, a feeling that can motivate some to become more active participants.

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E C L A C

Economic Commission for Latin America and the Caribbean

Regulation of the private provision of public water-related services *

* This work was prepared by Terence R. Lee and Andrei Jouravlev of the Environment and Development Division of ECLAC. The views expressed in this document, which has been reproduced without formal editing, are the sole responsibility of the authors and do not necessarily coincide with those of the Organization.

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Summary

Since the 1970's, the governments of the region have been transferring, in one form or another, public companies and other state institutions to the private sector. Privatization has now extended to all sectors of the economy, including water-related public utilities. Private sector involvement in the provision of water-related goods and services offers potentially significant efficiency gains. It will not, in itself, guarantee lasting welfare improvement unless, there is a competitive market. If not, results will depend on the regime of regulation in which the industries operate. The effectiveness of this regime is determined by the ability of governments to find and create adequate institutional and regulatory conditions that oblige supplies of water-related goods and services to be efficient and responsive to the needs of their customers. Monopoly regulation includes structure regulation, which determines which organizations or types of organizations can engage in which activities, and conduct or behavioral regulation, which concerns the permitted behaviour of organizations in their chosen activities.

This paper outlines the principles believed to be essential in formulating an adequate regulatory framework for the water sector. Its focus is on the issues to be confronted in developing a regulatory structure for water-related public utilities. It reviews a vast body of recent literature on economic regulation and private sector participation in the provision of water-related goods and services as well as the experience of the countries where privatization and regulatory reforms have advanced most. Emphasis is given to the regulation of prices, product and service quality, investments and quantity. The alternative means of overcoming the problems of asymmetric information between regulator and regulated firms, the limited commitment powers of governments and regulators, conflicts between regulators with different mandates, government failure and regulatory capture are also discussed, as are the possibilities of introducing competition and facilitating regulation through changes in the industrial structure, including horizontal and vertical restructuring.

The paper is the second of a series of studies on the privatization issue in water resource management. The focus of the first paper of the series - "***Private participation in the provision of water services. Volume I. Alternative means for private participation in the provision of water services***" (LC/R. 1576, 8 September 1995) - is on the alternatives available for the privatization of water-related services and the experience of governments with these different alternatives. Considerable emphasis is given to the number and variety of alternatives available for structuring private sector participation in the provision of water-related services and for institutional reform in the public sector. Other papers provide a country-by-country guide to current policy, with examples of actual cases of privatization, and discuss more directly the economic theory behind the policy alternatives for defining roles of the public and private sectors in the management of water resources and the provision of water-related goods and services.

Introduction

Historically, many water-related services were provided through the private sector, especially electricity generation, but, commonly, both drinking water supply and irrigation. Until the late 1950's, the power sector in most Latin American and Caribbean countries was privately owned (Santos, 1993); prior to 1950, it was not uncommon to see private provision of drinking water supply and sanitation services (Richard and Triche, 1994); and the private sector has always maintained an important role in the development of irrigation in most countries (UN/ECLAC, 1994a). The direct involvement of the public sector, other than municipalities, in the operation of water-related infrastructure is a relatively recent phenomenon. It is only this century, and since the 1920's, that governments decided that water-related services should be provided by the public sector and only since the 1940's that such services should normally be provided by agencies of the central government rather than by states or municipalities (Lee, 1990). The reasons for this expansion of the public sector into the provision of water-related services are complex, but basically arose from the decision of governments and international institutions that decisive government intervention in the economy was required to maximize economic welfare through economic growth.

Since the 1970's, however, opinion has begun to change to place emphasis on maximizing the role of the private sector. Again, the reasons advanced are varied. The basic reason is, however, a change in ideology and it is now accepted that the private provision of productive services is the more effective tool for bettering economic welfare. As a result, since the 1970's, and beginning in Chile, the governments of Latin America and the Caribbean have been transferring, in one form or another, many public companies and other state institutions to the private sector. Such transfers have been especially marked in manufacturing and other directly productive activities, but privatization has extended now to almost all sectors of the economy, including the provision of most water-related services. There are now numerous examples in Latin America and the Caribbean of the successful incorporation of the private sector into different water-related services in a great variety of ways.

Private sector involvement in the water sector offers potentially significant efficiency gains but does not in itself guarantee lasting welfare improvement. Unless, there is a competitive market, results will depend on the ability of governments to find adequate institutional and regulatory solutions to the provision of water-related services by the private sector. Given that the transfer of the responsibility for the provision of water-related goods and services and their management to the private sector has formed

and will continue to form in many Latin American and Caribbean countries an important part of the privatization process, it is important to identify those features which contribute to its success or failure in improving welfare.

Economic theory presents convincing evidence that under specific conditions competition, where it can be achieved, is a very powerful and effective force which directs privately motivated actions to socially desirable outcomes - i.e. it gives firms good dynamic incentives to reduce costs and increase efficiency, to improve the price/quality combination they offer to consumers, to innovate and to introduce new products and services - and ensures that markets automatically achieve economic efficiency and maximize social welfare. Overall, available evidence supports this conclusion and suggests that privatization of industries operating in competitive markets free from substantial market failures generally leads to significant efficiency gains and that private ownership is preferable on efficiency grounds. In these industries, the regulation of market power is typically indirect: competition does most of the regulatory work, and the task for public policy is to see that it is not undermined, i.e. that there is no prevention, restriction or distortion of competition (Vickers, 1995).

Under certain conditions inherent in the nature of the activity, competition between alternative suppliers of a commodity or service is not possible. Many water-related services, especially the provision of drinking water supply and sewerage, tend to be natural monopolies (i.e. firms whose costs fall as output increases in the range of production relevant to the market size), where the provision of the service by a single firm results in lower costs than its provision by two or more firms, and hence competition is not possible or would entail inefficient and prohibitively costly duplication of fixed assets. In the industries characterized by large economies of scale, the free market outcome would typically involve a multi-firm industry with imperfectly competitive behaviour as well as unexploited economies of scale (Perry, 1984). There are several policy options open to governments regarding natural monopolies managed or owned by the private sector whether providing water-related services or in other areas of the economy.

Firstly, a government might decide that monopoly rents are worth accepting and do nothing. Even though this approach implies that society will sustain a welfare loss, there may be cases where this loss is worth accepting and users may prefer paying monopoly prices for a high quality service rather than going without or making do with an inferior supply. Moreover, where under-provision of services and their poor quality are the major problem, as in many Latin American and Caribbean countries, concerns about the imperfections of service provision by an unregulated private monopoly may be of little importance compared with the existing losses from poor provision. Furthermore, losses due to monopoly pricing by unregulated private natural monopolies would be offset, at least in part, by the advantages given by size and integration.

Unregulated monopolies, however, have important drawbacks. On the one hand, where competition is not possible and consumers have no alternative sources of supply if the service is poor or the price is high, a natural monopoly, as any other monopoly either public or private, will try to maximize its profits. It does this by charging monopoly prices, and hence producing less output, or arbitrarily reducing service or product quality. Welfare losses from monopoly prices can be expected to be especially high in the case of water-related products and services because most of them are characterized by extremely low price elasticity of demand, particularly at low consumption levels (see Jones, 1994). On the other hand, the substantial market power that insulates a natural monopoly from competitive market discipline, diminishes incentives for innovation and efficiency. With no threat of competition from other firms, natural monopolies may not have the incentive to pursue cost-reducing behaviour, rather they will permit a considerable degree of slack in their operations. As Adam Smith (1776) said, "Monopoly … is a great enemy to good management, which can never be universally established but in consequence of the free and universal competition which forces every body to have recourse to it for the sake of self-defence". Finally, the fact that in a typical natural monopoly industry, a high proportion of the total cost has to be irrevocably committed before a project becomes fully operational and begins to earn profit, while government can never make a credible commitment not to regulate in the future and there is always the risk of new entry, means that a natural monopoly will not find it in its interest to invest at the efficient level.

Secondly, a government might decide to continue the provision through a public enterprise, although this option is likely to be unattractive in the present circumstances and lead to the continuance of the problems of inefficiency, capital shortage, poor service quality, etc. which have prompted the reconsideration of such an alternative in the first place.

Thirdly, cooperatives are potentially an interesting option. There is considerable experience in Latin America and the Caribbean with cooperatives, particularly for small electricity or drinking water supply and sanitation systems. However, cooperatives seem to work best only for smaller systems in rural areas and small towns.

Finally, a government might decide, as most governments in the region now have, to transfer services to the private sector and to use whatever means at its disposal to influence private sector behaviour. Where market failure, such as natural monopoly, occurs and is substantial in terms of the associated welfare loss and in relation to the associated government failure, intervention in the operation of the market by government would be desirable. This means that rather than owning and operating such facilities, it is the role of the government to undertake "optimal intervention" to correct for those failures and to help restore the conditions needed to achieve economic efficiency. In regulated industries, regulator acts as a substitute for the market, taking on some of the functions of

competitors, attempting to provide similar incentives to improve efficiency by regulating aspects of the firm's conduct (Helm, 1994b).

Regulation and privatization have distinct advantages over public ownership in that they allow market forces to operate and government intervention to be targeted on the areas where market failures are most pronounced (Bishop, Kay and Mayer, 1995). Effective regulation requires that the precise sources of market failure are identified, isolating them and targeting regulation specifically on them. Appropriate regulatory design maximizes the benefits from removing market failures, in relation to the cost of government intervention, because the marginal benefits of regulation decline linearly as intervention increases, while costs rise exponentially (Jones, 1994).

The shift from the reliance on public ownership and bureaucratic control for the provision of water-related services to the reliance on a regulated private monopoly, completely changes the demands on the water resource management institutions and also requires a thorough reconsideration of the policies that have been adopted towards water resource management in the past. The privatization of water-related services forces a reconsideration and readjustment of the role of the state in water resource management. It demands not only that the state withdraw from many activities but, that it takes on new ones, often of a very different nature and requiring different skills and knowledge of the public sector personnel. In water resources, all the experiences show that privatization does not just stop with the transfer of assets, but requires continuing regulatory action by the public sector.

This can mean, and has meant, the restructuring of ministerial responsibilities - for example, the transfer of the supervision of drinking water supply and sanitation companies from the Ministry of Health or Public Works to Economy or Finance or an autonomous regulatory commission - in line with the new role of government in the regulation of private companies instead of their direct control thought public ownership. It can mean, and has meant, the disappearance of activities from the public sector, as private operators take over responsibilities such as, for example, investment planning when the supply of new facilities is left to be determined through competition and the market, the plant operating (dispatching) schedules for power stations when they are decided by competitive bids rather than by a central dispatcher office, the supervision of cultivation plans for irrigation districts when the individual farmer decides on production or the determination of release schedules for reservoirs where the operators are privately-owned electricity generating companies. In the countries where state-owned enterprises have been entrusted with regulatory functions, privatization necessarily involves the reallocation of these responsibilities to an independent regulator. Keeping agencies responsible for operating functions independent of those with regulatory responsibilities is necessary to ensure consistent and unbiased administration of regulatory standards and because a service

provider with regulation functions can control access to the market and deter potential competitors.

The focus of this paper is on the issues to be confronted in developing a regulatory structure for water-related public utilities. To this end, it reviews a vast body of recent literature on economic regulation and private sector participation in the provision of water-related goods and services as well as the experience of the countries where privatization and regulatory reforms have advanced most. Emphasis is given to the regulation of prices, product and service quality, quantity and investments. The alternative means of overcoming the problems of asymmetric information between regulator and regulated firms, the limited commitment powers of governments and regulators, conflicts between regulators with different mandates, government failure and regulatory capture are also discussed, as are the possibilities of introducing competition and facilitating regulation through changes in the industrial structure, including horizontal and vertical restructuring. A lengthy discussion of these aspects is justified, and of particular importance for the water-related sectors, because the development of the idea or concept of water resource management in Latin America and the Caribbean has occurred within a context where the major users of water were within the public sector and where the private sector was largely excluded from participation in management (Lee, 1990 and UN/ECLAC, 1994a).

In deciding on a policy of introducing private sector capital and management into the provision of public water-related services such as drinking water supply, sanitation, hydroelectricity generation or irrigation and drainage, governments have many options. This paper presents and analyses the variety of regulatory instruments which are available, and which are being applied in the countries where reforms have advanced most, to attract and regulate private sector participation in the provision of water-related services. It is important to note that "effective regulation is necessarily a complex business, and to pretend otherwise is likely to have damaging long-term consequences for the industries concerned. Undue simplification of the initial framework of regulation for privatized monopolies will … very frequently lead to the emergence of much more serious difficulties in the longer term" (Vickers and Yarrow, 1988).

I. The regulation of monopolies

In industries with significant market failures, incentives for allocative and productive "efficiency depend critically on the regimes of competition and regulation in which the industries operate" (Armstrong, Cowan and Vickers, 1994). Regulation is a response to problems of market failure and monopoly regulation is such response to markets which suffer from ineffective competition and excessive market power. The aim of regulation is to correct market failures through either very specific actions, which can include measures of functional integration and separation, control of pricing and possibly investment and quality or a legal prohibition of the exercise of potential monopoly power.

Regulation is a system that allows a government to formalize and institutionalize its commitments to protect consumers and investors (Tenenbaum, 1995). Regulatory objectives usually include: (i) the promotion of allocative and productive efficiency; (ii) the minimization of informational rent (due to the asymmetry of information between regulator and firm); (iii) the avoidance of regulatory capture; and (iv) the development of credible commitment (Armstrong, Cowan and Vickers, 1994). How to reach these objectives simultaneously is one of the central questions for regulatory policy.

It is useful to distinguish two broad modes of regulation: ***structure regulation***, which determines which organizations or types of organizations can engage in which activities (e.g. merger control, market share of incumbent firms, measures of functional separation such as vertical and horizontal structure, and liberalization and entry restrictions); and ***conduct or behavioral regulation***, which concerns the permitted behaviour of organizations in their chosen activities (e.g. product price regulation, access price regulation, regulation of non-price behaviour such as policy against anti-competitive behaviour, regulation of service and product quality and environmental regulation) (Vickers, 1991). Thus, conduct regulation exercises direct control over the objectives of the regulated firm, while structure regulation exercises direct control over the structural environment of the firm, i.e. regulates the number and types of firms in the industry, but not their behaviour (Perry, 1984). The regulation of monopoly will usually require a combination of the two.

The nature of conduct regulation is largely dictated by structure regulation. In order to minimize the scope for government failure, there should be as little of conduct regulation as possible. Regulators should seek to create a reward structure which confronts firms with strong incentives that lead to socially optimum choices, rather than engage in micro-management which is not much different from the management of state-owned enterprises; there is little merit in converting a public monopoly into a heavily-regulated private monopoly. The creation of such a structure involves identifying the precise sources of market failures, using structure regulation to isolate the activities with which they are associated, and targeting conduct regulation directly on the areas where market failures are most pronounced. If structure regulation fails to achieve this end, conduct regulation may be ineffective in restraining monopoly power and may induce productive and allocative inefficiencies.

Five criteria have been proposed as a basis for comparing regulatory systems (Littlechild, 1983):

- ***Protection against monopoly***, which includes: (i) the distributional concern that may exist about the level of monopoly profits, and (ii) the economic efficiency concern that the dominant position that a monopoly enjoys in the market may allow it to become inefficient and to exploit its monopoly power, causing welfare losses (Rees and Vickers, 1995).
- ***Encouragement of efficiency and innovation***, or the dynamic aspect of economic efficiency, i.e. the incentives that the regulatory system provides for the allocation of resources to research and development, innovation, and technological change.
- ***Minimization of the burden of regulation***, since regulation is imperfect and consumes scare resources, it is important to compare different regulatory systems in terms of their need for information, i.e. how they address the problem of asymmetric information, and other resources, and their vulnerability to regulatory capture.
- ***Promotion of competition***. Since regulation is intrinsically imperfect while competition, where it can be achieved, is the best regulator, regulation should seek to encourage full and effective competition as a means to the end of achieving economic efficiency and reducing the regulatory burden.
- ***Maximization of the proceeds from privatization and prospects for the firms***.

To what extent should public authorities rely on structure or conduct regulation is an empirical problem that necessarily depends on industry-specific conditions such as the scope for new entry and competition afforded by the underlying technological and market conditions and the degree of the asymmetry of information.

At one extreme, in irrigation there are no questions of natural monopoly. Market liberalization, restructuring and reduced transportation costs can be counted on to supply the beneficial pressures of competition and of contestability which will autonomously perform a major part of the regulatory function and remove the need for most forms of industry-specific conduct regulation. Structural reform of this nature would also be the appropriate policy choice for other water-related activities which do not involve high sunk costs, produce tradable outputs with a wide range of substitutes and can be restructured to ensure effective and undistorted competition. Electric power generation, particularly in the larger countries, is a case in point, as is confirmed by the generally successful experiences of Argentina and Chile. The same considerations could also apply to some aspects of wastewater treatment and rural drinking water supply and sanitation.

At the other extreme, potential entry and competition are generally limited with current technology in the transmission and distribution activities of drinking water supply and sewerage. In this and other industries with severe natural monopoly characteristics, two or more firms usually cannot profitably coexist in the same area. Even if all barriers to entry were removed, new entry would not materialize except at the expense of productive inefficiency related to the prohibitively costly duplication of fixed assets. In industries with a high degree of natural monopoly, conduct regulation, rather than structural reform and the promotion of competition, is the appropriate policy response.

Even in the industries with severe natural monopoly characteristics where direct market competition in neither desirable nor feasible and where conduct regulation has to be relied upon, there are usually major segments where competition is both desirable and feasible. These segments comprise an artificial monopoly and the appropriate response is the application of general competition and anti-trust or anti-monopoly policies.

Structural reform and the promotion of competition is likely to be more effective, and should probably have priority over conduct regulation, in those sectors, such as electricity generation, characterized by fast changes in the underlying technological and market conditions, because change provides the very circumstances in which new entry is feasible (Beesley and Littlechild, 1989). It also renders conduct regulation less efficient because rapid change tends to increase the asymmetry of information between regulator and firm. As an industry becomes more competitive, the need for specific industry regulation will decrease. Conversely, industries where the underlying rate of change is relatively slow, such as, drinking water supply and sewerage, offer the most promising conditions for conduct regulation. Even in these industries, however, a permanently low rate of technological change cannot and should not be taken for granted.

A. Conduct regulation

The objective of conduct regulation is to determine the permitted patterns of behaviour of regulated firms in the public interest. In other words, it imposes constraints on the regulated monopolies in order to change their conduct in the interest of society.

Conduct regulation can include product price regulation, access price regulation, regulation of non-price behaviour such as policy against anti-competitive behaviour, regulation of service and product quality, quantity, investment and environmental regulation. The central question in conduct regulation is how to regulate all the relevant aspects of a firm's conduct simultaneously.

1. Price regulation

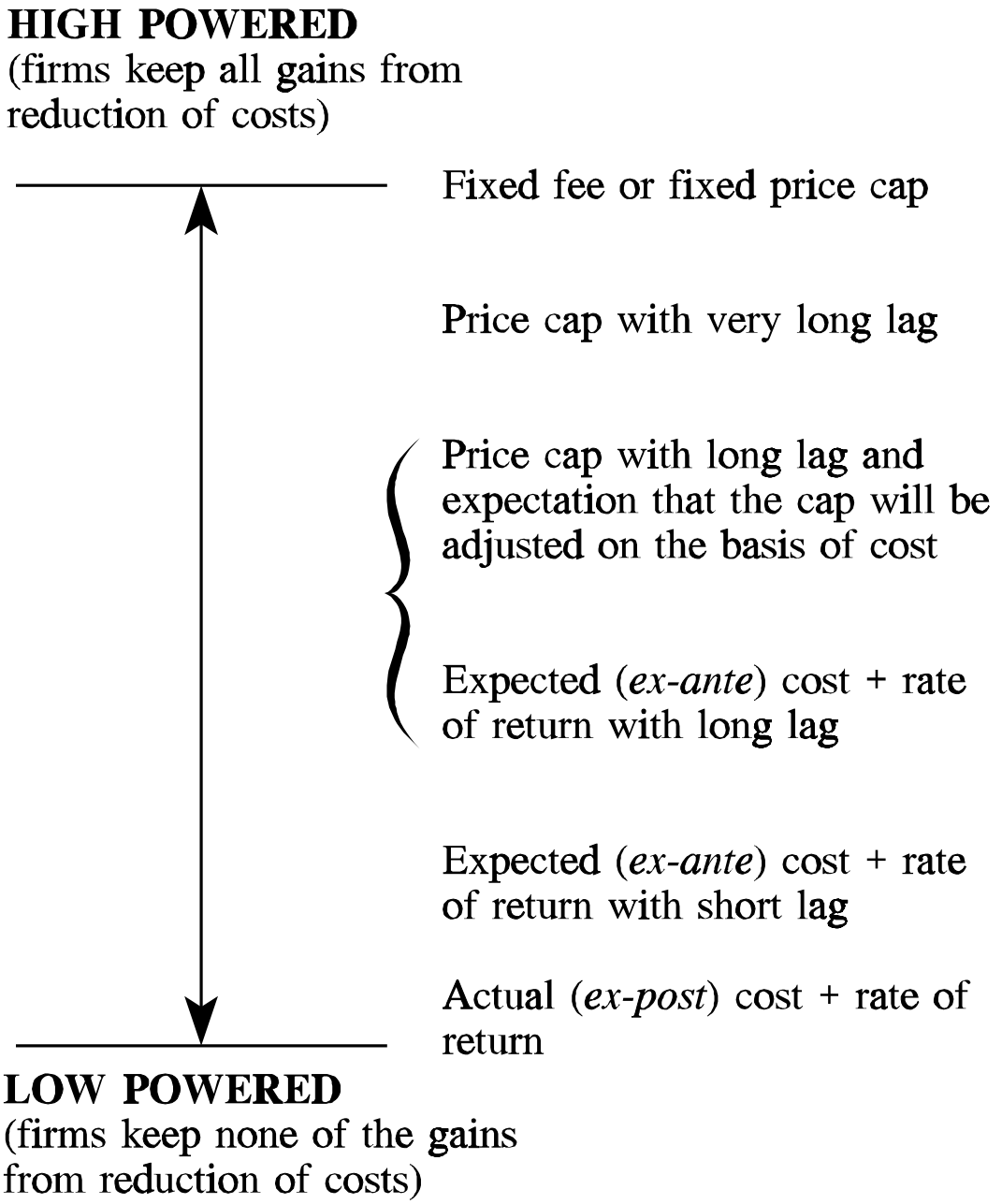
Price regulation is the cornerstone of conduct regulation. The purpose of regulating prices is to protect consumers from exploitation by monopoly providers, to protect private investors from exploitation by government and to create a macroeconomic and regulatory environment which gives an incentive to firms to invest and operate efficiently. Stated most broadly, the major issue in price regulation is how a regulatory institution can establish incentives for the regulated private firm to act so as to maximize social welfare in a situation where the firm's and society's interests usually diverge and where the information available to the regulator and the firm is asymmetrical in favour of the firm.

(a) The principal mechanisms of price regulation

Two principal mechanisms of price regulation are generally employed, commonly known as rate-of-return and price-cap systems. Neither is ever applied in a "pure" form. The options within the two systems really fall along a continuum between the extremes of actual costs plus a permitted rate of return, what are called *ex post* cost-plus (rate-of-return) contracts, under which a firm has no or little incentive to economize, to fixed fee (price-cap) contracts, under which a firm has full incentive to reduce costs, as it keeps all the benefits of its cost minimization behaviour (see Figure 1).

Figure 1

Incentive power of pricing schemes



Source: adapted from Jones (1994).

The choice of regulatory approach will depend upon the characteristics of the regulatory environment and particularly the underlying technological and market conditions. Much will depend on market structure and a country's institutional endowment (Nellis and Roger, 1994). Other relevant factors include the costs of monitoring performance, the extent of the information asymmetry between regulator and firm, the ability to design and implement the regulatory regime, the likely impact of the firm's cost-minimization activities, and the scope for efficiency improvements.

(i) Rate-of-return regulation*

Rate-of-return, sometimes known as cost-plus or cost of service, regulation is the traditional method of regulation of public utilities in many countries, including the United States (see Box 1). It ensures that the regulated firm earns a "fair" return on its invested capital, but not much in excess. It scores well on the criterion of restraining monopoly power, but poorly on the criterion of securing maximum operating efficiency, i.e. it puts emphasis on allocative rather than productive efficiency (Kay, 1993).

Under this system, the regulator establishes, through negotiations with the firm or on the basis of other factors, a rate of return which is above the market rate and guarantees this rate of return as long as investments are considered prudent. Tariffs are calculated so that total revenues equal total costs, including the cost of capital (fair rate of return). They are set for a fixed period of time, known as the period of regulatory lag, during which the firm can freely choose whatever input combination it wishes, although the regulator has oversight control over the firm's choices. Although tariffs are fixed until new ones are approved by the regulator, there may also be automatic adjustment provisions. The period of regulatory lag lasts until the next regulatory review which can be initiated by the regulator, the regulated firm, or the consumers. Reviews might occur at some time specified in advance or their timing might depend on the firm's behaviour or on other factors. The regulatory review is a process of checks and balances in which new prices are determined in negotiations between the firm and the regulator in representation of consumers.

Normally under this system if the regulated firm wishes to adjust its prices, it files to change the existing tariff, usually on the grounds that the achieved rate of return on the capital employed has become inadequate (Beesley and Littlechild, 1989). Rates are set on the basis of a number of factors (IEA, 1994). First, the magnitude of the assets that are "used and useful" in the provision of service is established. This is the "rate base" and it is usually calculated on the basis of historical costs, i.e. purchase costs less depreciation. Second, the regulator examines the utility's capital structure and sets the maximum return

* This discussion draws on Joskow, 1989, Laffont, 1994b, Train, 1991 and Vickers and Yarrow, 1988.

that it is allowed to earn on the equity part of the capital structure. Third, these data plus the cost of debt or interest payments, operating expenses, including depreciation and an allowance for working capital, and assumptions about demand are used to calculate the "revenue requirement", i.e. the revenue that must be generated by sales to cover all legitimate expenses and provide a fair return to the shareholders. The regulator then proceeds to allocate the revenue requirement to the various categories of customers (e.g. residential, commercial and industrial in different seasons and different times of day) on the basis of the costs they impose on the system. Finally, rates are computed using established rate design methods.

Box 1

Electric utility regulation in the United States

In the United States, the electric power industry has, traditionally, been regulated under the rate-of-return system. Only recently, have regulators begun encouraging more competition and adopting incentives or performance-based and price-cap regulation.

Under this system, electricity prices are set to reflect the historical costs of providing supply to each class of consumer. Rate increases are based on a utility's revenue requirements and are set to provide a reasonable return on equity. More recently, the regulatory agencies have required utilities to consider marginal cost pricing, and in several states are now calculating prices based on long-run incremental costs and are implementing time-of-day and seasonal rates.

This cost-based regulation system has many strengths and the industry has sustained a good financial record - bankruptcy is extremely rare. Regulators have authority to require disclosure of financial information and to direct how accounts will be maintained. They can examine the reasonableness of investments and exclude them from the rate base when such investments are considered imprudent. The regulatory bodies have independent and professional staff who are free of political influence and are protected by law from dismissal for political reasons. Open hearings and transparent information on costs and performance help ensure the integrity of utilities. Customers, investors, suppliers, environmentalists, and the public are all able to participate in the regulatory process.

The system has, however, certain weaknesses. The costs of regulation tend to be high, especially for parties participating in studies and hearings, and delays can be frequent because of the quasi-juridical proceedings for rate changes. Rate-of-return regulation encourages utilities to seek rate increases to cover increases in costs rather than reduce costs or increase efficiency. Utilities that overinvest and maintain excess capacity usually are able to pass on these costs to consumers. Moreover, apart from regulatory directives, there are no cost or market-based incentives to adopt least-cost investment, load management, or energy conservation.

Source: World Bank (1992).

Under traditional rate-of-return regulation, utilities are allowed to earn an acceptable annual rate of return each year, so regulatory reviews can be frequent. Rate-of-return regulation provides, therefore, a better insurance to regulated utilities against cost movements than price cap-regulation will. In the United States, for example, suppliers can apply for a rate review at any time (Grout, 1995). Filing a rate case and obtaining governmental approval to change prices tends, however, to be time-consuming and expensive (Mathios and Rogers, 1989). In other countries, however, rate-of-return regulation does not provide for this flexibility.

In recent years traditional rate-of-return regulation has been criticized because it is difficult to define a "fair" rate of return, and because: (i) it provides poor incentives to minimize costs and innovate; (ii) it encourages the firm to use an inefficiently high capital/labour ratio for its level of output; and (iii) it requires too much detailed knowledge of the industry on the part of the regulator.

The fact that rate-of-return regulation is based on capping profits rather than prices means that poor incentives are provided for cost minimization, except in a limited way through the regulatory lag. Since prices are set so that the regulated firm is assured of a specific return on its investment after recovering its costs and its prices are reduced in step with decreases in costs, it may have relatively little incentive to engage in cost minimization behaviour and innovate its production technology and service offerings (Mathios and Rogers, 1989).

The *ex post* version of rate-of-return regulation in which the firm is reimbursed for its actual costs, including the opportunity cost of capital, provides no incentives whatsoever for cost reduction. The United States (or *ex ante*) version where the last period's costs serve as the basis for the current period's prices provides more incentives to reduce costs and the regulatory lag reinforces these incentives (Jones, 1994). A series of empirical studies of the United States drinking water supply industry, however, has failed to find significant differences in the relative efficiency of private utilities subject to rate-of-return regulation and public utilities which would seem to confirm the low incentive properties of rate-of-return regulation (see Feigenbaum and Teeples, 1983, Byrnes, Grosskopf and Hayes, 1986 and Lambert, Dichev and Raffiee, 1993).

The perceived insufficient incentives under rate-of-return regulation have led regulators to move away from its traditional forms and toward versions incorporating efficiency incentives (Braeutigam and Panzar, 1993). These allow firms to share in the social gains from efficiency through increased profits and thereby provide incentives for increasingly efficient production and innovation. One of the common approaches is the "sliding scale" version of rate-of-return regulation which is closer to price-cap regulation. Under this approach, regulated firms keep all profits if the rate of return on investment

is below a specified level and then they share in profits for at least some levels of the rate of return above that level. To implement this approach the adoption of a progressive profit sharing formula is recommended so that customers receive a larger portion of the initial gains and the portion the utility is allowed to retain from the additional cost reductions gradually increases (Navarro, 1996). This gives the utility a progressively rising incentive to reduce costs, otherwise it will pursue the easiest cost reductions and then stop cutting costs too soon.

Rate-of-return regulation can give firms incentives to employ too much capital, i.e. use an inefficiently high capital/labour ratio for its level of output, often called "gold-plating" or the Averch-Johnson effect (Averch and Johnson, 1962). This occurs because, although there are restrictions on the return that the regulated firm may make per dollar of capital, there are no direct limits on absolute profits, providing an incentive to expand capital stock to increase the total return (Boadway and Wildasin, 1984). Because of this problem, regulators are forced to scrutinize expenditures carefully. Regulators usually require their approval for new investments and often disallow excess capacity from the rate base. Conversely, to limit underestimates of demand, they can penalize a firm if rationing occurs (Lewis and Sappington, 1988).

To the extent that the Averch-Johnson effect operates, it does so subtly (Johnson, 1973). For example, it usually does not result in a firm purchasing additional equipment solely for the purpose of including it in its rate base holding it otherwise idle, rather it will seek to derive whatever additional revenue is obtainable through overcapitalization (Bailey, 1972). The validity of the Averch-Johnson thesis has been subject to some discussion. Some analysts assert that regulatory lag offsets the potential adverse effects of the Averch-Johnson effect, the incentives the effect provides may enhance productivity and it may have a beneficial effect as incentives to overinvestment may offset the monopolist's tendency to restrict output (Phillips, 1993). However that may be, in most cases investment is directly regulated (Laffont, 1994b).

Rate-of-return regulation has been criticized on the grounds that it takes into account the whole business, or a large part of it, rather than centring on the particular services where market failures are most pronounced and public concern is greatest (Littlechild, 1983). On the other hand, it is usually inconsistent with competition and liberalization, since competition from new entrants will reduce the rate of return below the specified level (Levy and Spiller, 1994). One way to reconcile rate-of-return regulation and competition is to guarantee a fair rate of return on capital to the totality of investors in an industry, but to make the prospective allocation of returns among the different companies dependent upon their relative performance (Vickers and Yarrow, 1988).

Rate-of-return regulation is very detailed in application, i.e. requires accurate and detailed information on costs and determination of how to allocate common costs among services that are provided jointly or in common, which makes it unduly burdensome and costly to operate. Measurement of the rate of return can also be the source of considerable controversy. Rate-of-return regulation involves extensive research into the accounts of regulated firms to determine which costs should be included in the rate base, and which should be disallowed, and how the costs should be allocated among services or groups of customers. In the cases where the regulated firm produces other unregulated and even regulated products and services, this can be a complex process which requires regulators to make inherently arbitrary allocations of costs and assets between individual services or groups of customers. In addition, regulators must monitor the utility's revenues, costs, and capital stock regularly to ensure that it remains within the imposed rate of return ceiling (Levy and Spiller, 1994). The complexity of the system is believed to encourage unproductive lobbying, misrepresentation and misreporting of information, and inflation of the base on which rates of return are calculated. However, effective regulation is necessarily a complex process and whatever form of regulation is implemented, regulators will require extensive information about the relevant demand and cost structures and detailed information about the activities and performance of the regulated firm (Vickers and Yarrow, 1988).

Notwithstanding the criticisms that have been made of its incentive properties, rate-of-return regulation does possess some basic advantages which make it possibly attractive for Latin America and Caribbean countries. By providing a solid guarantee of a fair rate of return, it offers a type of long-run commitment which is crucial for investments with a high sunk cost component, as in hydroelectricity generation and drinking water supply and sewerage (Laffont, 1994b). It also defines a feasible procedure which provides guarantees to investors against risk of bankruptcy and it provides for a strong system of checks and balances. In addition, rate-of-return regulation is likely to have a downward impact on the cost of capital (Grout, 1995). Although it may provide weaker incentives for cost reduction, it generally performs well in the presence of cost uncertainty and asymmetric information about the capabilities of regulated firms, particularly in terms of consumers' surplus, and reduces the ability of the regulated firm to profit from regulatory ignorance or favourable cost shocks (Schmalensee, 1989).

(ii) Price-cap regulation[*]

Price-cap regulation, as developed in the United Kingdom in the mid-eighties, attempts to avoid the problems associated with rate-of-return regulation, particularly its tendency to put upward pressure on costs, and seeks to both limit the scope for regulatory failure

[*] This discussion draws on Train, 1991, Cowan, 1993, Grout, 1995 and Beesley and Littlechild, 1989.

and to reduce the burden of regulation (see Box 2 and Figure 2). Three central ideas have been influential in its design: (i) regulation should be based on the regulation of prices rather than profits; (ii) the substitution of discrete periods between regulatory reviews for continuous intervention (Helm and Yarrow, 1988); and (iii) the idea of establishing regulatory "contracts" with regulated firms (Helm, 1993).

It is argued regulation of prices rather than profits provides strong incentives to improve efficiency and to innovate production technology and service offerings, helps promote competition, and also focuses regulation precisely on the particular services where market failure and public concern are greatest so ensuring that consumers are effectively protected against monopoly abuse. Price-cap regulation can be seen as a form of contracting where "the state, through the regulatory licence, contracts certain outputs and services to the private sector, in return for which the private sector is entitled to a revenue stream which is lined to inflation" (Helm, 1993).

Under price-cap regulation, the regulator sets a maximum tariff (the price cap) so that an efficient firm will on average obtain the cost of capital on the assets employed. In multi-output situations - e.g. where the firm operates in two or more regulated markets - the regulator either establishes a separate price cap for each service or applies an aggregate price cap for a basket of interrelated products often complemented by further constraints (e.g. maximum permitted annual price changes). Delegating some price authority to the regulated firm, allows it to adjust to shifting demand conditions and permits more efficient capacity utilization (Riordan, 1984). The regulator determines the way the price cap can move for a fixed period which is usually longer than the periods used under rate-of-return regulation. During this period, the price cap is adjusted by a preannounced factor that is exogenous to the regulated firm. Typically, this is the percentage increase in an index of relevant input prices or similar adjustment factors less an efficiency factor which represents an *ex ante* estimation of the increase in the regulated firm's productivity to share efficiency gains between customers and stockholders. Although price-cap regulation has been sometimes implemented without a limit on the rate of return earned, a more common approach also places implicit or explicit limits on the rate of return.

Box 2

Water industry regulation in England and Wales

The Water Act of 1989 established ten water service companies responsible for both drinking water supply and sewerage services and their shares were sold in a public floatation. The companies are free both to borrow on the private capital market and to raise fresh equity. They are required to cover all costs through user charges. Each of the companies has been granted a license - appointment - for a minimum period of 25 years. The license may be terminated by the government at any time on or after the expiry of that period, provided at least ten years' prior notice has been given.

The 1989 legislation also brought the older 29 statutory (privately owned) water companies (they are nor involved in sewerage) under the same regulatory regime as the rest of the industry. Prior to the 1989 reform, they had been subject to the regulatory controls, which were effectively a form of rate-of-return regulation in which any changes in costs were passed through to consumers. Since then their number has been reduced as a result of merges and joint management arrangements.

The 1989 legislation established a regulatory system and created the Office of Water Services (OFWAT). OFWAT is responsible for the economic regulation of the companies.

The primary duty of OFWAT is to secure that the functions of the companies are properly carried out and to secure that the companies are able, in particular, by securing reasonable returns on their capital, to finance the proper carrying out of their functions. Its other responsibilities include:

- protecting all actual and potential customers in respect of water charges, in particular rural customers, and ensuring that there is no undue preference or discrimination in the fixing of prices;
- protecting the interests of consumers in respect of other terms of service provision and in respect of service quality;
- promoting economy and efficiency on the part of the companies; and
- facilitating effective competition.

The costs of maintaining OFWAT are financed by a portion of the annual license fees levied on the companies. It has a staff of about 130 and operating costs for the financial year 1992/93 were £ 7.3 million (about US$ 11.2 million).

Either OFWAT or the companies can refer points of dispute to the Monopolies and Mergers Commission (MMC). Rulings of the MMC have the status of advice to the Secretary of State who is empowered to enact or reject it. The companies may appeal to the MMC if they wish to contest the actions of the Director General of Water Services (DGWS), head of OFWAT, in respect of determining price limits, amendments to their licenses, and accounting guidelines. Alternatively, either party can take legal action against the other party in relation to specific violations of the license. Thus far, little resort has been made to either the MMC or the courts to arbitrate over disputes.

The companies have their prices controlled through "price cap" regulation. They must restrict the rate of growth in their prices by the Retail Prices Index (RPI) adjusted by a factor, known as the K factor, which may be positive or negative. The adjustment varies among companies and through time, and is designed to allow companies to finance their investment programmes, while encouraging them to be efficient. The factor is fixed for 10 years, although either OFWAT or a company can apply for a review after 5 years. To cover the industry against unforeseen cost increases, reasonable extra costs can be passed through to consumers outside a formal periodic review. OFWAT can use the same procedure to reduce prices under some circumstances.

The objective is to set price-cap so that an efficient company has just sufficient income to finance itself. The procedure for setting price caps takes

(continued)

account of various factors, including company asset valuation, capital investment programmes, comparative efficiency of company operations, legislative requirements balanced, where possible, by customer requirements, and a fair return to shareholders. Efficiency targets are set in relation to both operation and capital expenditures and take into account comparative levels of service. The relatively long period of regulatory lag provides a strong incentive to the companies to improve efficiency.

The water companies are required to give OFWAT details of their investment plans and performance information covering standards of service, capital expenditure programmes and asset condition. There are also regular asset surveys and OFWAT monitors any variations from the original asset management plans. Company reports are independently verified.

OFWAT has found the principle of setting prices for long periods difficult to sustain. It has intervened frequently to alter prices. For example, in 1991, only two years after privatization, OFWAT wrote to several companies suggesting that they limit their price increases on account of the unexpected gains that appeared to have arisen since privatization. All companies chose to follow the regulator's suggestion and did not increase their prices as far as they could. In 1992, seventeen companies had their prices reduced through the cost pass-through mechanism as construction cost had fallen below the levels assumed in 1989.

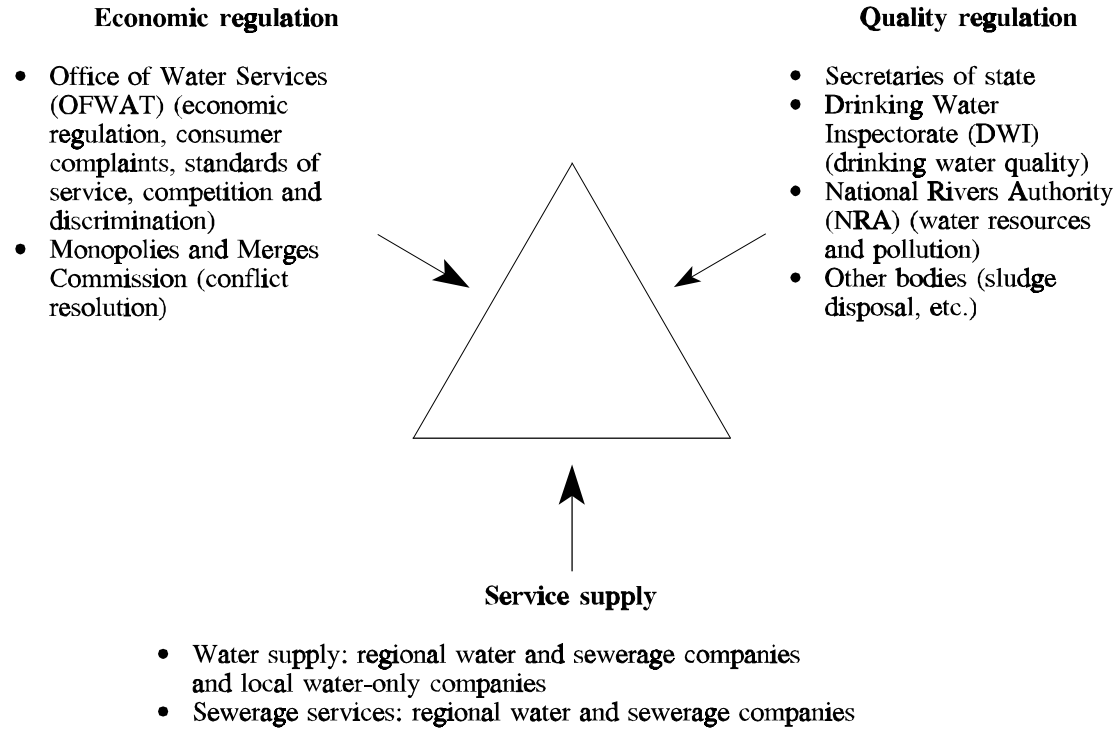
OFWAT decided to undertake the first regulatory review five years after privatization and in 1994 announced the new price regime for the 1995-2005 period based on smaller price increases, lower capital expenditure and higher efficiency savings. Price limits were set on the basis that profits would grow at a modest rate and that the return on capital would fall to about half the current level in real terms over the next ten years.

In fact, although nominally a price-cap, OFWAT action has much in common with rate-of-return regulation. The primary duty of the DGWS is to ensure that the companies are able to finance their functions and to earn reasonable returns on their capital, which implies that the rate of return is a major consideration in regulatory practice. This means that this form of price-cap regulation is a more incentive-compatible form of rate-of-return regulation rather than a radical departure from it.

Source: Armstrong, Cowan and Vickers (1994), Banyard (1995), Bishop, Kay and Mayer (1995), Booker (1994), Byatt (1995h), Cowan (1993), Grout (1995), Haarmeyer (1994), Helm (1994a), Kay (1993), McEldowney (1995), Mortished (1994), Myers (1995), OECD (1994) and Walton, Bateman and Heinrich (1994).

Figure 2

Water industry regulation in England and Wales



Source: Booker (1994).

At the regulatory review, the price cap, or its adjustment factor, is adjusted on the basis of the cost, demand, investment requirements, profit conditions, etc. of the regulated firm. The regulatory review provides the means by which consumers benefit from the cost-minimizing behaviour of the regulated firm because lower costs can mean lower tariffs. The review, needed to secure a reasonable rate of return, is also meant to deal with exogenous trends in firm profitability and initial design errors. There is usually a further procedure by which reasonable extra costs - to the extent that they are exogenous to the regulated firm and observable - can be passed through to consumers outside the formal periodic review.

Price-cap regulation is less vulnerable to the "cost-plus" inefficiency and the Averch-Johnson effect (Beesley and Littlechild, 1989). It also provides strong incentives to the regulated firm to produce with the cost-minimizing input mix, to invest optimally

in cost-effective innovation and to innovate in production technology and service offerings, and to adjust optimally to changes in cost. This happens because the regulated firm retains the benefits of any increase in profits derived from cost savings due to more efficient performance and cost-reducing innovations, at least until the next regulatory review. It also bears the costs of inefficient performance and a greater part of the financial risk.

The capacity of the price-cap regulation to encourage cost-minimizing behaviour depends on three factors:

- The "regulator's ability to derive some measure of what costs should be, which is at least partly independent of the actual costs incurred" (Kay, 1993). The incorrect selection of price caps may result in large inefficiencies even if inputs are chosen correctly for the level of output actually produced (Braeutigam and Panzar, 1993). The asymmetry of information between regulator and firm seriously constraints the regulator's ability to determine how prices would have changed under competition in response to variations in factor prices, general price level, changes in technology and consumer tastes and preferences, and income level and its distribution.
- Choosing the correct period between reviews: incentives for productive efficiency are good immediately following a review, but deteriorate greatly as the next review approaches (Vickers, 1991); eventually a firm would come to favour higher costs when review is close at hand (Vickers and Yarrow, 1988). A shorter period of regulatory lag will tend to reduce incentives for cost minimization and to increase uncertainty and regulatory risk, but a longer period may adversely affect allocative efficiency
- Restraint and commitment on the part of regulators: the efficiency incentives only apply if the utility believes that the benefits of efficiency savings will not be confiscated by *ad hoc* interventions (Helm, 1993). If regulators fail to provide long-term guarantees as to the decisions made at the regulatory review, the cost of capital will increase and there will be an incentive for underinvestment.

The incentive qualities of price-cap regulation also mean that profits and losses can diverge significantly from normal levels. This can be a serious problem because there are many indications that, for political and other reasons, regulated companies will never be allowed to earn excessive profits (Helm, 1994a) even though these profits will lead to future reductions in prices. The experience of British regulators would seem to suggest that public acceptability of price cap regulation will depend both on transparency and a willingness by companies to be ready to share at an early stage benefits with their customers (Byatt, 1995f).

On the other hand, if profits are below the cost of capital, a regulated firm is likely to demand a higher price cap on the grounds that low prices threaten its financial viability and given the high political visibility and economic importance of many water-based services and the problems associated with asset hand-over, such pressure may be successful. Given this, it could be difficult for a government to commit to pure price-cap regulation. However, if the regulators try to influence the regulated firm's rate of return when they are setting the price cap, "the scheme may degenerate to rate of return regulation" (World Bank, 1995).

These potential problems have led to the emergence of new regulatory instruments. In the United States, for example, one approach balances the risk of windfall profits or losses from the selection of inappropriate adjustment factor by the provision that if returns fall below a prespecified limit, price increases greater than those implied by the cap are permitted in some cases, but if the rate of return exceeds the higher limit, the firm has to refund the differences to customers (World Bank, 1994a). Under another approach, a regulatory institution offers the regulated utility a choice of a low price cap but no monitoring of profits or larger price cap but with closer monitoring of profits inducing it to reveal its cost-minimization ability and its attitude towards risk. Other proposals include the use of profit-sharing which involves giving customers a share of profits above a "normal" level through automatic rebates, and the imposition of a windfall tax on utility profits (Maddox, 1995).

Such schemes, however, can adversely affect incentives to reduce costs and are difficult to design. This would seem to suggest that regulatory discretion, provided that it is carefully exercised and that regulators explain the reasons for their decisions, is the most appropriate solution (Byatt, 1995d). In the United Kingdom, for example, industry-specific regulatory bodies enjoy a great deal of discretion in the performance of their duties and the Office of Water Services (OFWAT) has relied on this to limit the accumulation of abnormal profits by the water companies during periods of formal regulatory lag. This discretion has also led to significant inconsistencies across industries and a widespread feeling of lack of accountability (Ergas, 1994), and is considered to make United Kingdom-style regulation not readily transferable (Levy and Spiller, 1994).

Since price-cap regulation can effectively control the prices of dominant firms when the competitive marketplace controls their profits, it has been suggested that this form of regulation is probably most effective and appropriate as a transitory step on the path toward total deregulation and full competition (Braeutigam and Panzar, 1993 and Schmalensee, 1995). Although price-cap regulation performs particularly well under certainty, high levels of uncertainty generally make rate-of-return regulation and other regulatory regimes in which price depends in part on actual cost preferable to pure price caps (the higher the degree of uncertainty, the higher cap must be set to keep the regulated

firm profitable), particularly if regulators are more concerned with consumers' surplus than with the profits of regulated firms (Schmalensee, 1989).

One of the arguments for price-cap regulation is the lighter regulatory burden, and hence less scope for regulatory capture, and the reduction in the administrative and compliance costs of regulation, because it is unnecessary to measure the cost of capital or rates of return (Littlechild, 1983). The concern about allocative efficiency has inevitably forced regulators to consider such factors at review time (Armstrong, Cowan and Vickers, 1994). The fact that "rate of return considerations are necessarily implicit in setting and resetting" price caps (Littlechild, 1986) considerably increases the information requirements for effective regulation and blurs the distinction between price-cap approach and rate-of-return regulation. On the other hand, it is important to realize that it is the profit motive which gives the ultimate incentive for companies to improve efficiency and economies in the expectation of attracting investors and increasing business (Booker, 1994).

Initial expectations that price-cap approach would reduce information requirements, allow regulators to make do with relatively simple cost and demand information and avoid all the problems associated with profit control have "proved illusory" (Helm, 1994a). Public authorities quickly came to the conclusion that in a capital-intensive monopoly industry, such as the drinking water supply and sewerage, price controls must be complemented by an assessment of capital expenditure requirements, including recognition of the financing implications of the capital expenditure on price adjustments, and the provision for monitoring performance against defined levels of service (see Box 3) (Jeffery, 1994). As a result, British water regulators found themselves "dragged into a complex mass of detail - covering the intricacies of business plans and fixing the cost of capital and the value of shareholders' assets" (Helm, 1994a). However, this approach has avoided the lengthy price reviews and the huge legal bills that characterize rate-of-return regulation in the United States (The Economist, 1995).

There are strong reasons for preferring price-cap regulation initially following privatization. Principally because productivity gains are potentially larger at the time of privatization than subsequently, hence the improved incentive properties of price-cap regulation are particularly important during that period (Beesley and Littlechild, 1989). They are also potentially larger in industries where the underlying rate of change in technology and market conditions is faster (e.g. electricity generation). In the industries with a decentralized industrial structure, the reasons for preferring price-cap regulation initially are reinforced by the regulator's potential for generating superior information and overcoming the asymmetry of information through benchmark or yardstick competition.

Box 3

How is a price determined under a price-cap regulation system?

The process begins with using financial models to estimate the cost of capital to the industry, i.e. the minimum return that investors require to provide them an adequate incentive to invest in it. This estimate is applied to the value of capital assets employed in the company. The product of the cost of capital and the value of assets is an estimate of the minimum profits that the company requires to reward its shareholders adequately. The minimum profit is then adjusted by an estimate of operating costs to arrive at an estimate of the required revenue of the company. Finally, the revenue stream is converted to a price - the price cap - on the basis of a projection of demand.

Other factors that regulators may take into account at price review include future investment programmes, expected future changes in productivity, and the effect of price setting on actual and potential competitors. Making projections requires that regulators also make general assumptions about macro-economic factors such as future inflation, interest rates and real wage growth. Regulators may also need to ensure that the levels and trends of accounting ratios are appropriate. For example, prospective lenders take into account interest cover and the debt-equity ratio, so the regulator must ensure that the projected ratios are such that they do not jeopardize potential lending.

The calculation of the appropriate price-cap is fraught with many difficulties. For example, measuring the cost of capital is not easy. In the water industry in England and Wales, for example, there has been a great deal of disagreement about the appropriate measure of the cost of capital, even though there are standard approaches to its determination. There has also been considerable controversy over the value of the parameters that should be used, particularly the appropriate level of the risk premium for equity returns above riskless government securities. The utilities and the regulators have referred to estimates that differ by almost 6 per cent. Each extra 1 per cent return on equity is equivalent to £ 82 million (about US$ 130 million) of additional profits for the water companies.

Further complications can arise with the valuation of pre-privatization assets because assets that are in the public sector usually have no observable market value before privatization and because the accounting valuations shown in utilities' books typically bear little relation to the underlying economic valuation of the assets. The problem is particularly serious in the drinking water supply and sewerage sector because most of its assets are sunk in the sense that they are not transferable to other activities, and extremely long-lived. For example, in England and Wales, the book value of the water companies' assets on a current-cost basis exceeds their market value (as recorded by their stock-market valuations) by a factor of ten. As a result, it has been necessary to develop alternative methods of asset valuation based on the market valuations at the time of privatization. The problem was resolved by valuing the existing assets on the basis that the existing owners should neither lose nor gain from the changes in regime. This involved projecting the cash flows that the pre-privatization assets would have generated if the previous regulatory regime had continued.

These considerations help explain, at least in part, why: (i) price-cap regulation is considered to be more forward-looking than rate-of-return regulation, which is largely based on historical data, with adjustment for the future limited to an adjustment for inflation or the extrapolation of historical trends; (ii) price-cap regulation is considered to offer greater and more direct scope for bargaining, especially on productivity improvements, with a correspondingly more active role for the regulator, than rate-of-return regulation, aspect of particular importance in industries characterized by a high rate of change and many firms; and (iii) setting prices for several years is difficult where there are large investment programmes and where the degree of uncertainty surrounding capital expenditure programmes required to meet particular standards is substantial.

Source: Armstrong, Cowan and Vickers (1994); Bishop, Kay and Mayer (1995); Grout (1995) and Beesley and Littlechild (1989).

(iii) Regulation by commercial code

Commercial code regulation, also known as "potential" or "implicit regulation" or "regulation by threat" or "light-handed regulation" or "regulation without regulators", does not require a sector-specific regulatory framework. Firms operate freely without specific regulation, but regulators monitor and evaluate their performance on the basis of principles established by competition or anti-trust legislation in general. The monitoring does not need to be undertaken by a regulatory authority *per se*, this responsibility may be entrusted to an agency established by competition or anti-trust law, such as a fair trading commission or a monopolies and mergers commission (IEA, 1994). There is a credible threat of regulatory intervention if firms engage in anti-competitive behaviour, if prices rise too much or if quality becomes compromised or if customers are not reasonably satisfied.

The argument holds that the threat of regulatory intervention will create sufficiently strong incentives to comply with general efficiency principles and not to abuse the monopoly position that a company enjoys (Guasch and Spiller, 1994). Reputation effects may also be important: most well-know companies are concerned with protecting their reputation and that of their shareholders' in the market.

Studies of the behaviour of firms threatened with regulation suggest that (Glazer and McMillan, 1992):

- the behaviour of the monopoly threatened with regulation is determined by the marginal effect of changes in price on the probability of regulation;
- an unregulated monopoly will consider the effect of its pricing policy on the probability of regulation;
- because under a threat of regulation monopoly lowers price to prevent regulation, the actual imposition of regulation may have little effect on its price or on its expected profits; and
- firms may alter their prices more in response to changes in the perceived probability or strictness of regulation than to its actual imposition.

Commercial code regulation gives a firm strong incentives to reduce costs because of the - potentially - indefinitely long regulatory lag. Other advantages of commercial code regulation are that it is simple to implement, it is very inexpensive, and it provides a means to institute regulation gradually, all factors particularly important in countries with little experience in formal regulation. It is particularly suitable where the cost of errors is low and as a temporary measure to protect consumers against monopoly power until competition arrives. On the other hand, the rational fear, that some future government will impose strick price regulation, will force the firm not to increase profits excessively which

can be achieved by keeping prices low but also by not working too hard and not pursuing every opportunity to reduce costs (Jones, 1994).

Commercial code regulation does require a well-developed arbitration or juridical systems (Nellis and Roger, 1994), and is more appropriate for the countries with developed legal systems, regulatory precedents and political stability, and predictable regulatory policy. Under the right conditions, this approach may be a useful complement to or substitute for other forms of regulation, particularly in smaller countries and in the industries where effective competition is feasible. It can be strengthened by encouraging consumer participation in the oversight process and by organizing small customers into large, more effective bargaining units.

In the privatized drinking water supply and sanitation industry in England and Wales, for example, OFWAT has a role in monitoring levels of service relative to agreed standards of performance such as water pressure, flooding incidence from sewers, speed of response to billing enquiries and hose pipe restrictions (Armstrong, Cowan and Vickers, 1994). The Director General of Water Services (DGWS), head of OFWAT, has indicated that he will consider requesting the Secretary of State for the Environment to impose enforceable quality of service standards if the performance of water companies is poor relative to expectations.

Another example from the United Kingdom is electricity generation. The market structure of the British electricity generation industry has been described as an "unregulated asymmetric duopoly" - where two companies have substantial market power (Armstrong, Cowan and Vickers, 1994). Such a concentrated industry structure could well lead to serious inefficiencies. However, the threat of regulatory intervention to change licence conditions may be an important factor discouraging the two dominant incumbents from exercising their duopoly power (Rees and Vickers, 1995).

The threat of regulatory intervention might influence competition in hitherto unregulated industries (Armstrong, Cowan and Vickers, 1994). If a regulator, in judging the adequacy of competition, were thought to be largely influenced by price levels then a tacit collusion on maximum prices might result, with the aim of forestalling regulation rather than deterring new entry. Conversely, if the regulator were thought to be more influenced by market shares than by price levels, the incumbents might not mind a degree of entry and might even be inclined to dispose of some facilities to satisfy the regulator that no regulatory intervention is needed.

The competitive behaviour of state-owned enterprises is one of the sources of the threat of regulatory intervention. There is strong evidence that competition between public and private utility companies - either in the form of direct market competition, or

benchmark or yardstick competition, or by threat of displacement, as in the drinking water supply and sewerage sector in France - is highly conductive to improved performance (Kahn, 1988).

State-owned enterprises, if they behave as if they were operating in a competitive market, can provide a strong check on the ability of privately owned utilities to exercise market power (Schmalensee and Golub, 1984). If a state-owned firm lowers its price, this will stimulate the efficiency of the other firms in the market, irrespective of the reason why the prices have been lowered (Fraja, 1991). As a result, the presence of even a relatively inefficient state-owned utility may improve the overall efficiency of the sector. The competition between private and public enterprise can also be beneficial for the latter as competition can overcome, at least in part, a tendency toward the inefficiency resulting from public ownership (Caves and Christensen, 1980).

Competition may not be feasible unless state-owned utilities are placed on a non-subsidized, full-cost recovery basis (McCullough, 1992). Subsidized utilities could expand supply by virtue of their subsidy rather than because they use scare resources more efficiently (Joskow and Schmalensee, 1985). In addition, there is no guarantee that state-owned enterprises would behave competitively once free from direct governmental control and their anti-competitive behaviour can undermine investors' confidence and increase regulatory risk.

(b) The problem of asymmetric information

Adequate information is of paramount importance for effective regulation, but regulators are fundamentally constrained by the lack of information on the utilities they regulate (Laffont, 1994b). The regulated company's management always has (or can acquire) better information than the regulatory agency about both industry costs and demand conditions, including the effects of the incorporation of new technologies and the most efficient means of operation, and the firm's own behaviour, particularly its level of cost-reducing effort. This asymmetry arises because of such factors as proximity to clients and the production process, and differences in staff size, technical training, budgetary and other resources (Sappington, 1994b). The same problem also exists in the public sector (Laffont, 1994a).

Since the objective of a regulated industry is to maximize profits and, therefore, to be confronted with the weakest regulatory constraints, and since regulated firms have an element of control or even monopoly over the information provided to the regulator, there is an opportunity and incentive to present information selectively and to distort it (Helm, 1994b). The problem is particularly acute in industries where the underlying rate of technological change is high, because the regulator's knowledge can become obsolete very

quickly, and in industries where there is only one firm or a few firms which differ substantially one from the other (Beesley and Littlechild, 1989).

The information available to the firm's management is not in itself perfect, but it is better than that available to the regulator. Even where relevant demand and cost structures are observable in principle, the detailed and sophisticated knowledge that the firm has, cannot be matched by most regulatory bodies given the resources and manpower available to them (Lewis and Sappington, 1988). As a result, companies are almost always better informed than regulators about the consequences of adopting particular regulatory schemes for prices or conditions of service (Acton and Vogelsang, 1989). Additionally, as many water-related assets are underground and also have very long working lives, the monitoring of capital and maintenance spending is much more difficult in the water sector than elsewhere (Kinnersley, 1990).

In most regulatory settings, the regulator can to an extent observe the level of costs incurred by companies, particularly product-specific costs of one- and multi-product firms, as well as the level of their earnings, but cannot observe any cost-reducing effort, which is the key to productive efficiency and a prerequisite for effective regulation. The latter problem is especially important because a firm can influence its environment, i.e. cost and demand conditions, by expending effort which the regulator cannot see.

Asymmetric information and limited observability mean imperfect incentives and impaired economic efficiency, creates a divergence of interest between the regulated firm and its customers, and gives rise to strategic behaviour on the part of both the regulator and the regulated firm. If the regulator is uninformed about industry condition, then any regulation, even optimal, will leave firms with undesirable rents due to their monopoly of information (Armstrong, Cowan and Vickers, 1994). Asymmetric information allows a firm to extract rents from its monopoly of information and hence obtain supernormal profits resulting in an overall welfare loss or allocative inefficiency. Thus, asymmetric information blocks the possibility for simultaneous attainment of productive efficiency, which requires that price be kept as low as possible, and allocative efficiency, which requires that price be kept close to marginal cost, and leads to a trade-off between them (Rees and Vickers, 1995).

The existence of informational asymmetry suggests that instead of using command-and-control methods, i.e. instructing the firm on every aspect of its operation and requiring it to follow the orders it is given, and relying on micro-management, the regulatory goal should be to design incentive mechanisms for the regulated firm that will motivate it to employ its superior information to maximize society's objectives while pursuing its own self-interest, rather than to extract rents from its monopoly of information (Acton and Vogelsang, 1989 and Sappington, 1994b). This means, for example, that when

the firm has better knowledge that the regulator about production technology, and hence about the likely consequences of different cost reducing activities, it may be better, for the firm and for the customers, if the firm is rewarded for achieving cost reductions, but is not told exactly how to achieve the desired results (Sappington, 1994b).

When the regulator cannot observe directly all relevant actions undertaken by the firm, the appropriate course of regulatory action would be to provide indirect incentives for the firm to act diligently (Sappington, 1994b). The regulator can achieve this by basing the firm's compensation on observable performance measures that are correlated with its unobservable behaviour. The use of observable performance measures to motivate the regulated firm to undertake unobservable actions depends on the characteristics of performance measures, particularly sensitivity and variability. The former refers to the extent to which the observable measure is correlated with the underlying unobservable activity, while the latter characterizes the "noise" in the relationship.

The regulator should seek to base the firm's compensation on those observable performance measures which are closely and systematically correlated with the key unobservable activities (Sappington, 1994b). Since the unduly "noisy" relationship will tend to increase the cost of capital, the regulatory policy should seek to reduce undesired variability in performance measures. This can be accomplished by controlling for the factors exogenous to the firm (e.g. weather conditions), basing the firm's compensation on the sufficiently long history of its performance rather than on isolated events, or using ranges and general performance targets, possibly in conjunction with measures of benchmark or yardstick competition, rather than specific performance measures. Except where regulatory goals are very specific or broad-based performance measures are insufficiently sensitive or excessively variable, it might be advisable to avoid targeting specific components of cost and service quality in incentive scheme because this risks - because the firm has better information about how to best achieve a broad goal relative to the regulator's information - distracting the firm from pursuing those cost-reducing activities for which it does not receive explicitly targeted rewards.

The prospects of generating information for regulatory purposes should be an important consideration in a government's decision about the nature of the regulatory regime and the structure of the industry (Beesley and Littlechild, 1989). Efficient regulatory systems should incorporate mechanisms designed to overcome informational asymmetries. This requires substantial regulatory discretion - appropriately restrained - as well as substantial administrative capabilities and sophistication (Guasch and Spiller, 1994).

These considerations suggest that price regulation is likely to be most effective in the industries where the extent of the information asymmetry between regulator and firm is small or where the regulator can reduce the firm's informational advantage and acquire adequate information without undue difficulties. Industries that satisfy these conditions are usually those: (i) where underlying technological and market conditions change slowly, like drinking water supply and sanitation, and the regulator can gradually acquire more relevant information that will permit it to set realistic efficiency targets; and (ii) where there are many firms in an industry and the regulator can use the performance of one as an indication of what another could achieve (benchmark or yardstick competition) (Beesley and Littlechild, 1989).

(i) Information-extracting mechanisms

There are several information-extracting mechanisms by which a regulator can reduce the informational advantage which the regulated industry enjoys.

Direct market competition. Competitive market prices aggregate and communicate dispersed information and thereby influence the direction of entrepreneurial energies (Vickers, 1995). In the sectors which can be restructured to ensure effective and undistorted competition (e.g. electricity generation) direct market competition is the most efficient way to solve the problem of asymmetrical information. Unfortunately, technological characteristics and demand and cost structures of many water resource management activities are such that except at the unacceptably high cost of a spatially fragmented industrial structure and a major loss of substantive economies of scale and scope, there are limits to substantially increasing direct market competition.

Franchising (competition for the market). Where direct market competition is not possible within an industry, franchising, or competition for the right to be the monopolist, is another information-extracting mechanism. Where many parties facing the same technology and production costs enter non-collusive bids for the right to be the monopolist the competition for the market among the *ex ante* producers will hold in check the potential informational advantage of the *ex post* supplier through the competitively determined terms of the franchise contract. This competition will increase efficiency and bid down the price of the product to the point where it does not reflect the monopoly power of the eventual holder of the franchise. Franchise bidding acts as a discovery

mechanism which enables the regulator - through competition rather than through administrative decision - to select the most efficient firm and to reduce the size of the informational rents it enjoys (a detailed review of franchising, its applicability and limitations as regards the provision of water-related goods and services is to be found in UN/ECLAC, 1995b).

This approach is increasingly used in Latin America and the Caribbean. One example is the Buenos Aires concession where the contract was awarded to Aguas Argentinas, a consortium led by Lyonnaise des Eaux Dumez, which won the concession with a bid which reduced residential user tariffs by about 27 per cent (Richard and Triche, 1994). Any subsequent tariff adjustments will be based on the changes in the cost of service provision.

Contestability (threat of entry). The theory of contestable markets (see Box 4) suggests that the threat of hit-and-run entry and the associated competition can serve to limit the monopolist's capacity to extract informational rent (Baumol, Panzar and Willig, 1982). In the water sector, public authorities can use contractual arrangements to create an environment of contestability. Contestability can be facilitated by encouraging new private operators to enter the market by removing and reducing barriers to entry and exit and ensuring that new rivals can compete on fair terms with incumbents. Provisions can be included in regulatory schemes to ensure that an alternative producer can be called upon to replace the incumbent if the latter fails to meet certain specified performance targets. For this and other reasons, such as the likelihood of service disruption, some countries retain a capacity to compete with the private contractors, or to provide a residual means of performing essential functions should the contractor fail (Kessides, 1993).

Benchmark or yardstick competition. The most promising attempt to formally address the problem of asymmetric information in the privatized water-related utilities seems to be through benchmark or yardstick competition, also known as competition by comparison or competition by example. This method promotes competition in cost minimization between monopolists indirectly - via the regulatory mechanism - by replicating comparisons with performance elsewhere.

Endogenous information. Regulators can improve access to the internal information of the regulated firm. For example, they can undertake audits, although audits can be expensive and errors are possible. Since the opportunity to audit would yield welfare improvements, regulatory bodies usually audit and monitor costs and have the authority to impose penalties by disallowing costs and by ordering refunds to customers when, on the basis of an audit, they find that a firm had overstated or overestimated its costs (Baron and Besanko, 1984).

Box 4

The theory of contestable markets

A perfectly contestable market is one in which entry and exit are absolutely costless. In such a market, competitive pressures supplied by the perpetual threat of entry, as well as by the presence of actual current rivals, can prevent monopoly behaviour.

If sunk costs were zero, even where economies of scale are significant, a potential entrant could undercut any excessive prices (or unnecessary costs) of incumbent firms yet earn an attractive rate of return. This is a very improbable situation in most water-related industries. In the absence of other restrictions on entry and exit, economies of scale alone do not constitute an effective barrier to entry. Perfect contestability precludes excessive profits and prices as well as waste and inefficiency, and prevents anti-competitive behaviour.

Baumol, Panzar and Willig (1982) showed that "if an industry is structurally contestable and is behaving accordingly, and if, in addition, it has sustainable configurations available to it, and if none of these involve any significant welfare problems, then that industry is best left to its own devices with no government interference, *even if it is composed of a very small number of firms*". Where an industry is not behaving in that way, even though there are no inherent structural impediments to contestability, then the most promising course for public policy is identification and removal of any artificial obstacles to contestability and the prevention, so far as possible, of anti-competitive behaviour by incumbents. This is normally called a process of deregulation. If the industry is structurally not contestable, it may still be possible to seek measures that decrease "natural" entry barriers. Another option would be to isolate the portion of the industry's activities that causes uncontestability and regulate that portion, leaving the remainder of the industry's activities free from government interference.

Competitive discipline can prevail if sunk costs were zero, but sunk costs weaken the disciplining power of market contestability and thus yield a wide diversity of dynamic patterns of market performance. Yet the disciplining power of contestability remains impressive in preventing sustained monopoly pricing.

Although at a first glance, most water-related industries do not seem to come close to satisfying the conditions of contestability, since entry involves substantial sunk costs and dominant incumbents have at their disposal a range of instruments of strategic entry deterrence and of exit inducement, nevertheless some forms of private sector participation may create an environment of contestability.

For example, although sunk costs are a fundamental characteristic of networks, they are not necessarily so important for the provision of services over networks. For the tradable goods and services produced in the water sector (e.g. irrigation and hydroelectricity generation), freedom of trade and reduced transportation costs can supply the beneficent pressures of contestability.

A market can remain highly contestable if it is feasible for an entrant to achieve contractual relations with prospective customers, which can render the entrant immune from retaliation. Where this is true, the incumbent can protect itself from intruders only by behaving well - for instance, by offering customers reasonable prices and a good level of service. Such behaviour will foreclose entry opportunities, but only by providing customers with all the benefits that an entrant could be expected to bring.

The degree to which costs are sunk may depend in part on public policy. In the water sector, public authorities can use franchising and other measures to create an environment of contestability. Although there may still remain barriers to entry and competition imposed by protectionist policies, lack of adequate regulation (e.g. regarding access on a fair basis to network facilities) or other factors (e.g. access of potential entrants to capital markers and to foreign exchange), these barriers may be addressed separately as long as an activity is contestable in principle. Governments can facilitate contestability by encouraging new operators to be formed and ensuring that they can compete on fair terms with incumbent suppliers. Contestability can also be encouraged through the promotion of leasing and the development of a domestic market for reselling capital equipment.

(continued)

The French experience in the provision of drinking water supply and sanitation services demonstrates that the contestability of the franchise can achieve almost the same efficiency benefits as competition. In France, municipalities own the physical assets of the sector and secure management through a wide range of franchise contracts (e.g. leasing and concessions) with private companies as well as retain the right to operate the system themselves. Since the threat of being replaced provides a powerful incentive for good performance, incumbent franchisees normally win contract renewals over challengers. The end result is that the drinking water supply and sewerage market of each municipality is contestable and consumers appear to be satisfied with the level of service they receive. This approach creates a workable market for water services, a market that appears to work so well that price regulation, which is a major issue in the private water industry in England and Wales, and in the United States, is virtually non-existent in France.

The French experience could have important implications for Latin American and Caribbean countries in that it underlines the desirability of the flexibility to switch from one form of contractual relation to another, from public to private and vice-versa, and existence of several companies that can operate in the sector. For this reason, as markets expand, governments that choose private participation would be well advised to encourage the emergence of competing companies, rather than leave sector operation in the hands of a single private or state-owned company.

In the privatized drinking water supply and sewerage industry in England and Wales, OFWAT can create partial contestability by making new appointments for new developments within existing allocated company areas. These are known as "inset appointments", the appointment of new licensees to supply new developments and customers that consume more than 250 megalitres of water a year within an existing undertaker's area. The competitor would have to be able to supply water to the site either by laying new pipes from an existing supply or via a bulk supply or sewerage connection from a local company. The terms and conditions of such connections are determined by agreement between the interested parties or by the DGWS if they fail to reach an agreement. In addition, OFWAT is considering introducing a common-carriage approach to competition for water services (use of a competitor's network to carry the product to the customer), an approach which is already widely used in the electricity sector. Common-carriage is already widely practiced in the water industry is the form of bulk supply.

The existence of regulatory barriers - permissions, licenses, concessions, etc. - weakens the impact of contestability because some potential entrants who may wish to enter the market to compete cannot do so because they fail to hold the relevant permission or license. The existence of the regulatory instrument itself and the longevity of such instrument represent a barrier to free entry and limit the validity of the contestable markets theory in the sector. The barrier to entry is especially large when regulatory instruments are for long periods and require a long termination notice.

The system of re-bidding for concessions at shorter periods lowers the barrier represented by the existence of the instrument itself by affording an opportunity to new entrants to outbid for the existing concession. However, this approach has its drawbacks. The practical application of contestability is also hampered by "invisible" barriers to entry, such as the information asymmetry between incumbent and challengers and the winner's curse.

The theory of contestable markets is not universally accepted. On the whole, the main contribution of the theory may be as a guide for regulation. On the other hand, it has also been characterized as a theory of the consequences of deregulation rather than as a theory of regulation.

Source: the discussion of the contestable markets theory is based on Baumol and Lee (1991), Baumol, Panzar and Willig (1982) and Coursey *et al*. (1984); its criticism is to be found in Shepherd (1984); the discussion of its application in the drinking water supply and sewerage sector and examples are from Booker (1994) and Haarmeyer (1994); other sources are Kessides (1993), Lyon (1995), Mulgan (1994), Peterson (1991b), Stewart-Smith (1995), Triche (1993), Vickers (1991) and Winston (1993).

Regulatory authorities should also ensure the transparency of information. Transparency of accounts in a very important feature of regulation in the United States where a "Uniform System of Accounts" is used that classifies all utility accounts under a common system (IEA, 1994). It should be borne in mind, however, that, although internal information is important, regulatory authorities should avoid placing unnecessary burden on utilities. It is the quality of information what matters, not quantity. Collecting more data than needed does not contribute to efficient decision-making.

Exogenous information. Finally, regulators can seek exogenous information in order to reduce the informational advantage that the regulated utilities enjoy. Sources vary, but usually include these broad categories of data: general cost trends in the economy, expert engineering appraisals, equity and debt market valuation of risk (cost of capital), and utilization tests and system comparisons (asset valuation) (Helm, 1994b). Last but not the least, the customers can be useful sources of information.

Most of the information which regulatory authorities have on company performance should be made available to the public so that customers can judge for themselves that their interests are being protected (Byatt, 1995a). Access to information on company performance increases accountability of service providers and regulators, improves and stimulates public debate on water-related issues, and reduces the risk of regulatory capture. It also makes the regulatory process more efficient because it encourages independent research of regulatory issues.

(ii) Benchmark or yardstick competition

The most promising attempt to overcome the problem of the asymmetry of information is benchmark or yardstick competition (Kay, 1993). The basic principle behind this is to decouple the utility's price structure from its own reported costs and hence limit its opportunity to distort its cost data, i.e. to regulate each firm by making its reward contingent upon the performance of others or that of an efficient prototype as well as its own performance (Weyman-Jones, 1995).

Benchmark competition promotes competition between monopolists indirectly - via the regulatory mechanism - by replicating comparisons with performance elsewhere, nationally or internationally. It reduces the rents which individual regulatees can extract from the monopoly of information they enjoy and hence improves the terms of trade-off between productive and allocative efficiency (Armstrong, Cowan and Vickers, 1994). It has two important advantages: (i) because each firm can keep the benefits of its cost-reducing activities, it gives a strong incentive to be more efficient than the average, thus improving internal efficiency; and (ii) by keeping prices and service standards in line

with the industry averages, it passes on to the customer the benefit of the average cost reduction and service quality improvement, and hence improves allocative efficiency.

The opportunities for the use of benchmark competition in the water industry follow from the fact that - as a result of the common regulatory structure and many common features in the operational environment and in the input and output markets of the service providers - when setting prices or target service quality levels for one firm, the performance statistics of other firms usually contain informative signals concerning the underlying economic trade-offs faced by the given firm's management (Vickers and Yarrow, 1988). The more closely the cost conditions of one firm are correlated with another's, the more effectively benchmark competition can be implemented. On the other hand, if the firm's compensation is based on benchmark competition, the firm should not be able to influence the benchmark to its strategic advantage; ideally, the benchmark should be entirely exogenous to the firm.

It is not easy, however, to implement benchmark competition and regulators have found it difficult to incorporate it explicitly in regulatory frameworks (Cowan, 1993 and Helm, 1994a). In the United Kingdom, for example, although the regional structure of the electricity supply and water industries could allow benchmark competition between regional companies, "little *explicit* use has been made of" it (Armstrong, Cowan and Vickers, 1994). Nevertheless, OFWAT has relied heavily on it to set tight price limits and secure good standards of service for customers (Byatt, 1995i). Benchmark competition is expected to play an increasingly useful role in the regulation of the industry once the huge investment programme, which at present is the main factor in tariff-setting, has sufficiently stabilized (Armstrong, Cowan and Vickers, 1994).

The main difficulty is that where the cost conditions of different firms are not sufficiently correlated, the introduction of benchmark competition could increase the uncertainty and risk facing the regulated firms. Given that there are important differences in the economics of water management activities between geographical regions and the asymmetry of information, it can be extremely difficult to factor out exogenous location-specific influences from local costs even with sophisticated econometric techniques. The costs incurred by any one firm depend on a large number of factors, some of which can only be measured imprecisely (Bishop, Kay and Mayer, 1995). There are also problems in incorporating the relevant factors in an econometric regression, as it is not always clear what factors are exogenous and what are not or what output measure should be used. Econometric modelling is always subject to some degree of estimation error. In addition, the burden on the industry of information provision and on the regulator of information processing is heavy (Armstrong, Cowan and Vickers, 1994).

Another potential difficulty with implementing benchmark competition is that it can: (i) give incentives for one firm to intentionally undermine the performance of other firms included in the benchmark; (ii) undermine incentives for the regulated firms to share research findings or otherwise collaborate with each other; and (iii) encourage all firms to collude to implement uniformly low levels of measured performance (Sappington, 1994b). To overcome these difficulties, it would be advisable to reward each firm on its performance relative to other firms and on some absolute measure of its individual performance.

While it is clear that benchmark competition is potentially a very useful source of information, the development of a practical means of incorporating it explicitly into a regulatory framework remains a major challenge. As a result, benchmark regulation is rarely used explicitly in price controls, rather it is seen as an extremely desirable complement to other regulatory mechanisms which can help address the problem of asymmetrical information and mitigate some of their undesirable effects.

The advantages of benchmark competition are part of the case for having horizontally separated companies (e.g. regional) rather than a single national company in natural monopoly industries (Vickers, 1995). Despite its problems, benchmark competition is increasingly used, usually implicitly or informally, in the regulation of the energy and water industry in many countries. For example, the service area for the franchise contracts to renovate and improve the drinking water supply and sewerage services in Mexico City, Mexico, was awarded for four similar-sized zones so as to permit performance comparisons (Casasús, 1994).

In Chile, economic regulators use a model company variant of benchmark competition. The reference model establishes a standard for efficiency for utility companies. A company benefits if its costs are below those of the reference provider. This encourages utilities to match or exceed the reference level of operating efficiency of the model company in order to maximize their profits. The system has been successful, but there is obvious room for improvement and the regulators are considering modifications to the present system with the introduction of further private sector participation.

In France, the contracts of the local water companies usually depend on the quality of services and their production costs relative to those of other water companies (World Bank, 1994a). The existence of two dominant firms in the provision of services, Compagnie Générale des Eaux and Lyonnaise des Eaux, permits the use of benchmark indicators (Kessides, 1993). The Paris "affermage" contract gives one company responsibility for the Left Bank of the Seine River and another responsibility for the Right Bank (Haarmeyer, 1994) provides a measure of comparative or benchmark competition (Kessides, 1993).

(iii) Benchmark competition and mergers

Benchmark competition is possible where there are different providers of comparable services, e.g. regional drinking water supply and sanitation companies, provided that they operate in similar environments (regulation, demand and cost conditions) and do not collude.

Mergers, takeovers, joint management arrangements and other changes in the industry structure can affect the regulator's ability to effectively use benchmark competition (market concentration reduces the effectiveness of econometric analysis and the efficiency of frontier modelling, and might facilitate collusion, as collusion might be easier among fewer firms). This does not rule out mergers, but since the loss or degradation of comparators, particularly among bigger or more efficient companies, damages the efficiency of benchmark competition, a regulator should seek: (i) to create new and improved comparators; and (ii) to link this with immediate benefits to customers, notably in the form of lower prices (Byatt, 1995b, 1995c, 1995g and 1995i). This can normally be achieved through substantial price reductions which force the newly-merged company to become more efficient and ensure that customers, as well as shareholders, benefit from the merger. The magnitude of price reductions or other remedies sought in each case should reflect the effect of the proposed merger on the regulatory regime. Other measures could be necessary to enable the regulator to have proper access to information about the performance and costs of the newly-merged company, and about the efficiencies and cost savings arising from the merger (OFWAT, 1995p).

In the privatized water industry in England and Wales, for example, the ability of the DGWS to make comparisons between companies is protected by the provision in the Water Industry Act of 1991 for automatic reference to the Monopolies and Mergers Commission (MMC) of mergers between water companies if the value of the assets of the acquiring company and the company being taken over each exceed £ 30 million (about US$ 46.2 million) (HMSO, 1993 and OFWAT, 1995m). When determining whether a merger will operate against the public interest or not, the MMC is obliged to have regard to the desirability of giving effect to the principle that the number of water companies which are under independent control should not be reduced so as to prejudice the ability of the regulator to make comparisons between them (Armstrong, Cowan and Vickers, 1994). The MMC agrees to the reduction of the number of comparators if there are substantial benefits from economies of scale and scope and if the claimed gains from the merger are passed back to consumers, e.g. in the form of lower tariffs.

One example is the Three Valley merger which involved three water-only companies which shared an important water treatment works and had cooperated for a long time (Armstrong, Cowan and Vickers, 1994). Although the MMC found that the

merger was against the public interest because it would reduce the number of independent comparators, it was allowed to proceed on the condition that efficiency savings of 10 per cent would be passed through to consumers.

More recently, the takeover of the Northumbrian Water by Lyonnaise des Eaux of France, which will merge Northumbrian's operations with the neighbouring North East Water, was allowed to proceed on the condition that it guaranteed price cuts of 15 per cent in customer's water bills by 2001 (Price, 1995). In addition, Lyonnaise des Eaux has given undertakings that it will not mount any takeovers or acquire sufficient interest to enable it to influence the policy of any other water or sewerage company in England and Wales for ten years unless it has the DGWS's consent (OFWAT, 1995o).

2. Other forms of conduct regulation

A number of other issues of significance in the practice and discussion of conduct regulation have application to the regulation of the private provision of water-related services. In the regulation of natural monopolies of the public utility type there is an need to control incentives to under-provide quality, to consider the possible underinvestment problem which arises if the regulator cannot fully commit itself not to behave opportunistically, and the implications of the underinvestment problem for the structure of water-related investments.

(a) Quality of service[*]

Any public utility has the obligation to render safe and adequate service (see Box 5). A reduction in the quality of output or service standards is equivalent to an increase in price. Without adequate quality of service regulation, price regulation may be rendered ineffective: "buyers can be exploited just as effectively by giving them poor or unsafe service as by charging them excessive prices" (Kahn, 1988).

[*] This discussion draws on Cowan, 1993, Leland, 1979, Rovizzi and Thompson, 1995, Shapiro, 1983, Spence, 1975, Vickers, 1991 and Vickers and Yarrow, 1988.

Box 5

Legal aspects of quality regulation

Effective control of drinking water quality depends on the existence of adequate legislation which should clearly state that the service provider, who sells water to the customer, carries the legal responsibility to supply safe and wholesome water to the house connection. The service provider must be responsible both for product liability and for the provision of continuous and effective water quality control. The water utility should also have the legal responsibility to notify the public of any serious deterioration in water quality.

A utility should not be held legally responsible for deterioration of water quality within the household. In addition, it is advisable to consider making legal provisions enabling a utility to initiate legal actions to protect its water sources and distribution networks from pollution and other interferences, particularly where there are no effective pollution control programmes.

The health and water management authorities should place the burden of the primary level of water quality control testing on the utility, which should develop the infrastructure necessary for quality control and recover the costs through the proper pricing of the water supplied to the customer. At the same time, a system of independent surveillance should check water quality. The public should have free and regular access to this information.

Source: Shuval (1992).

In the countries where the state-owned enterprises have been entrusted with regulatory functions with respect to quality-related issues, privatization necessarily involves the reallocation of these responsibilities to an independent regulator. Keeping agencies responsible for operating functions independent of those with regulatory responsibilities is necessary to ensure consistent and unbiased administration of regulatory standards and because a service provider with quality regulation functions can control access to the market and deter potential competitors.

(i) Service quality under monopoly provision

In a market in which there is full and effective competition, and hence no asymmetry in information, there should be no reason to regulate service quality. If a firm arbitrarily reduces the price/quality combination it offers to consumers, this will lead to a corresponding reduction in its market share. Customers will switch to other products or firms, and competition will ultimately weed out those firms which fail to produce the price/quality combination which consumers demand. The only effect of service standards under the regime of perfect information and perfect competition would be to restrict artificially the range of products offered for sale (Shapiro, 1983).

The market system is based on a model in which all buyers and all sellers would have "perfect information" on the products and prices being asked and offered in all parts of the market. In reality, in most markets, including those for water-related goods and services, there is an informational asymmetry in which the firm knows the quality of the product it sells, but its customers do not have complete information about all aspects of quality. In the drinking water supply and sanitation sector, for example, some aspects of the level of service that a firm provides, such as water pressure, incidence of flooding from sewers, speed of response to leaks or other complaints, among others, and of water quality, such as colour, odour, sediment and taste, are readily discernible by consumers. Many other aspects of quality are much less observable, however, unless consumers test the water themselves.

This informational asymmetry constraints the ability of consumers to choose among suppliers. In the regulation of quality, the "issue is not high or low quality *per se*, but that efficient price/quality combinations are offered to consumers. If (say) the buyer of a product is less informed than the seller about its quality, then there may be a bias towards inefficiently low quality, mutually advantageous trades involving high quality may fail to be accomplished, and market breakdown can even occur" (Vickers, 1991).

In markets, even competitive market, with informational asymmetries, and no regulation, there is an incentive for sellers to reduce quality and take short-run gains (Shapiro, 1983). Such markers reach equilibrium at sub-optimal quality levels and are characterized by general quality deterioration (Leland, 1979). Minimum quality standards in such markets are normally considered to be socially desirable. They could also be desirable where consumers cannot readily evaluate the information available and the costs of mistakes are high. The good reputation of the supplier - one worth protecting - could be expected to ameliorate, at least some of the adverse effects of asymmetric information.

Even where consumers have complete information about product quality, a monopoly, however, has incentives to reduce quality, particularly if by so doing, it can reduce its costs. The revenue penalties to the monopoly from reductions in demand are small where substitutability in demand is limited, i.e. where quality reductions have relatively small effects on the quantity demanded at the relevant price (Vickers and Yarrow, 1988).

In general circumstances, the unregulated monopolist's selection of product characteristics is likely to be biased away from the social optimum; in the case where price is fixed, the firm always sets quality too low (Spence, 1975). Since no firm can, absent perfect price discrimination, capture all of the marginal social benefits of extra quality, it has an incentive to under-provides quality for a given price. The magnitude of the bias to reduce costs by reducing quality would be greater: (i) where the price elasticity

of demand is low; (ii) where the valuation placed on quality change by marginal consumers is low relative to the average; and (iii) where price discrimination is not feasible (Rovizzi and Thompson, 1995).

These considerations imply that under monopoly, the quality problem is potentially a serious one. Unfortunately, the regulation of service and product quality is one of the most neglected problems in the debate on private sector participation in the water sector. Given that competition is at present limited in the core transportation and distribution services of the water sector, that markets for its services are characterized by informational asymmetries, and that most service providers operate under regimes of monopoly, it is extremely unlikely that price control alone would be capable of giving sufficient incentives to profit-maximizing firms to make socially optimum quality choices.

There are qualifications to this conclusion. Even under monopoly provision a change to more market-style management should lead to a general enhancement of service and product quality. In the industries where full and effective competition is feasible, liberalization and other structural reforms which promote competition are likely to lead to enhanced product quality and product differentiation by comparison with that offered under public sector provision. Reputation effects may also be important as well-know companies move into the sector.

On the whole, there is, therefore, a strong case for supplementing price regulation with the regulation of service quality. An important role for the government is to set standards, to ensure their enforcement and to establish an appropriate system of incentives. The regulation of product quality tends to be more advantageous in markets characterized by: (i) greater sensitivity to quality variations; (ii) low elasticity of demand; (iii) low marginal cost of providing quality; and (iv) low value placed on low-quality service (Leland, 1979).

Logically, a profit-seeking drinking water supply company would not be confronted with non-regulatory incentives to increase the quality of the service it provides unless the service is metered (Cowan, 1993). The reason for this is that an increase in quality might encourage additional consumption, and hence impose additional costs on the firm, but there is no direct means for it to obtain extra revenue as a result of the incremental demand. A lack of metering may even encourage a firm to reduce the quality of the service it provides. Reputation effects may negate this argument.

(ii) Alternative mechanisms for service quality regulation

In considering incentives and regulatory instruments for service quality control, it is useful to distinguish between those aspects mainly determined by managerial efficiency (e.g. the speed of response to leaks or other complaints, timely connections and repairs) and those that primarily depend on capital expenditure (e.g. drinking water and effluent quality, adequate capacity, modern technology, reliable electricity and drinking water supplies) (Vickers, 1991).

There are four broad modes of service quality regulation, three are particularly appropriate for managerial efficiency, publishing information on quality performance, liability and related schemes and incorporating quality measure in price controls. The fourth, the form of price regulation, is meant to address those aspects of quality determined by capital expenditures; other forms of service quality regulation, particularly liability and related schemes are also useful in this respect. Selection of the most appropriate regulatory mechanism depends on the characteristics of the product or service as well as on market structure and a country's institutional endowment.

Whatever form of service quality regulation is implemented, it should be closely coordinated with price regulation. Setting and re-setting quality and price controls at the same time and in the same framework of evaluation helps avoid inconsistency and has the advantage of providing the regulated industry with a stable regulatory framework in the periods between periodic reviews (Rovizzi and Thompson, 1995).

Since many water utility assets are located underground and have very long working lives, whatever form of regulation is implemented, the information and enforcement burden on regulators will be large. The regulator must ensure that companies devote sufficient resources to maintenance and improvement and monitor carefully their capital and maintenance spending to keep assets in good condition for adequate levels of reliable service (Kinnersley, 1990).

Regulatory agencies facing utilities with discretionary control over aspects of product and service quality require non-market information, such as consumer surveys, to evaluate changes in prices and quality (Spence, 1975). In the privatized water industry in England and Wales, OFWAT places considerable importance on the involvement of consumers whenever possible in the debate about the standards of service that the customers want and are prepared to pay for, and the water companies share this view (Jeffery, 1994).

Publishing information on quality performance. Requiring companies to publish information on quality performance is simple and inexpensive. It usually provides few incentives, however, for compliance, although it can be a useful complement to other measures. It encourages public and media pressure on any company with a poor performance and may encourage new entry in the industry (Rovizzi and Thompson, 1995). To be more effective, it should be complemented with awareness campaigns intended to inform the public.

Liability and related schemes. Under *liability schemes*, companies are responsible for the nuisances and losses to customers caused by poor service. This approach provides strong incentives where there are private companies for quality improvement, enforcement is decentralized, and customers receive compensation for poor service. Customers may find it costly to make their case, although a number of measures can be taken to reduce these costs, e.g. creating a data base of materials on which citizens may draw to identify and assemble cases, setting up an efficient reporting machinery to facilitate selection of violations and to reduce the costs of bringing a case, awarding the full value of the fees and costs incurred in litigation to plaintiffs bringing effective or useful suits.

Customer compensation schemes or *guaranteed standards of performance* involve the setting of standards of service backed by a system of financial penalties payable in the event of non-compliance either to the government, or preferably if it is feasible, directly to affected customers (Rees and Vickers, 1995). In England and Wales, for example, the "Guaranteed Standards Scheme" (GSS) provides for fixed payments to be made when the company fails to meet certain guaranteed service standards (OFWAT, 1995a). The current GSS provides a flat rate payment of £ 10 (about US$ 15) in respect of each failure to meet the guaranteed standard, except for sewer flooding where the payment is a refund of the customers' annual sewerage charge (OFWAT, 1995s). Payments for some service failures are made automatically; if they are not made within 10 working days of the failure, the customer is entitled to an additional payment. For other failures, claims must be made in writing by the customer.

The main advantages of customer compensation schemes are that they provide for consumer- and fault-specific compensation and their flexibility in the sense that the company is allowed to trade-off changes in service quality against its incremental costs (Rovizzi and Thompson, 1995). This approach suffers from high transaction costs, however, and is more appropriate when quality failures can be easily verified. It seems particularly appropriate for supply interruptions, rationing and similar problems. A regulator does not need to directly observe rationing because it is observable by customers and there would be few disputes because an interruption typically affects a large number of customers simultaneously. By making compensation penalties sufficiently high, the

regulator can make rationing always unprofitable, and thereby essentially force the firm to remain on its demand curve (Riordan, 1984).

Although customers should receive compensation if the service for which they have paid is of poor quality which causes demonstrable damage, loss or inconvenience, the design of compensation schemes should take into account the following factors: (i) exceptional costs - in some cases the application of customer compensation schemes could have a significant impact on the utility's ability to properly carry out its functions, and thus to make improvements to services in the longer term; (ii) exceptional circumstances - the delivery of water-related services is contingent upon external events and it is not cost effective to plan service delivery against every eventuality; and (iii) customer responsibility - it would be inappropriate to compensate customers for losses which have arisen from their own action or inaction (OFWAT, 1995a).

Minimum quality of service standards, as well as service quality standards in general, should focus on those aspects of quality of service for which consumers care most about (Rovizzi and Thompson, 1995). They could be backed by explicit legal sanctions, such as fines or license amendment or revocation, or by implicit threat to revise the regulated price or to impose enforceable quality of service standards (Armstrong, Cowan and Vickers, 1994). Efficient resource allocation requires that standards be set with reference to the benefits of regulation and its costs.

Minimum service quality standards are appropriate for the situations where there are informational asymmetries between supplies and customers, and where there are severe non-linearities in the consumer-benefit function (Rovizzi and Thompson, 1995). They may also be attractive as a public relations exercise. There are also disadvantages with minimum standards, including the difficulty of determining the correct level of service quality, the efficient level of penalty and how to redistribute the fines to consumers (without redistribution, there will be no compensation) and a lack of flexibility as well as of incentives to the regulated firms to improve quality beyond the minimum.

Formal incorporation of quality measures in price regulation. Incorporating a measure of service quality explicitly in the price-control formula or taking it into account implicitly at the regulatory review may include acting to reduce price, profits or revenues when a firm fails to meet quality targets or initiating a regulatory review in the event of service quality falling below some preset levels.

A well-implemented mechanism of this kind would mimic the incentives existing in competitive markets where any arbitrary reduction in quality has a direct effect on the revenues of the firm and it can give strong dynamic incentives to improve the service above the minimum. Including a service quality factor in the price-control formula is a

self-operating incentive mechanism, at least until the next regulatory review, hence transaction costs and regulatory burden would be low, and it is flexible because the firm can select the price/quality combination which it finds the most appropriate given the price and service quality constraints, hence its implementation does not depend on the availability of information about the incremental production costs in supplying different levels of quality (Rovizzi and Thompson, 1995).

Including a measure of service quality in the price-control formula does involve regulatory costs incurred in establishing the mechanism, a heavy informational burden and a need for independent monitoring of service quality. Both the definition of a quality index, which implies identifying service quality dimensions and weights, and judgement on the appropriate balance between price and quality in the regulatory formula are not easy in practice and fraught with controversy (Rovizzi and Thompson, 1995). In addition, it does not compensate directly those who have experienced poor service.

The form of price regulation. Any price regulation which guarantees the ability of public utilities to incorporate additional costs of maintaining and improving the quality of service in their cost-of-service and hence to recover these costs in their prices, will presumably encourage such utilities to incur them to a greater extent than a non-regulated monopolist (Kahn, 1988). This means that rate-of-return regulation has attractive qualities when service quality is a capital-intensive attribute (Spence, 1975). Rate-of-return regulation encourages higher capital expenditures and if such expenditures are associated with improvements in service quality, this form of regulation would tend to offset the incentives to reduce quality when the allowable price is fixed (Vickers and Yarrow, 1988). However, if service quality is labour-intensive, this form of price regulation is likely to exacerbate the quality problem because of the Averch-Johnson effect.

In contrast, price-cap regulation typically does not give correct incentives to maintain service quality, on the contrary, the firm has an incentive to under-provide quality, given the particular price level (Armstrong, Cowan and Vickers, 1994). However, the fact that under this form of regulation profits can diverge significantly from normal levels while customers may be less inclined to support the imposition of financial penalties on a firm they think is performing well (Sappington, 1994a), may encourage managers of price-cap regulated utilities to assume more responsibility for giving a good level of service.

In the privatized water industry in England and Wales this problem was addressed by fixing price caps so as to finance the prospective investment expenditures required by each company and OFWAT may disallow the full extent of permitted price increase if a company fails to meet its prescribed investment objectives (Rees and Vickers, 1995). Even more important is the requirement imposed on the DGWS to ensure that companies are able, in particular by securing reasonable returns on their capital, to finance the proper carrying out of their functions (HMSO, 1993). OFWAT works with the quality regulators

to check that companies achieve the quality standards allowed for in the price limits on time (OFWAT, 1995h). If companies do not deliver the standards required, the DGWS will reclaim appropriate allowances from them either at a periodic review or by adjusting price limits between reviews at an interim determination.

(iii) Standard setting

Setting standards is a complex and demanding task, as regulators need to make correct cost-quality trade-offs which involve making judgement on consumers' valuation of quality improvements. The guiding principles include: (i) setting standards, as far as possible, to reflect the balance between the social cost of the damage avoided (i.e. benefits) and the social cost of avoiding the damage, including the costs of regulation incurred both by the regulatory agency and the firm; and (ii) consultation with those who have to pay for and abide by them. In practice, however, it is difficult to estimate the public preferences for marginal changes in water or service quality. In addition, the existence of separate regulators for water quality, environmental standards and prices with different responsibilities and powers - the so-called common agency problem - can complicate efficient standard setting.

Standards must be realistic, attainable, well defined, technologically sound, enforceable, and above all, in line with social and economic reality and consistent with providing a reasonable degree of environmental protection. The uncertainty stemming from the adoption of ambiguous, unenforceable and prohibitively expensive quality standards undermines confidence in regulatory policy and government commitment, and distracts regulated firms from the need to achieve compliance at minimum cost.

The technical studies required for the setting of standards, environmental and otherwise, can be contracted to the private sector and there are good reasons to do so. In general, however, self regulation should be avoided. If an industry is allowed to set its own minimum quality standards, it can be expected that these standards may be set too high or too low, but on balance, there is some reasons to expect too high standards to be the more likely case (Leland, 1979). Where the public interest is very large, the cost of errors is unacceptable and the standards have to be coordinated with other regulation, public intervention in standard setting is called for. A failure of market mechanism, which is due in part to the problem of asymmetric information and that of the lack of competition, means that it is appropriate for governments to determine and enforce standards.

Once standards are set, it is important that the regulator makes efforts to ensure that utilities minimize the cost of reaching them. The important aspects of the issue to be taken into account include: (i) the Averch-Johnson effect; (ii) the asymmetry of information, which requires careful monitoring and certification of expenditure plans; and (iii) the need

to ensure that utilities choose the most efficient means of compliance, which suggests the need to pay attention to the feasibility and desirability of setting-up some type of market mechanism for achieving environmental objectives (Armstrong, Cowan and Vickers, 1994).

(iv) The common agency problem

Where a firm faces separate regulators for quality of service, pollution and other environmental aspects, and prices, whose preferences for the various possible actions typically conflict what is generally referred to as the common agency problem can arise (see Holmstrom and Tirole, 1989 and Bernheim and Whinston, 1986). This can create tension between regulators who simultaneously and independently attempt to influence a common agent, such as a drinking water supply company (Jeffery, 1994), and create the danger of inefficient outcomes (see Box 6) as well as of inconsistency and a lack of credibility.

Obviously, higher standards demanded by environmental regulators requiring additional capital and maintenance expenditures have implications for rate setting. If the environmental regulator does not need to consider the costs of achieving a given standard then it will tend to set standards which are too high from the point of view of economic efficiency. Such a situation can arise when the benefits and the costs of regulation (e.g. pollution control or consumer protection) are borne by distinct groups whose interests are represented by different regulatory agencies (Baron, 1985).

On the other hand, the regulation of prices and quality or environmental aspects by the same regulatory agency might give rise to concern that this would give insufficient weight to consumers' or industry's interests. In addition, the separation of economic from environmental regulation helps avoid the conflict of interest, reduces the possibility for regulatory capture, avoids the incompatibility of the different requirements for regulation in the different areas of regulation and allows specialization among regulators.

Box 6

The common agency problem

The common agency problem can arise when a regulated monopolist is subject to regulation by two regulators, e.g. an environmental protection agency and a public utility commission. A study by Baron (1985) illustrates the kind of conflicts that can arise. In this study, an environmental protection agency (EPA), is responsible for achieving an acceptable balance between the damage from pollution and the cost of abatement, and a state public utility commission (PUC), is responsible for pricing electricity on the basis of the total costs of production, including pollution control, and for providing a firm with a fair return on its assets. Any firm will have private information about its production process and hence about the effectiveness of its abatement alternatives.

Although cooperation, i.e. joint regulation of emissions and prices, would internalize the conflicting interests and mandates of the regulators, the distributive consequences of the regulatory alternatives inhibit cooperation (a PUC wants to minimize abatement costs and an EPA does not want cooperation to impede achievement of its abatement objectives).

In a non-cooperative equilibrium, an EPA would set the maximum emission fee enforceable by the courts and mandate abatement standards that are more stringent than the regulators would choose in a cooperative equilibrium. This forces a PUC to respond with prices higher than would be set under cooperation. As a result, abatement is carried beyond the point of efficiency and the output of the firm is lower.

The firm would prefer that the regulators not cooperate because it then earns rents on its private information. Under plausible conditions, an EPA also prefers not to cooperate because it is better able to serve its own mandate if it does not take into account the PUC's interests. Only a PUC prefers cooperative to non-cooperative regulation because cooperation would reduce both the costs of abatement and information costs.

Source: Baron (1985) and (1989).

The potential for inefficiency underlines the need for closer cooperation between the regulatory agencies, for institutional procedures that guarantee collective decision-making, for the responsibilities of regulatory agencies being compatible, and for an explicit duty to be imposed on the environmental regulator to balance costs against benefits, as long as legal obligations are not compromised (Cowan, 1993).

In the privatized water industry in England and Wales, as economic regulator, OFWAT does not decide on environmental policies, but it ensures that decision-makes have all the necessary facts, strives to ensure that costing is available and that sufficient solutions have been considered, and is concerned that companies should be able to plan their investment programmes in a reasonably stable regulatory environment (Booker, 1994). It impresses on the quality-regulating agencies the importance of carrying out adequate economic analysis before they adopt more stringent standards. OFWAT also impresses on both quality regulators and water companies the need to arrive at efficient

solutions in which quality and environmental objectives are achieved in a cost-effective way (Booker, 1994). It also tries to alert customers to the possible impacts of new environmental regulations (OFWAT, 1995d).

The common agency problem is not limited to the possible conflict between economic and environmental regulation. For example, a similar problem might occur where the regulatory bodies for electricity and other energy resources such as gas are dissociated from one another, thus complicating the tasks of medium- and long-term investment planning, design of policies for energy substitution and rational use of energy, etc. (Azpiazu and Vispo, 1994).

(b) The regulation of quantity

Many water-related goods and services form a small but indispensable part of the total cost of the wide range of products in which they are used. As a consequence, the losses from service failure can be very large, in financial, social and political terms, relative to the basic cost of service provision.

Where a utility provides a necessity that consumers cannot readily forgo, as to a greater or lesser extent applies to drinking water supply, sewerage and electricity, it is usually subject to obligations to supply through universal service obligation (i.e. to serve all those who live within the area where it holds itself out to serve, apply for service and are willing and able to pay for it) (Bishop, Kay and Mayer, 1995). Without such an obligation, utilities would not have a motivation to serve when the costs of demand temporarily increase. For the utility industries this requirement sometimes implies that they must provide capital investment in unprofitable areas or must maintain an unprofitable type of service, but more commonly it means that a utility must expand capacity ahead of demand growth (Phillips, 1993). In some countries, utilities are allowed to charge one-off fees to finance network or production capacity expansion when new users are connected.

Although under a universal service obligation, a utility is typically expected to provide service to anyone willing to pay, this is not immediately feasible in many Latin American and Caribbean countries where the level of coverage is low or the supply unreliable and will continue to be so for some time to come. This problem can be met by requiring that the number of connections or installed capacity must expand at a specified rate or by committing the utility to a specific programme of investment. A commitment of this kind, if adequately formulated and sufficiently flexible, should not be unduly costly. One of the advantages is that once the investment is in place, the potential for enhancing profits by reducing quantity is substantially reduced (Jones, 1994). On the other hand, private investors would require a higher expected return as a compensation for the

commitment, and if credibility and commitment were an issue, that return might be very high. The example of Aguas Argentinas, which has won a 30-year concession contract to provide drinking water supply and sewerage services in Buenos Aires, Argentina, suggests that privatization can bring rapid improvements. In less than 2 years, it expanded the drinking water network to 600 000 new residents, eliminating water shortages, increased drinking water production by 26 per cent and improved the reliability of service (Donaldson and Wagle, 1995).

Universal service obligation implies that in the case of an essential public service, the public sector can never wholly abdicate its responsibilities for its operation to the same extent as in other industries, without placing the public at risk. Given that the operator of last resort will always be the public sector, governments should probably consider either to regulate privatized water-related utilities more comprehensively than is traditionally the case, including their debt accumulation, dividend policy, diversification and investment or to forego more comprehensive regulation but charge the privatized firm a risk premium for "public insurance" covering the contingent costs of the public sector intervention should the firm enter into a critical operating condition (Devlin, 1993). An alternative would be to retain a force account capacity to provide a residual means of performing essential functions should the private sector fail to perform its functions (see OECD, 1987).

Public utilities usually also have the obligation to serve all customers on equal terms, i.e. without unjust or undue discrimination among them (Phillips, 1993). The classification of customers for the purpose of rate-making is typically permitted, however, subject to the condition that within each class, the same rate structure must apply. The prohibition of undue preference or discrimination in the fixing of prices has also been interpreted as the requirement to set prices roughly proportional to attributable costs.

(c) Regulating investment[*]

Many of the benefits of private sector participation in water-related pubic utilities result from the provision of protection to necessary, but politically dispensable, water-related investments from general budgetary pressures. It also provides a means of tapping the greater pool of private capital to help finance them. The direct object of regulation is usually pricing policy, the effect of regulation on social welfare depends critically, however, on the investment behaviour that price regulation induces in regulated firms (Vickers and Yarrow, 1988). Given the nature and technological characteristics of most water-related goods and services, advantage in competition in production and supply are likely to be small unless there is competition in investment.

[*] This discussion draws on Cowan, 1993, Helm, 1993 and 1994b and Vickers and Yarrow, 1988.

Where prices are regulated, regulatory agencies must monitor carefully the capital and maintenance spending of the regulated firms to ensure that they make the investments allowed for in the price limits on time and achieve the expansion, quality and other targets for which the investments had been approached. The need for close monitoring is underlined by the capital intensive nature of most water-related public utilities which provides scope to evade the constraints imposed by price regulation by reorganizing their investment profile to enhance short-term financial performance at the possible expense of longer-term efficiency and prospects (Bishop and Kay, 1989).

(i) Commitment, regulatory risk and investment

Worldwide, there is no shortage of capital to make the necessary investments in the water sector; "there is, however, a shortage of confidence" (Graham, 1995b). An adequate supply of private finance to the privatized water sector will only be forthcoming, if investors are confident that: (i) their investment will not disappear though direct expropriation or through many small regulatory actions that are tantamount to a *de facto* expropriation; and (ii) they will earn a rate of return on the capital invested in the sector which is commensurate with the risk they take. Potential investors need government commitment to respect, over the long run, their property rights, the rules and regulations governing tariffs, entry conditions, and expansion plans.

The problem of commitment "arises from a fundamental asymmetry: the regulated price is flexible but the regulated firm's capital stock is not" (Besanko and Spulber, 1992). Although an incentive to act opportunistically exists in any multiperiod relationship, "opportunism may be more characteristic of the policies of public agencies than of private parties because although courts will prohibit inefficient breach by private parties they generally will not proscribe revisions of policies by regulatory or administrative agencies. Instead courts tend to restrict their review to procedure, process, and consistency" (Baron and Besanko, 1987).

Limited commitment powers involve both political and regulatory risks. Political risk arises from potential future radical changes in general government policy and regulatory risk arises from uncertainty surrounding the regulatory rules and regulatory environment (Grout, 1995). A particular feature of regulatory and political risk is that, unlike other risks, they are asymmetric around the expected return, i.e. investors perceive them as being mostly of a negative nature.

The potential for underinvestment is significant because water-related utilities are highly capital intensive, and most assets are specialized, location- or site-specific, and extremely durable with slow capital depreciation. Much of the investment is long-term and sunk and this can create a temptation for a regulator to ensure, once capital is irrevocably

sunk, that prices are kept artificially low, i.e. only cover future avoidable costs, marginal operation and maintenance costs and the return on non-specific assets, so that there is no profit margin left to compensate the firm for its prior investment. In such circumstances a company may be willing to continue operating, but not to invest at the efficient levels, because exit does not allow it to recover any of its investments, while shutting down and deploying its assets elsewhere involves additional costs (Guasch and Spiller, 1994). The existence of asymmetry of information between regulator and firm, however, may mean that the regulator is unable *ex post* to set price equal to average avoidable costs and this could mitigate underinvestment incentives (Besanko and Spulber, 1992).

Such *ex post* opportunism on the part of regulators can take various forms, but their effect is always to claw back company earnings reducing the value of the initial regulatory contract. Some of the more notable include interim price reductions; excessively slow depreciation; arbitrary changes in regulatory lag, quality or other aspects of service enhancements, without compensating price increases; disallowing recovery of supposedly "imprudent" investments; increased investment requirements, without compensating price increases; and market-share reduction (on the basis of Helm, 1994b and Salant and Woroch, 1992).

This type of expropriation may be profitable for a government if its direct costs (e.g. reputation loss *vis-à-vis* other utilities, lack of future investments by utilities) are small compared to the short-term benefits (e.g. achieving re-election by reducing utilities' prices or attacking a (foreignly owned) monopoly), if the indirect institutional costs, such as disregarding the judiciary, are not too large, and if the government's horizon is relatively short (Guasch and Spiller, 1994). The fact that (i) utilities' customers constitute a large proportion of the population, and are mostly captive and outspoken; and (ii) water-related projects, because of their social, economic and environmental implications and because they serve a lot of people, are highly visible and often serve as powerful political tools which can make a difference in the elections of public officials, reinforces the incentive for opportunistic behaviour (Guasch and Spiller, 1994 and Lyon, 1995).

It is essential, therefore, to develop a stable regulatory environment to encourage and maintain private investment in water-related services. Unless there is a stable regulatory environment, the rational fear of *ex post* opportunism by governments will deter efficient investment in sunk cost assets. The magnitude of the bias to underinvest depends on the nature of the assets involved, including the degree to which costs are sunk, the speed of depreciation, the rate of discount and the method used to finance investment, among other factors (Salant and Woroch, 1992).

Since the costs of investment are in part determined by the risk involved, any uncertainties associated with regulatory policy will raise the cost of capital to regulated firms. The immediate effect will be an upward pressure on tariffs. Uncertainty will also affect both the magnitude and composition of the investment programme, including the extent of technical innovation. This could also lead to an inefficient technology choice on the part of private investors providing a bias towards less capital intensive types of technology. Such uncertainty can also encourage the firm to seek to improve its short-term performance at the expense of the long-term one. Attempts to secure private sector participation, in an uncertain regulatory environment, would tend to attract mainly those entrepreneurs who have greater lobbying power or with greater willingness to take risks.

If a government cannot commit itself to a confined regulatory mechanism, private enterprise will not perform better in terms of the public interest than does public enterprise, because risk averse managers would have an incentive to make as much profit as possible, but not to invest (see Willig, 1993). If governments want to motivate private investment, it is necessary to design institutional arrangements to limit their own ability to behave opportunistically (Guasch and Spiller, 1994). Otherwise, private investment will not be the best way to finance water-related projects and the public sector might have to assume responsibility for investment. In these cases, service, management and lease contracts become the appropriate form of private sector participation.

Measures to reinforce private sector confidence

The only secure route to private sector confidence is a history of rational government committed to policies encouraging private investment in public services. Governments must demonstrate that they do not indulge in *ex post* opportunism. There are, however, some policies which governments can adopt to reinforce private sector confidence. For example, deregulating to the maximum, i.e. allocating decision-making authority to the firm responsible for most of the specific investments. This has the advantage of reducing the possibility for government or regulatory failure, but its disadvantages are the inefficiencies arising from market failures. The efficiency of this approach also will depend on the strength of the commitment not to introduce regulation in the future.

There are also what can be called technological alternatives which involve structuring the operating methods and technologies in the regulated industry to limit the incentives for opportunistic behaviour by a government or regulator (Sappington, 1994a). For example, since durability increases the regulator's incentives for opportunistic behaviour whereas such behaviour is not possible where assets are highly mobile, one solution would be to limit highly sunk expenditures on plant and equipment. "Compromising production efficiency may be a small price to pay for strategic stability" (Salant and Woroch, 1992).

The more effective alternative is, however, to begin with long-term regulatory contracts which guarantee the right of the regulated firm to earn a fair rate of return on investments. To be effective, these contracts must be credible and backed by guarantees limiting detrimental modifications. This requires setting out the rules of the regulatory scheme in detail and ensuring that past regulatory promises are honoured in future proceedings. It is difficult, however, to ensure regulatory stability. The basic problem is that regulators and governments in general cannot impose binding obligations on their successors.

In Chile and Argentina, very specific regulatory laws have been adopted and regulatory discretion has been strictly limited. The private sector has been investing massively in public utilities, particularly, all segments of the electricity sector, but in drinking water supply and sanitation, as well. It is, however, generally difficult to write and enact very specific regulatory laws, in part because some contingencies cannot be effectively anticipated. In addition, having all the rules set out in detail precludes the use of flexible regulatory schemes that require administrative discretion to be feasible and has an offsetting cost in terms of the reduced flexibility to adapt to changing circumstances. It may also encourage political interference in the regulatory work.

Another alternative is to specify in the transaction-specific contract documentation (e.g. operating licence) all regulatory procedures and parameters. The use of contract law requires a capable and independent judiciary to arbitrate disputes between the government and the utility. Specifically, courts must view licenses as contracts, be willing to uphold them against the wishes of the executive and not grant it too much freedom in their interpretation (Guasch and Spiller, 1994). For the success of this approach, it is essential to provide a long-term assurance to the private operator that the regulator will respect the letter and spirit of the contract and related laws. The use of contract law has important advantages in that: (i) it provides a strong guarantee against opportunistic behaviour since contracts cannot be changed unilaterally; and (ii) it provides a means to institute regulation gradually, adapting the regulatory framework to the changing conditions and needs of the country, a factor particularly important in countries with little experience in formal regulation.

The main disadvantage of using contract law is that it may introduce rigidities in the regulatory system. Contracts give the operator substantial bargaining power, limiting the flexibility of the regulatory framework, which would be undesirable if there is a genuine need to amend the license (Guasch and Spiller, 1994). Going too far down the road to explicit contract would in effect transfer the responsibility for regulation to judges or tribunals, entrusting the responsibility for determining the return on capital to the judiciary, a task which they tend to be poorly equipped to undertake (Holtram and Kay, 1994). Reliance upon project-specific rules embodied in a contract also carries dangers if

a government lacks the skills and bargaining leverage to ensure that the resulting contract fairly balances public and private interests (Stewart-Smith, 1995).

The use of contract law as a means of restraining regulators and ensuring regulatory credibility is more appropriate when privatization is limited in scope, e.g. relatively small concessions, build, operate and transfer (BOT) projects and independent power producers or producers which operate under a contract with state-owned utilities, but is much less appropriate when privatization is more comprehensive - involving, for example, divestiture of major utilities. The latter calls for a regulatory agency being created because it is impossible to pre-specify the complete terms of regulation in one or more contracts (Tenenbaum, 1995).

Credibility can also be enhanced through the use of domestic or international guarantees and by building up regulatory reputation and policy credibility. The regulator can overcome the credibility problem by building up a reputation for fair treatment, including a fair rate of return on investments. The longer a government is involved in contracts with private investors, the more the incentives to exploit the sunk nature of their investment will be reduced by reputational effects.

External guarantees through the participation of multilateral credit agencies, such as the International Bank for Reconstruction and Development (IBRD) and the Inter-American Development Bank (IDB), can help address the problems of limited commitment powers of governments and regulators. The World Bank has recently created stand-alone guarantees for various sovereign risks, including government regulatory actions (Tenenbaum, 1995).

Although external guarantees can help reduce regulatory risk, they may also have unintended side effects that undermine successful private sector participation: (i) the guarantees might become excessively broad undermining the efficiencies obtained from investors bearing the risk of a project's failure; (ii) since there is no efficient market for regulatory risk, the guarantee might be difficult to price and if mispriced, might send incorrect signals to investors and increase the costs to consumers; (iii) excessive guarantees might reduce, rather than enhance, credibility; and (iv) since guarantees are not free and government resources are limited, excessive guarantees might delay, rather than speed private sector participation (World Bank, 1995).

Finally, it is important to define the regulator's authorities so as to leave as little discretionary power as possible. Since social objectives are notoriously difficult to define in operational terms, social obligations imposed on the regulator should be kept to the minimum required by economic efficiency. It is equally important not to curtail the powers of the regulator too much, however, because the protection of the public interest may require changes in the initial framework. There is a need to find a proper balance between the legitimate interests of the private operator and those of the public.

The effects of price regulation on investment

The long asset lives in the water industry mean that the rates of return on new investment will be mainly a function of future regulatory decisions rather than of the decisions made at the time of privatization (Vickers and Yarrow, 1988). In the absence of clear guidance on the long-term conduct of regulatory policy, the uncertainty associated with future public policies can provide a strong incentive for underinvestment.

Properly interpreted, rate-of-return regulation - and its inherent promise that utility investors will earn a "fair" rate of return - can be viewed as "a form of long-term, incomplete contract with guarantees against capital expropriation" (Yarrow, 1991) and hence as a means of commitment that addresses the underinvestment problem (Greenwald, 1984). On this view, the rate-of-return regulation, as implemented in the United States, is attractive because it entails a commitment, which has juridical backing and historical precedent, that a fair return on investment will be earned (Rees and Vickers, 1995). The Averch-Johnson effect reinforces these incentive properties.

Price-cap regulation has serious drawbacks in this respect because it fails to provide long-term guarantees as to the decisions made at the regulatory review. Unless clear guidelines binding the decisions taken during regulatory review to ensure a reasonable rate of return are laid down, or emerge from precedent, the cost of capital will increase and there will be an incentive for the firm to underinvest. These guidelines, however, must necessarily embody an explicit feedback from cost reduction to eventual downward tariff

adjustment and this would negate some of the superior incentive properties claimed for price-cap regulation (Beesley and Littlechild, 1989). This underlines the need to design the framework of regulation accordingly. In the privatized water industry in England and Wales, this problem is addressed by the requirement that OFWAT must determine the price controls it sets for water companies by reference to an obligation to ensure a reasonable return on capital (Holtram and Kay, 1994).

Although pure price-cap regulation may fail to offer the same type of long-term commitment which the rate-of-return regulation, as implemented in the United States, is considered to provide, the decisive influence is likely to depend more on the structure and behaviour of institutions, both regulatory and political, than on the form of price regulation *per se* (Rees and Vickers, 1995). In both cases there remains the question of whether political institutions are capable of offering secure long-term commitments to regulated firms (Yarrow, 1991).

The incentives for opportunistic behaviour tend to be particularly pronounced when realized returns on incentives are unexpectedly high (Sappington, 1994a). This implies that price regulation can be designed to make private investments less susceptible to expropriation. For example, since under price-cap regulation profits can diverge significantly from normal levels, rate-of-return regulation can be expected to provide more protection against expropriation. If price-cap regulation is used, it would be preferable to combine it with profit sharing arrangements. Finally, efforts should be made to make the link between increased earning and increased effort, diligence and creativity on the part of the regulated firm as apparent as possible to the customers so that they understand that both they and the firm are better off under a well-designed high-powered price regulation than they would be in its absence (Sappington, 1994b).

The Chilean electric power industry affords an interesting example of an intent to address the problem of ensuring an adequate supply of private finance to a capital-intensive industry through a combination of regulatory and market mechanisms. In Chile, the electricity pricing system provides both for regulation of prices and for large consumers to freely negotiate price with any generation company. The regulated prices for bulk power sold to distributors are set at each node (the place of transfer from the national transmission grid to the distributor) of the high voltage transmission system. Node prices cannot vary by more than 10 per cent around the average price in the non-regulated contracts. The intention of the regulation is that the private sector will invest in electricity generation to the extent that new projects provide a return on capital compatible with the level of risk (Bitran and Sáez, 1994). If investments in new generation are not made, the future short-run marginal cost will increase, and this will lead to higher node prices, which in turn will give the incentive to expand capacity when demand increases. Under this scheme, most investment choices and decisions are left to the private sector.

Other sources of regulatory risk

Other sources of regulatory risk which could give rise to underinvestment include environmental policy (e.g. uncertainty about the potential liability for environmental damages either in the future or those caused by the operation of the former state-owned enterprise), policy concerning liberalization and industrial structure, the risks of (re)nationalization on unfair terms and anti-competitive behaviour of state-owned enterprises. These risks can be minimized by credible commitment not to change to the detriment of the regulated industry the regulatory regime which guarantees the right of the regulatees to earn a fair rate of return on their investments.

In the United States, for example, private investors "do not believe that water utilities are potentially lucrative economic properties at present because of the regulatory overhang of the unissued standards for many of the contaminants listed in the Safe Drinking Water Act" (Rogers, 1993). The 1986 amendment to the Safe Drinking Water Act, requires the Environment Protection Agency (EPA) to develop maximum levels for eighty-three new contaminants by the end of 1989 and to develop at least twenty-five additional primary standards every three years (Phillips, 1993). These new standards raise a number of problems for water utilities, but perhaps the most important of them "is the fact that few, if any, of the contaminants were taken into account in designing currently installed plants, with the result that both the ultimate treatment processes and final costs of meeting the new standards over the coming years are unknown" (Phillips, 1993).

A closely related problem is that of the asymmetric treatment of uncertainty by regulators, i.e. regulators tend to apply a stronger standard of scrutiny to extraordinary gains forcing the firm to pass on these gains to customers, than to extraordinary losses forcing the firm to bear a large part of the cost of bad decisions (Train, 1991). This asymmetry can distort the firm's incentives and induce it to make decisions in a way that ultimately works against welfare maximization (e.g. the firm may be induced to undertake projects that are too conservative).

(ii) <u>The structure of investment</u>

One effect of privatization will be to increase significantly the discount rate applied to investment projects as the discount factors used by governments are usually low, because unlike private investors governments can spread the risk over the entire population (Vickers and Yarrow, 1988). Allowance for regulatory risk may also affect the discount rates used in investment appraisal by private investors.

There is a tendency for the public sector, facing lower discount rates, to favour long-life, capital-intensive projects, but the funds available are typically rationed and some

projects do not materialize while others come to only a slow conclusion (Kay, 1993). The private sector, while it tends to favour shorter-life, lower-capital cost options, ensures that capital is available for any project the meets the rate-of-return criteria.

Privatization can affect the choice of technology. For example a higher rate of discount implies a bias toward less capital-intensive technologies and fuel choices in electricity generation. Thermal power may become the technology of choice rather than hydroelectric generation. Changes in the structure of capital flows with privatization are not likely to be limited to hydroelectricity generation. Change can be expected wherever there are less-capital intensive technological solutions and where there is competition from less-capital intensive substitutes. Irrigation *vis-à-vis* rain-fed agriculture, and to a lesser significance water transport, versus rail, road or air, are other areas where privatization could produce important changes in the structure of investment.

These considerations do not mean to say that governments should interfere with technology choice, although there could well be some instances when some form of regulatory intervention is warranted, rather their concern should be to know if the adopted technology "is the optimal investment choice or if it is the outcome of a bad regulatory system which has lost any credibility to guarantee reasonable rates of return for long run investments" (Laffont, 1994b) or some other deficiency of the regulatory framework. If a government decides to use subsidies to encourage the private sector to follow a specific investment path, attention should be paid to the need to ensure that any subsidies are channelled to the most efficient companies. Moreover, subsidies should not be hidden in preferential prices, regulatory concessions or other privileges, rather they should be awarded in such a way that they are explicit and easily accountable to the public.

One example of measures of this kind is the Law to Encourage Private Investment in Irrigation and Drainage Works (Laws Nº 18.450 and 19.316) in Chile. Chilean agriculture is highly dependent on irrigation, but almost 40 per cent of the irrigated area receives water intermittently due to deficiencies in the conveyance and distribution infrastructure and other problems (World Bank, 1994b). Under the Law to Encourage Private Investment, the government may reimburse up to 75 per cent of the cost of studies, constructing or repairing irrigation or drainage works, as well as private-sector investments in mechanical irrigation that increase the irrigated area, improve water availability in an area of short supply, improve water application efficiency, reclaim poorly drained or waterlogged land for agricultural production, etc. (Chile, 1985 and 1994). Funds, up to a maximum of approximately US$ 350 000 for any one proposal or twice that for projects presented by water users organizations are allocated on a competitive basis. Proposed projects are ranked with priority given to those with a higher proportion of total costs contributed by the beneficiaries, a larger benefitted area, and a lower project cost. The subsidy is paid only once works have been completed and duly certified. The law has

been well-received by farmers (World Bank, 1994b) and competition has reduced the level of subsidy (UN/ECLAC, 1995a).

(d) Creating a consumer constituency

Giving consumers, both individuals and businesses, a voice in the regulatory process, so that they can present their views and be informed of the decisions, can make utilities more responsive to customers, reduce the risk of regulatory capture and increase accountability of regulatory authorities, as well as make the regulatory process more effective. It is also desirable to require public disclosure of relevant information, including periodical publication of key indicators of utility performance. Consumer participation should be effective but not undermine the private operators' confidence in the stability and impartiality of the regulatory system (Kessides, 1993). Excessive consumer involvement not only can make the process slow and cumbersome, but also encourage cross-subsidization.

For regulatory bodies, consumers are a useful source of information which otherwise they have only limited means of acquiring. Consumers are usually the best monitors of service quality and reliability. Consumer involvement in the regulatory process supported by requirements for public disclosure of relevant information will also make utility companies, both private and public, more responsive and accountable to customers and less subject to capture by interest groups. In investment planning, consumer involvement can promote a demand orientation to investments, and consequently greater commercial viability (Triche, 1993). In addition, regulatory agencies can employ consumer feedback to motivate suppliers to provide high-quality service (World Bank, 1994a). Consumer involvement in regulation is especially important in those services in which customers lack the means of exerting pressure to perform or to express personal preferences to suppliers.

For the private service provider, consumer involvement can be not only an extension of public relations policy, but a critical factor for financial well-being because good customer relations can be vital to dissipating the political pressures on regulatory bodies, particularly during elections. Greater consumer participation can help create acceptance of the higher tariffs that often accompany sector reform and private sector participation and build confidence in the changes (Triche, 1993). Private utilities increasingly realize that, it is not the regulators who are deciding the permissible rates to charge and service or environmental quality standards, but the customer (Graham, 1995a). In addition, relations with consumers provide private utilities with the information, including critical feedback on operation and maintenance, they need to make good business decisions and reinforce community trust in the company. Various means can be

used to facilitate the dialogue, including public forums, one-on-one meetings with local leaders and the press, customer round-tables and written communications.

The approach of due process, open hearings and rights of appeal adopted in the United States has advantages in that all legitimately interested parties have the opportunity to participate and there is openness and transparency in the decision-making process (Stewart-Smith, 1995). Rates are determined in the context of a public hearing process in which all relevant information is made public and in which all interested parties, including consumers, may participate (Triche, 1993). Consumer groups testify regularly in these public hearings; and in some states, public service commissioners are elected by popular vote. During the public hearing, participants submit oral and written evidence to the tribunal and at the end of the hearing, the tribunal issues its decision, with reasons and rules in all questions asked (IEA, 1994). Although under this approach the regulatory process tends to be adversarial and decision-making is costly, in terms of both money and time, to say nothing of the costly rent-seeking on the part of interest groups, the gains obtained from transparent and open decision-making are seen by many experts as outweighing those costs (Stewart-Smith, 1995).

In the privatized water industry in England and Wales, OFWAT has set up Customer Service Committees (CSCs) in each of the 10 water and sewerage companies' areas of operation (Myers, 1995). They are independent of the water industry and their members are appointed by the DGWS. The committees identify the main concerns of water consumers and represent their interests both to the water companies and to the DGWS; closely monitor the services water companies provide and deal with customer complaints ensuring that they are satisfactorily investigated; and advise and report to the DGWS on particular issues affecting customers (OFWAT, 1995c and 1995e). The committees meet in public with company staff to discuss matters of concern to customers (Booker, 1994). They also advise the DGWS on the customer dimension of various proposals such as changes in charges, levels of service, etc. (Banyard, 1995). Consumers are also involved in the price review process. For example, as part of a recent price review, the companies conducted extensive public opinion surveys of consumer preferences and their willingness to pay (Jeffery, 1994).

In March 1993, the DGWS set up the OFWAT National Customer Council (ONCC) - its members are the Chairmen of ten regional CSCs and the DGWS - to strengthen the representation of water customers' interests (OFWAT, 1995a). The Council is a non-statutory body; its role is to formulate the views of customers on matters of national importance and to represent these effectively at all levels of regulatory decision-making (government, the European Commission, etc.).

Organising effective consumer involvement in the regulatory process will probably take time in most Latin American and Caribbean countries. In general, water management in the region has been characteristically highly centralized within the public sector and in the national governments (UN/ECLAC, 1991 and 1994a). One consequence has been the prevalence of national institutions with responsibility for a single water use. These highly centralized systems of service delivery have been largely unresponsive to citizen demand and have been subject neither to market nor political tests of responsiveness (Peterson, 1991a). As a result, most citizens have never had to face the realities of budget-constrained service choice, i.e. the fact that water-based services are not free but have to be paid for, and that the choice of service level should be made collectively and rationally in light of the costs and benefits to the community at large. As a result, citizens tend to "demand" free or far better service than is realistic at a given price level and than they are prepared to pay for and blame central government bodies when the level of service they demand fails to materialize (Peterson, 1991a).

Greater private sector participation tends to stimulates greater consumer involvement. In Mexico, for example, the four contractors in Mexico City came rapidly to the conclusion that they would need to engage in an aggressive public relations exercise to educate the consumers about the social and economic importance of water, water conservation and contractor activities which required door-to-door visits for meter installation and bill distribution (Richard and Triche, 1994). This has led them to establish the Foundation for Water Conservation in Mexico, a not-profit water conservation fund, as the basis for these public relations activities.

B. Structure regulation

The purpose of structure regulation is to introduce changes in the organizational structure of an industry so that it approximates more closely the structure needed for competitive behaviour. The structure of an industry largely determines the conduct of its member firms. In the case of monopolistic public services, the regulation of the structure should seek to facilitate effective conduct regulation where competition cannot be relied on to ensure socially desirable outcomes. Structure regulation must take into account many factors including, the technological characteristics of the industry, informational asymmetries, coordination requirements, and transaction costs (see Table 1).

Table 1

Technological and coordination characteristics of the water sector

Activity	Economies of scale	Degree of sunk costs	Degree of coordination necessary
Hydroelectricity	Moderate	High	Very high
Irrigation			
· terminal system	Low	Low	Low
· diversion and distribution systems	Moderate	High	High
· groundwater systems	Low	Varies	Low to moderate
Water transport			
· Piers and harbour	Moderate	High	High
· port equipment	Low	Moderate	Low
· ships	Low	Low	Low
Drinking water supply			
· piped	High	High	High
· non-piped	Low	Low (except well)	Low
Sanitation			
· conventional sewerage	Moderate	High	High
· other	Low	Low to moderate	Low to moderate

Source: adapted from Kessides (1993).

Structure regulation largely dictates the nature of conduct regulation. Failures to isolate the natural monopoly elements and to create adequate competition can considerably complicate conduct regulation and make its task more demanding and its scope broader than necessary. Any failure will also impose on regulators the task of trying to compensate for the deficiencies in structure through more intrusive conduct regulation. Inappropriate industrial structure is one of the main causes of regulatory failure and competition is the best form of control.

The opening of markets to competition requires an approach which permits participants to adapt to the new circumstances. It is difficult to move from a nationalized monopoly to a competitive industry in a single step, even in industries without barriers to competition. In monopolistic industries, the regulator needs the authority and duty to ensure the success of the transition process and to remove, as far as possible, the obstacles to competition without disrupting supply. The mere repeal of the statutory monopoly,

however, is not always sufficient to ensure effective competition, especially where the incumbent retains significant market power and has at its disposal a range of instruments of strategic entry deterrence and of exit inducement.

In restructuring any water-related utility to allow private sector participation, the first step is to break up the monopoly of the public sector over service provision, including the elimination of any discriminatory treatment against the ownership and management of water-related utilities by private or foreign companies. It is equally vital to eliminate distortions in the overall incentive environment (tax regime, labour laws, import and foreign investment regulations, etc.) and any excessive regulations and restrictions which inhibit private sector participation.

The second step is to create a credible and stable regulatory framework which guarantees a fair rate of return and protects against anti-competitive behaviour of state-owned enterprises. There must be a level playing field between public and private companies. This can be difficult to achieve because the private contractor's costs are often different from those taken into account for provision by the public sector. Private service providers have to recover all their costs as well as pay taxes and make a reasonable profit. Public utilities, in contrast, often operate at a loss, receive subsidies in the form of grants, concessionary loans, use of public land, staff time and other resources, usually do not pay taxes, and receive abundant assistance in project planning, design, and financial packaging from the external lending institutions (McCullough, 1992). Competition will be unfair unless public utilities are placed on a non-subsidized, full-cost recovery basis.

Aspects of the broader legal and regulatory environment for public works can also act as significant barriers to private sector participation and especially investment in the water sector (Richard and Triche, 1994). For example, accounting laws and practices, laws governing construction contracts, public works laws and conventions, etc. may be inappropriate for private sector participation and should be carefully reviewed and, if necessary, amended or modified. The administrative burden imposed on private firms in complying with administrative rules and regulations can be a significant obstacle. It should be minimized as much as possible.

1. Vertical and horizontal restructuring

As a matter of general principle, public policy should seek to isolate the natural monopoly elements in an industry and to prevent the firms entrusted with activities with natural monopoly characteristics from extending their monopoly powers beyond the segment of the market where these characteristics exist (Vickers and Yarrow, 1988). This objective can be achieved by detaching, by means of restructuring or contractual arrangements, the potentially competitive activities from those which are natural monopolies or characterized

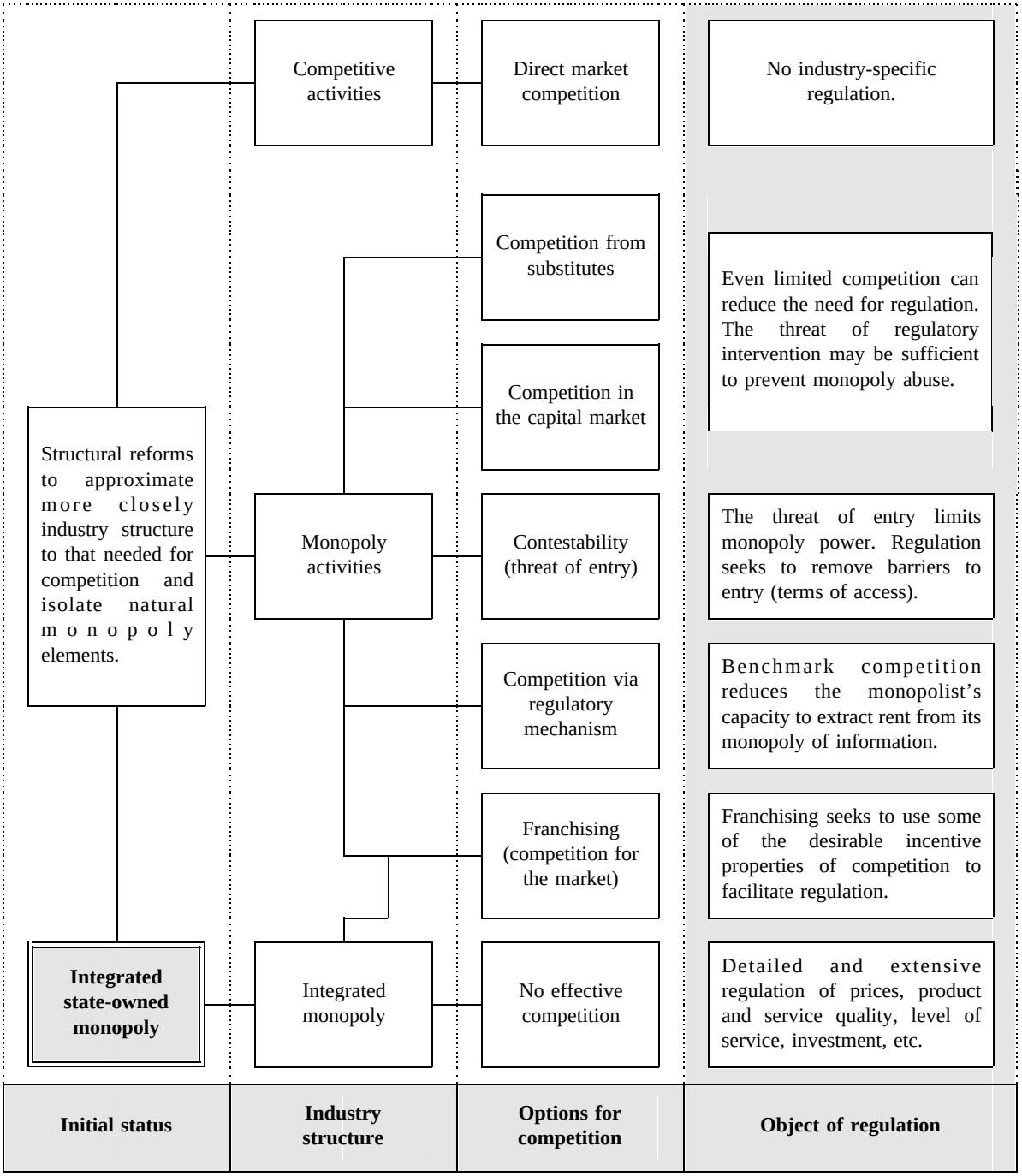
by other categories of market failure, and opening them to various forms of competitive provision (see Figure 3).

When sunk costs are not pervasive in an industry, but rather are centred in a particular sector of its operation, "by isolating the activities with which the heavy sunk costs are associated, their damaging consequences can be quarantined" (Baumol, Panzar and Willig, 1982). Recent advances in economic theory and technological innovations have contributed to the understanding that some water resource development activities commonly regarded as natural monopolies or characterized by other categories of market failure in fact "bundle" together the activities in which market failure is not important with those in which it is. Many elements of market failure inherent in the provision of water-based services are associated with some, very specific, elements of market structure and do not occur equally in all parts of a water management system. The rest of the system comprises artificial monopoly, and therefore the appropriate policy response is the application of general competition and anti-trust policy.

The most common firm in water-based services is an integrated utility responsible for all aspects of service provision in the area under its jurisdiction. For example, the provision of network facilities, whether for drinking water supply, sewage or electricity, exhibits scale economies of such significance that they can be regarded as natural monopolies, but these economies are less important in the case of water extraction and treatment, wastewater treatment and electricity generation, and hardly exists in certain drinking water supply, sanitation and irrigation technologies.

Figure 3

Functional separation increases the options for competition and facilitates regulation



Source: adapted from World Bank (1994a).

The problem with the integrated model is that a market failure in the provision of one service may allow its provider to gain an unfair advantage over other firms in the services which are potentially competitive. Functional separation promotes competition by separating out - to the extent permitted by economies of scale and scope - the potentially competitive elements from those in which competition is inevitably imperfect. It seeks to leave the maximum number of operations to the free market and to limit industry-specific conduct regulation to the segment of the industry that is inextricably associated with heavy sunk costs.

Other potential benefits of functional separation include expanding the domain of economic activity in which there is effective competition, increasing the spectrum of opportunities for private sector participation (e.g. by increasing the scope for franchising), reducing the asymmetry of information between regulator and firm, and improving the quality and quantity of the information available to the regulator. It should improve management accountability and increase efficiency by allowing operators to specialize provided that adequate incentives and channels for communication and coordination are incorporated into the institutional design.

Functional separation is, however, by no means a panacea. For example, vertical or horizontal integration which apparently reduces competition may also raise efficiency. The potential benefits of structural reform may also be counter-balanced by other concerns such as the encouragement of a higher rate of service expansion and the achievement of higher service quality. To decide whether and how to effect separation, many factors need to be carefully analyzed, such as technical, technological and economic constraints to separation and the legacy of history and institutions. Attempts to separate closely interdependent activities can impose high costs on the sector, including the loss of the economies of scale and scope for each firm as its size and service area fall and the costs of sector restructuring, which need to be carefully weighted against the potential benefits of cost-minimizing behaviour under competitive pressure.

The network characteristic of most water sector activities raises the possibility that the efficient operation of the system as a whole will not be achieved without adequate mechanisms of central coordination. This can impose high transaction costs as the coordination between several independent and rival firms is inherently more difficult and costly and less effective than within a single organization. The experience of successful integrated organizations questions the wisdom of excessively dismembering the integrated production, particularly where integration involves significant technological and transactional economies, and suggests that undue fragmentation can lead to serious misallocation of resources and over-investment. Fragmentation of responsibilities for planning, investment, operations, maintenances, and debt services may lead to lack of

accountability and inefficiency because actors do not have an appropriate level of control over decisions and actions that affect their efficiency (Triche, 1990).

Where economies of scale and scope are significant for a relevant market size, water sector services can be provided more economically by a single supplier and separation will raise the costs of service provision (see Figure 4). On the other hand, the existence of potential benefits is not sufficient to ensure that they will be effectively realized under monopoly provision. It is possible that the inefficiencies resulting from the sacrifice of economies of scale and economies of scope would be more than off-set by efficiencies resulting from a competitive market structure and advantages of flexibility and proximity to clients that smaller organizations usually enjoy. Large organizations suffer from organizational diseconomies of scale. In the real world where a monopoly without external pressure usually undertakes only limited cost minimization activity, the introduction of competition, even in a naturally monopolistic industry, could result in lower costs.

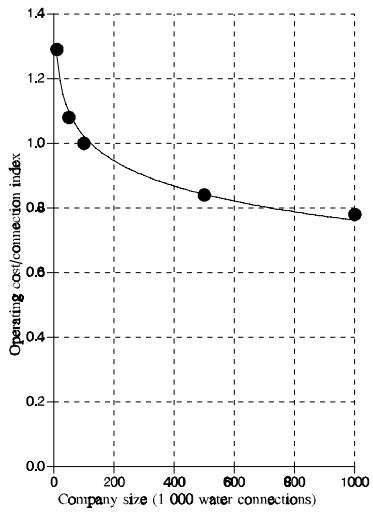
To the extent that effective competition can be established, in the long run the costs of making wrong separation decisions about the initial post-privatization industrial structure may not be too severe (Vickers and Yarrow, 1988). In theory at least, the subsequent evolution of market structure, through mergers, new entry, division, takeovers, etc. will take care of the problem. This underlines the importance on injecting as much competition as possible in the water sector at the moment of privatization. Unfortunately, the underlying technological and market conditions of many water-related activities are such that there are limits to substantially increasing competition, as in drinking water supply and sewerage, but in others, particularly in hydroelectricity generation and, possibly, wastewater treatment, there are greater possibilities.

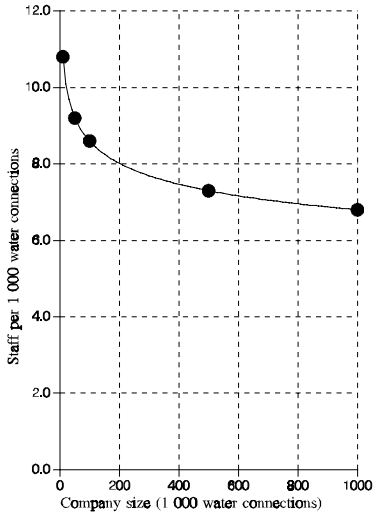
(a) Horizontal restructuring

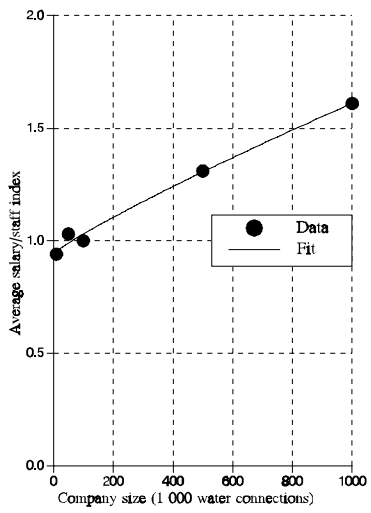
Horizontal separation breaks up, or unbundles, firms by markets - by geographical regions, by service categories or by individual units - creating entities which directly or indirectly compete with each over. Typical examples of horizontal separation are the subdivision of national drinking water supply and sewerage, power or irrigation companies into state, provincial, regional or other units. The fact that in many Latin American countries, the pre-privatization water sector has been already regionalized or is in the process of regionalization, facilitates horizontal separation (see UN/ECLAC, 1991, 1994b and 1994c).

Figure 4

Economies of scale in the operation of drinking water supply and sewerage systems







An analysis of operating indicators of 36 water supply and sewerage companies in Brazil indicates that there are important economies of scale in the operation of water supply and sewerage systems. This conclusion is supported by data from other Latin American countries, Western Europe, U.S.A. and Canada.

Large companies are in a better position to capture the economies of scale present in the construction of large works (water intakes, water and sewerage treatment plants, etc.).

Moreover, the data indicated that while operational costs per connection decreased with the size of the company, average salaries rose. Large companies, therefore, are able to attract more competent personnel, which in turn allows them to operate at a higher efficiency level to offset larger unit labour costs.

There is strong evidence that drinking water supply and sewerage services in communities with population of less than 150 000 to 200 000 (20 000 to 40 000 water connections) can be provided more efficiently and at a lower cost if they are managed and operated by regional companies.

Large and centralized national organizations are not an optimal solution. Experience during the 1960's and 1970's in Argentina, Colombia, Mexico and other countries indicates that central agencies stretched managerial capacity to the point where gross service inefficiencies were readily observable.

Source: Yepes (1990a) and (1990b).

Direct product competition. The horizontal separation may lead to direct product competition, as in hydroelectric generation. Where horizontal separation leads to the emergence of multiple service providers which have to compete with each over, the need for conduct regulation dissipates. Increased competition will also improve the efficiency of any state-owned enterprises that may remain in the sector. Empirical studies suggest that the relative inefficiency of publicly owned enterprises stems largely from the isolation from effective competition rather than the public ownership *per se* (Caves and Christensen, 1980).

Even limited competition is usually desirable because it reduces the need for conduct regulation and enhances its effectiveness by improving the information available to regulators. The existence of regional producers constrains incentives for monopolistic behaviour, encourages new entry, promotes market contestability, increases the scope for franchising, mitigates some of the potentially negative effects of vertical integration, and impedes collusion.

The underlying technological and market conditions of drinking water supply and sewerage mean that, usually, there are no national or regional drinking water and sewerage networks because the cost of network facilities and of pumping long distances over sparsely populated areas exceed the costs of water extraction and treatment. To be successful, such competition would require sophisticated metering technology, a high degree of coordination, and strict and continuous monitoring of the quality of water that each utility supplies to the common network. Moreover, the barriers to competition are unlikely to be reduced by the kind of technological progress which opened the telecommunications and, to a lesser extent, electricity sectors to competition.

Horizontal separation does provide, however, even in drinking water supply and sewerage, the opportunity for direct competition for larger industrial and commercial customers. Although duplication of the network of water mains or sewers is almost always inefficient and implies a large loss of economies of scale, direct competition for larger customers could be feasible under certain circumstances, especially if there is some product differentiation, i.e. the competing utilities provide different qualities of water or wastewater treatment (Armstrong, Cowan and Vickers, 1994).

The existence of several geographically separate drinking water supply and sewerage utilities could allow competition between contiguous utilities for the right to supply customers at the boundaries of the utilities' service areas. The greater the number of geographically separate utilities, the greater is the scope for such competition and the greater are the losses of economies of scale for each utility as its size and that of its service area fall.

For example, in the privatized water industry in England and Wales, spatial competition currently takes two forms - new appointments for new developments within existing allocated company areas (see Box 4) and cross boundary competition where a company must respond to requests for domestic water from any customer regardless of location (OFWAT, 1995f). The customer would have to meet any costs involved in providing the necessary pipework. The possibility of extending cross boundary access to non-domestic water supplies is being considered.

Horizontal separation in the electric power generation sector would tend to encourage inter-utility competition, conclusion which is confirmed by the generally successful experiences of Argentina and Chile. In Argentina, for example, the three major federal utilities were broken into numerous concessions (Torres, 1995).

On the other hand, the exhaustion of economies of scale for generation does not in itself guarantee that a full and effective competition will emerge from horizontal separation. For example, the effects of potential entry on market behaviour may generally be small, particularly is the short- and medium-term, because of the importance of sunk costs in generating plant investments, the lumpiness of those investments, and the ability of generators to communicate price changes rapidly (Schmalensee and Golub, 1984). In the longer-term, new entry will depend on the growth of demand. Breaking-up an integrated utility can impose high costs on the sector which need to be carefully weighed against the potential benefits of cost-minimizing behaviour under competitive pressure.

If effective competition cannot be introduced through vertical separation on balance it may be better to leave the industry horizontally integrated (Bacon, 1994). The effects of horizontal separation would probably be negative in the economies at lower levels of development and small power systems because of the inability to exhaust economies of scale at the level of individual generators and the impossibility to adopt sophisticated bidding systems such as power pools. Furthermore, in the countries where such sophisticated devices cannot be made to work, horizontal separation will involve the extra cost of maintaining reserve margins against uncertainties.

For effective competition there should be a sufficient number of firms to avoid collusion and gaming in the system (Bacon, 1994). In the smaller and less developed countries, the market can be too small to support enough firms to achieve truly competitive behaviour, except at an unacceptable loss of economies of scale. A concentrated industry structure where generating capacity is concentrated in two or three firms which can influence the price at which electricity is purchased from them is likely to be seriously inefficient. Firms should be similar in size and cost structure, adequate transmission capacity should exists and transmission costs should be low. Entry into the industry (obtaining licenses, constructing the plants, etc.) should be easy and rapid and

incumbents should not enjoy important cost advantages unavailable to new entrants (Bacon, 1994).

Horizontal separation along regional lines may tend, however, to encourage companies to develop geographic market sharing. As a result, competition would be constrained through tacit collusion not to compete for each others markets (Vickers and Yarrow, 1988).

Improved access to information. Even when horizontal separation leads to local monopolies, unless there is no correlation in the cost conditions among them, it enables regulators to have access to information from a group of independent providers of comparable services, characterized by a variety of common features in the input and output markets. This provides a basis for comparisons across those firms useful for setting incentives, based on relative performance, and hence opportunities for the implementation of more effective regulatory incentive structures - based on comparative yardsticks or benchmarks - than those that are feasible when there is only one firm.

The benefits of informational advantages in creating and maintaining many similar firms are more likely to outweigh the loss of economies of scale or scope where a regulated industry is mainly an aggregate of several local monopolies (e.g. drinking water supply and sewerage) than where the natural monopoly element is itself on a national scale (Beesley and Littlechild, 1989). The higher the correlation in the firms' environments, all else being equal, the more likely it is that the benefits from the enhanced effectiveness of regulation when there are several firms outweigh the possible loss of economies of scale and scope that functional separation would involve (Armstrong, Cowan and Vickers, 1994).

Although an increased number of firms can assist regulators by providing them with greater information and improving its quality, horizontal separation also implies that regulatory agencies will be faced with the prospect of regulating and monitoring different sets of tariff structures and service quality standards with variations in cost and other conditions (Vickers and Yarrow, 1988). This may cause serious administrative problems that could potentially impair the quality of regulation, particularly if the regulatory body does not have adequate resources.

The role of the capital market. The transferability of private ownership rights in the capital market reveals information via changes in share prices, which, if the market is efficient, capitalizes the consequences of current actions for future profits (Vickers and Yarrow, 1991). The existence of regional private companies exposes the industry to competition in the capital market where water sector utilities must complete for capital both among themselves and with other investment opportunities. By reducing the size of

privatized utilities, horizontal separation facilitates acquisition and reorganization of the poorly performing utilities and facilitates the generation of comparative information with which shareholders can assess their performance (Bishop and Kay, 1989).

Although the capital market can encourage productive efficiency through competition in terms of corporate takeovers, this might conflict with the need to maintain a sufficiently large number of independent utilities to enable the regulatory agency to conduct benchmark competition (Armstrong, Cowan and Vickers, 1994). Restrictions on the concentration of shareholdings and the large size of public utilities, some of them rank among the largest private enterprises in the economy, can reduce the threat of takeovers (Bishop and Kay, 1989). In addition, since mergers increase industrial concentration and market power, there may be a loss of incentives for innovation and managerial efficiency. This implies that additional regulatory vigilance could be needed to ensure that customers are not penalized for any inefficiency.

This concern has led in England and Wales, to the DGWS to call for separate Stock Exchange listings for all regulated water companies after takeovers, mergers or where a company outside the water industry wishes to acquire a regulated water business, to ensure that sufficient transparency is maintained to allow effective regulation (Murray, 1995 and OFWAT, 1995r). One example is the Lyonnaise des Eaux/Northumbrian Water merger where OFWAT has secured agreement by Lyonnaise des Eaux to list its entire water interests in England and Wales on the Stock Exchange by the end of 2005 (OFWAT, 1995q and 1995r).

Capital markets also provide a powerful disciplinary force on poorly performing regulators. The stock market valuation of the firm changes following any action by the regulator as its decisions are reflected in the change in share prices, i.e. if the market regards the regulator's decision as less favourable to the firm than expected, its share price is marked down and its cost of capital increases and vice-versa (Beesley and Littlechild, 1989). For example, compering the stock market returns for a regulated company or industry with the returns for a comparable sample of unregulated companies provides a useful way to test whether there is a regulatory capture (Dnes, 1995). Capital market response to regulatory decisions provides a feedback to the regulator and its supervisors, i.e. political authorities and customers, about the decision it takes and constraints regulatory discretion by the expectations of shareholders and customers to whatever range they deem acceptable or can be so presented. The role of capital market is particularly important because of the problem of government or regulatory failure and because regulators may be ill informed about the consequences of particular regulatory decisions for the regulated industry.

(b) Vertical restructuring

A utility can be described as being vertically integrated if it extends its activities over more than one successive stage of the production process of transforming raw water into final goods and services (Pearce, 1986). Vertical integration eliminates contractual or market exchanges, and substitutes internal exchanges within the boundaries of the utility (Perry, 1989). Vertical separation breaks up, or unbundles, activities previously performed by an integrated vertical monopoly. Typical examples of vertical separation are the division of a state-owned power utility into separate generating, transmission and distribution companies as has been done in Argentina.

There are three broad determinants for vertical integration: technological economies, transactional economies, and market imperfections such as imperfect competition, externalities and imperfect or asymmetric information (Perry, 1989). Vertical integration adopted by unregulated firms that are subject to a reasonable degree of competitive pressure generally promote efficiency and increase welfare. The negative consequences of strong vertical links may be sufficient to overturn the general presumption in favour of vertical integration where either (Yarrow, 1991):

- vertical arrangements are not the products of competitive process, e.g. have emerged from the pre-privatization structure of a sector; or
- there is a major horizontal failure of dominance or collusion; or
- there are existing regulatory controls.

Although, even where these conditions hold, the continuation of vertical integration can usually be justified on efficiency grounds (e.g. economies of scope), in regulated industries with natural monopoly elements, vertical integration usually does possess potentially negative effects on economic efficiency.

Vertical integration can allow a natural monopoly to extend its monopoly power to the non-regulated upstream and downstream markets. It can discriminate in its own favour or in favour of affiliated firms, increasing barriers to entry and foreclosing competitors - by means of prohibitive network access charges or discrimination in other terms of interconnection such as the quality of access. Such negative effects are associated chiefly with network services. The existence of regulation in one of the market segments can greatly enhance the incentive for the firm to use its market position to extract profits from other stages of production or distribution (Yarrow, 1991).

Some potentially competitive and not naturally monopolistic water-related activities, e.g. electricity generation and water extraction and treatment, are upstream from the distribution network which typically is a natural monopoly, while others e.g. wastewater

treatment and commercial operations, are downstream. Effective competition in any of these activities will require a regulatory framework to ensure access on a fair basis to network facilities. Ownership of network facilities, by a vertically integrated firm, is not necessarily, however, a decisive obstacle to the emergence of competition. Advances in technology, changes in factor prices and in other market conditions can erode the advantages of vertical integration and create opportunities for new entry and competition.

Vertical integration tends to hamper effective conduct regulation and, in practice, it can be difficult to hold in check anti-competitive behaviour of vertically integrated firms by vertical conduct regulation without some measures of structural separation. Vertical integration usually worsens the asymmetry of information between regulator and firms and impairs the quality of the information available to the regulator. This hinders effective conduct regulation and provides opportunities for circumvention. As a result, to be effective, conduct regulation has to be more proactive and intrusive (Stewart-Smith, 1995).

The potential benefits of vertical separation have to be carefully balanced against the loss of the economies of scope and scale, the costs of sector restructuring, and the possible loss of some internalization of externalities. If these factors - in particular, economies of scope - are significant, there may be a case for the continuation of vertically integrated monopoly. If these factors are not so significant or the benefits of competition and of more effective conduct regulation are substantial, then vertical separation would be desirable. If parts of industry must remain vertically integrated, vertical conduct regulation or measures of partial vertical separation will be needed to establish conditions for effective competition.

There are various policy options for countering the negative effects of vertical integration short of breaking up the vertically integrated firm, including, laissez faire, establishing a right to interconnect with terms left to negotiations, using antitrust law to limit anti-competitive behaviour, publishing the terms of negotiated agreements, imposing terms if the parties fail to agree, and imposing public service obligations for interconnecting firms (Guasch and Spiller, 1994).

(i) Vertical restructuring in drinking water supply and sanitation

There are two separate natural monopolies in drinking water supply and sanitation - water distribution and sewerage collection (Vickers and Yarrow, 1988). Economies of scale are much less in raw water extraction and treatment and in wastewater treatment and disposal. The scope for increasing competition through vertical structural reform is, however, extremely limited because of the strength of the natural monopoly conditions which derive from the established local networks of water mains and sewers. The obstacles are the need

for extremely tight coordination between the services, due to the interrelated demand, the high costs of service delivery, in relation to the costs of water production or wastewater treatment, and the fact that the experience gained and the equipment used in one is useful for the other.

One alternative for promoting competition is the use of franchising, specifically service contracts, concessions and BOT contracts (see UN/ECLAC, 1995b). Many water utilities already use franchise-type arrangements, especially for auxiliary activities such as cleaning, food catering, security, vehicle leasing, etc. It is also common to contract out administrative, commercial, training, technical assistance and standard professional services as well the managing of non-core assets and activities. Activities, such as construction, billing and collecting, meter reading, and operation and maintenance, can also be contacted. It is more complicated to ensure effective coordination, controls and supervision when contracting water production, treatment and distribution, and wastewater treatment, but it also can be done. Economies of scale are not sufficiently large to justify high levels of national or regional concentration of sewage treatment (Vickers and Yarrow, 1988).

In Latin American and Caribbean countries, water utilities have been usually heavily vertically integrated to a degree that they include all operational and support functions, including those which do not exhibit natural monopoly characteristics. Many utilities could realize substantial cost savings and enhance efficiency through vertical separation by means of franchise arrangements with private firms. Many activities can be opened to direct competition. For example, approved contractors can compete for connection work. In Chile, services not subject to regulation, including connections, may be undertaken by contractors or the customers themselves, subject to meeting approved standards (Chile, 1988). In Mexico, wastewater treatment is contracted out on a large scale (Mexico/CNA, 1993). The Mexico City franchises are an example of what can be done in the separation of functions (see UN/ECLAC, 1995b). In England and Wales, consideration is being given to allow developers and builders to carry out connection work, subject to company inspection (Byatt, 1996), and to oblige companies to put connections out to competitive tender (Buckley, 1996).

(ii) Vertical restructuring in electricity

Natural monopoly in the electricity sector is confined to the transmission and distribution systems. There is also, however, a need for very close minute-by-minute coordination between generation and transmission, since demand fluctuates randomly, supply is subject to unpredictable outages and equilibrium must be maintained continuously throughout the system (Armstrong, Cowan and Vickers, 1994). This provides powerful arguments in favour of a policy of vertically integrated monopoly for generation and transmission and

explains why in most countries the two activities have typically been vertically integrated. Other arguments in favour of integration include optimal investment and capacity planning and operational coordination (IEA, 1994). Integration also facilitates the handing of power disruptions and supply emergencies.

The problem with the integrated model is that effective competition can be difficult to achieve because control over the transmission network would give its owner an enhanced ability to deter new entry and discriminate in favour of its own subsidiaries (see Paredes, 1995). The separation of electricity generation from transmission and distribution creates conditions for effective competition and encourages new entry. Various forms of competition between generators become possible under vertical separation ranging from contract competition to supply the transmission grid under long-term contracts, which may be tradable or not, to spot market competition (Armstrong, Cowan and Vickers, 1994).

Electricity pools simulate a competitive marketplace where generators compete for the right to supply bulk electricity in time slots (usually 30 or 60 minute periods) by specifying a supply schedule of price and quantity for the slot they wish to bid for (World Bank, 1994a). Although power pools facilitate competition and provide the prospect of the maximum gains from competition for customers, they are difficult and costly to develop and operate and these costs may outweigh the benefits while their complexity and volatility can discourage investment (Turgoose, 1995).

Spot markets in electricity can make prices volatile and unpredictable so that contracts between generators and distributors or large customers are widely used. Competitive discipline is maintained through contract competition. Although long-term contracts offer generators an adequate insurance against risks, contract specification is a complex task. Inefficiencies can arise because it is impossible to cater for every eventuality and there are difficulties with contract monitoring and enforcement. In addition, the grid operator needs to have considerable authority over generators to deal with short-run contingencies (Armstrong, Cowan and Vickers, 1994).

In the countries where the power market is small in relation to the minimum efficient scale of generation, suitable sites for new generating plants are few, transmission capacity is insufficient or the costs of sector restructuring are very high, the potential benefits from vertical separation will be restricted because any efficiency gains from increased competition would be offset by the loss of economies of scale and scope and the additional coordination costs. The effectiveness of competition under vertical integration depends on characteristics of the bidding process, the terms of access to integrated firm’s network and on the configuration and evolution of the transmission and distribution systems.

An energy system, whether vertically integrated or not, which includes independent power producers has a number of important advantages over the traditional integrated utility. In addition to diversification benefits of having a number of independent generators, independent power producers have powerful incentives to ensure reliability and operate plants at optimal standards. In addition, competition provides a powerful market-based system of contract selection as each contract typically must pass at least four highly efficient financial and technical evaluations from those of the developer, the construction-lender, the equity participant and long-term creditors (Siddique, 1995). Many countries in the region already have or plan to have electricity systems incorporating independent power producers.

(c) Structural reform and service provision in rural areas

Privatization combined with horizontal separation has given rise to the possibility of a deterioration in services provision in rural and remote areas, because market forces might tend to focus supply on strong-demand, low-cost areas, at the expense of sparsely populated and remote areas (Brun, 1991). It is argued that horizontal separation will eliminate cross-subsidies between urban and rural areas. These subsidies have been extensive within public utilities providing water-related services in urban and rural areas and have been the main mechanism for subsidizing services in rural and remote areas in many countries.

Separating service provision in urban and rural areas generally does not imply a major loss of economies of scale and scope, with the possible exception of some loss of economies of scale in administration and regulation, and of the possible benefits from some internalization of externalities. The technology widely used in rural areas means that rural drinking water supply systems are not natural monopolies or have low economies of scale. By isolating the urban service, horizontal separation could promote new entry and direct competition in rural areas. The benefits of cost-minimizing behaviour under competitive pressure can be counted on to offset, at least in part, any losses of economies of scale or scope.

Horizontal separation makes cross-subsidies between urban and rural areas more transparent, helps identify more precisely the subsidies needed to provide services in rural and remote areas, and improves accountability in service delivery. It also facilitates conduct regulation, because service providers will have less opportunity to circumvent regulation and because it allows for better performance comparisons and more efficient regulatory monitoring through benchmark competition.

Cross-subsidies between urban and rural sector are difficult to justify, except for political reasons. There is nothing intrinsically "fair" about cross-subsidies between two groups of a population where the supply of a product such as water or electricity to one group consumes more scarce resources than supply to the other. Poorly designed cross-subsidy schemes can also affect the international competitiveness of exporters. Direct assistance to the disadvantaged population groups generally would be more efficient, than to use market-distorting cross-subsidies to achieve income redistribution objectives (Stevens and Michalski, 1993).

Rural and urban drinking water supply and sanitation require different technological, institutional and financial approaches, therefore, it may not be wise to assign responsibility for the two to a single operator (Triche, 1990). Failure to effect horizontal separation can have perverse, unintended consequences for service provision in the rural areas, such as the application of urban standards. The continuation of subsidies can stifle the emergence of alternative technologies and forms of service provision better reflecting the needs and peculiarities of the rural sector.

For a long time it has been widely assumed that because of the special characteristics of rural areas - low population density and low income level - financially viable service provision of adequate quality is impossible there without an external subsidy. These considerations have led many governments to believe that rural people have only a basic need which can be best met by limiting services by supporting only low-cost technologies. This approach has restricted choices and has proved highly counterproductive, even in many instances offering services which do not correspond to what rural people want and has led to the so-called "low-level equilibrium trap" in which customers are not willing to pay for what they find to be an unsatisfactory service (Serageldin, 1994).

A recent multi-country study by the World Bank of households' demand for improved drinking water supply services found that household income, although important, is not the overriding determinant of demand for improved services, and that there are many villages in which most households' willingness to pay for reliable private connections is high relative to the costs of supply (Briscoe *et al.*, 1993). According to the study, many more communities fall within this category than is commonly assumed. Although the study specifically refers to rural communities in northeastern and southeastern Brazil, its authors are of the opinion that, in general, most of the large rural communities in Central and Latin America probably fall in this category. In these communities a large proportion of rural people want and are willing to pay substantial amounts for private connections, and will pay more if the service is reliable.

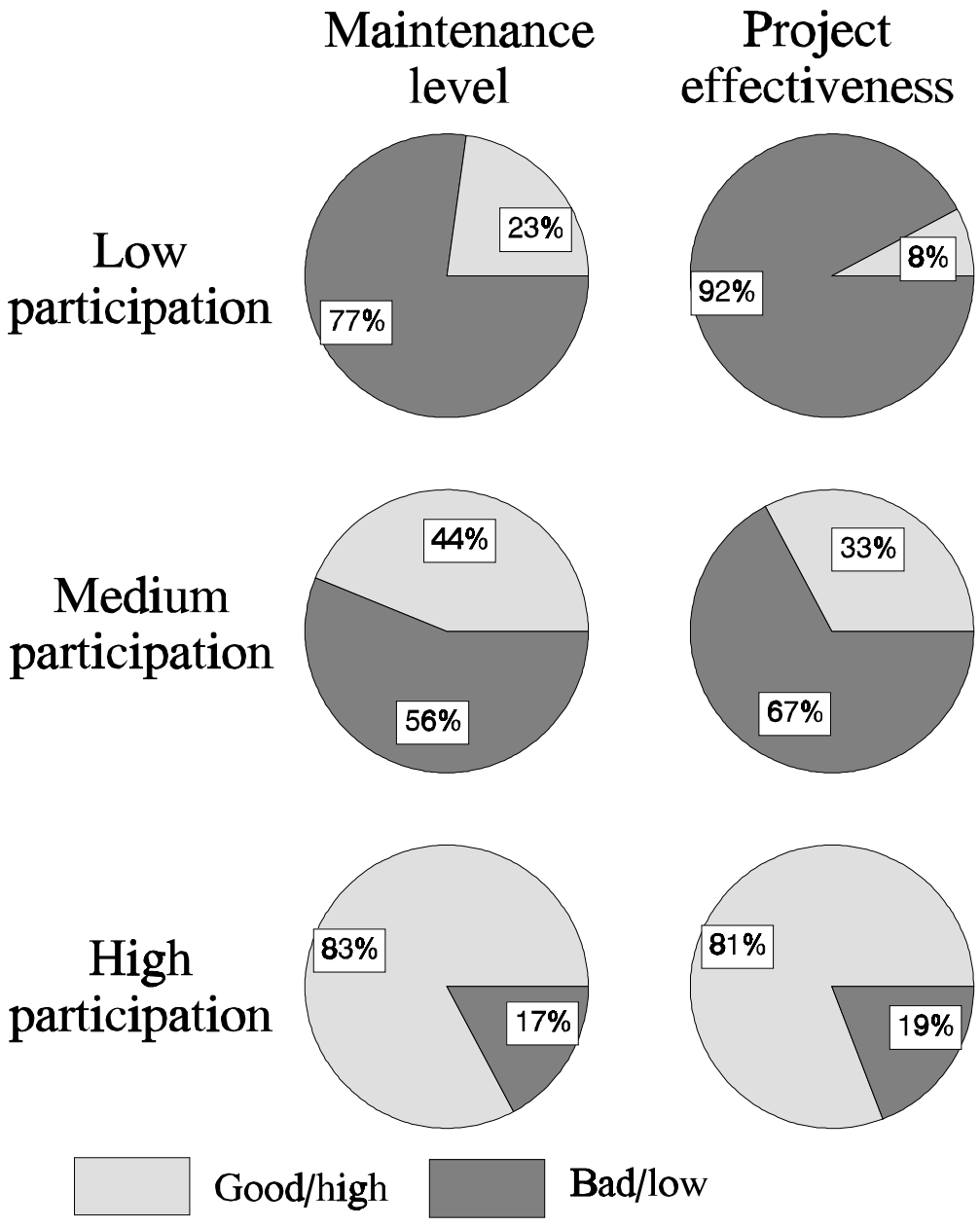
The possible negative consequences of horizontal separation for service delivery in rural areas could be avoided by adopting measures to facilitate private sector participation in the provision of services in the rural areas where households face difficulties in paying the full cost of improved services. External subsidies can be maintained or other forms of fiscal equalization and spatial transfer could be adopted. Rural drinking water supply programmes should be, however, demand-driven, any subsidies should not distort the community's choice, and beneficiaries should mobilize a considerable portion of the resources (see Briscoe *et al*., 1993). Demand-side assistance, i.e. giving subsidies directly to households and not to utilities, should be encouraged because these ensure that the intended beneficiaries are properly targeted.

Where supply-side subsidies have to be used for rural drinking water supply, one option would be to award contracts either on the basis of an explicit, pre-specified subsidy, with the winning bidder quoting the lowest tariff, or on the basis of a given tariff, with the bidder quoting the lowest subsidy. Where initial connection charges are large and rural households cannot mobilize the funds needed to pay them, subsidies in the form of soft loans, recoverable over an extended period, would do more to improve households' welfare than price subsidies.

Community participation is often an essential feature of the provision of drinking water supply and sanitation services in rural areas. There is much evidence that projects with high levels of community participation are more likely to have the drinking water supply maintained in good condition (see Figure 5).

Figure 5

Participation improves maintenance and increases effectiveness in rural water supply projects



Fuente: WB (1994a).

2. Diversification

Diversification is a common tendency in many regulated industries. These is an obvious incentive for any regulated company to generate earning which fall beyond the controls of regulatory authorities and the stronger regulation of the core (regulated) business, the stronger the incentives to diversify (Freeman, 1991).

Historically in the United Kingdom, and currently in North America, there are precedents for joint utility companies (OFWAT, 1995i). Many British water companies have diversified into non-regulated business ranging from environmental services, waste management, engineering and environmental consultancies and process engineering to computer information technology, bottling mineral water and television (Nakamoto, 1991). In France, the major water companies have diversified taking over other urban services such as sewerage and sewage treatment, solid waste, public transportation, heating networks, cable television and even funerals or absorbing or been absorbed by public works companies or engineering consultants (Barraqué, 1993).

While diversification is generally accepted to be beneficial and desirable - it allows to spread risks and compensate for fluctuations in demand, improves management and productive capacity utilization, provides an opportunity to diversify away from declining markets, permits to exploit to the full comparative advantages and could have other beneficial effects - diversification of regulated firms (or a merger between two regulated firms, particularly in an overlapping geographic area) might represent a concern for regulators for several reasons (Armstrong, Cowan and Vickers, 1994):

- a failure of the non-core (unregulated) business could negatively affect the ability of the utility to raise capital for and operate the core business;
- diversification makes estimation of the cost of capital more difficult and if the firm diversifies into a risker business, diversification might increase the cost of capital; and
- the operation of non-core business might consume excessive amounts of management time and resources.

Diversification of a regulated firm or mergers between regulated firms can worsen the asymmetry of information between regulator and firm and reduce the regulator’s ability to implement benchmark competition either by reducing the number of available comparators or by affecting the comparability of the firm with others.

Diversification also allows scope for cross-subsidization through transfer pricing in intra-company transactions, which could result where the regulated business pays higher prices than the market rate for the goods and services provided by associated companies.

Transfer pricing can be used to circumvent economic regulation and to support anti-competitive behaviour of affiliated companies. To cope with this problem, a regulator could impose an obligation to use competitive tendering or other appropriate methods of market testing to ensure that the work contracted out to affiliated companies is being done at competitive rates. To prevent cross-subsidization, it is also important to ensure that there is an appropriate allocation of costs between the regulated and non-regulated business. However, rules for cost allocation are difficult to determine given the asymmetry of information (Armstrong, Cowan and Vickers, 1994).

For these reasons, regulatory policy should be prepared to impose some constraints on the diversification of regulated firms into unregulated activities (Rees and Vickers, 1995). On the other hand, it would be imprudent to impose a blanket prohibition on the diversification of regulated firms because there may be economies of scale and scope, so cost reductions can be realized when a single supplier is able to offer both regulated and unregulated services (Braeutigam and Panzar, 1989). An important question for policy is how to structure the regulatory system to take advantage of economies of scale and scope while avoiding the undesirable effects of diversification into unregulated markets.

To deal with the issue of diversification, regulators can adopt a number of measures including requiring utilities to maintain separate accounts and issue separate financial statements for the regulated part of the business or to separate the regulated part of a company from the unregulated activities and impose an arm's length relationship between the two parts of the business (IEA, 1994). These measures can be strengthened by close supervision of dividends, loans, asset transfers and other financial transactions between regulated business and the group and by prohibiting the regulated business to lend, extend guarantees, pay dividend or transfer assets to the other companies in the group without the regulator's consent.

In England and Wales, OFWAT has obliged the directors of drinking water supply and sewerage companies to ensure that there are sufficient financial and managerial resources to run the core business, and that they certify that this remains so after a diversification (Armstrong, Cowan and Vickers, 1994). In addition, water companies are under a legal requirement to conduct their business at arm's length from other companies within their group structures and ensure that there is no cross-subsidization between the regulated business and non-regulated activities or any associated company (Byatt, 1995e). OFWAT has also strengthened its controls over inter-company transactions through both formal licence amendments and the issuing of guidelines and reporting requirements for the companies.

The form of price regulation has important implication for the incentives of the regulated firm to diversify. Rate-of-return regulation might give the firm an incentive to

expand into other regulated markers, even if it operates at a loss there (Averch and Johnson, 1962). This behaviour may discourage new entry and drive out other - even lower-cost - producers from these other markets. This incentive might arise where expanding into other markets enables the firm to increase its rate base and hence permits it to earn a greater total profit than would have been possible without diversification.

In competitive markets, rate-of-return regulation can give a firm incentives to misreport its cost allocation reporting any expense as attributable to the regulated service or, failing that, as a common cost; charge prices below marginal cost in a competitive market included in the set of core markets subject to an aggregate rate-of-return constraint; and view diversification decisions inefficiently (Braeutigam and Panzar, 1989). Diversification might also affect the firm's incentives governing the choice of output level and technology, as well as its incentives to undertake cost-reducing innovations in the regulated and competitive markets.

Price-cap regulation replicates the competitive process more accurately than rate-of-return regulation and, at least in principle, induces the firm to diversify into a competitive market if and only if diversification is efficient (Braeutigam and Panzar, 1989). Since pure price-cap regulation does not require allocation of costs, incentives to misreport cost allocations and choose an inefficient technology would disappear or greatly diminish. In practice, however, given the asymmetry of information and the fact that price-cap regulation usually incorporates some of the features of rate-of-return regulation, the same problems are still of concern (Armstrong, Cowan and Vickers, 1994).

3. The timing of industry restructuring

Any restructuring of an industry, with characteristics of a natural monopoly or other market failure, is much more easily done while it is still state-owned. Where an industry with characteristics of a natural monopoly is transferred to the private sector, its most valuable asset may not be the physical infrastructure, but rather the license or right to provide the monopoly service under specified conditions (Guislain, 1992).

The form of regulation has a direct impact on valuation, as more stringent regulation or lower protection from competition means lower profits, hence lower price. This implies that in order to be able to make a rational decision on whether to bid and what technical and financial offer to make if they do bid, investors need to know under what regulatory regime the utility will be operating. Uncertainty with regard to the applicable regulatory regime and future restructuring would result in lower investor interest and sale price, might attract those entrepreneurs who have greater lobbying power or with greater willingness to take risks, and is likely to reduce incentives to invest. In addition, subsequent restructuring might constitute a breach of faith with investors, and

uncertainty about future reforms might seriously undermine investment planning and increase the cost of capital (Vickers, 1991).

Any entrepreneur has a very strong interest in preserving, creating, and generally trying to reassemble monopolies (Newbery, 1994). On the other hand, by shifting emphasis in corporate objectives towards profit maximization, privatization might increase dangers of anti-competitive behaviour (Vickers, 1991). These considerations imply that the success of privatization can depend on resolving such issues as functional separation and establishing a transparent and credible regulatory framework prior to sale, with a view not only on managerial efficiency, but more importantly on preventing the consolidation of private monopolies in competitive markets (Bitran and Sáez, 1994). If these issues are postponed, uncertainties about their resolution will make it difficult to promote competition once market structures are consolidated and property rights allocated.

II. Government or regulatory failure

In the case of market failures, economic theory prescribes that the proper role for the government is to intervene in a manner that will correct them and restore or substitute the requisite conditions to restore economic efficiency (Ward and Deren, 1991). Unfortunately, government interventions are often non-optimal, in the sense that they either fail to correct for market failures and restore efficiency or introduce additional distortions. In addition, markets often find ways to mitigate their own failures, in other cases, an apparent market failure does not reduce welfare in any appreciable way.

Public interest theory holds that regulation is undertaken to protect the public from the abuses of market imperfections (Phillips, 1993) and views the government and the public sector as omniscient and benevolent maximizers of social welfare, i.e. which attempt to maximize some kind of social welfare function. The theory emphasizes government's role in correcting for market failures (Laffont and Tirole, 1991).

Given the different forms of government intervention that have occurred in recent decades, in general, and the state of water-related services under public sector provision in particular, it does not seem appropriate to assume that governments are sufficiently efficient, fair and wise to be capable of adopting the optimal intervention prescribed by public interest theory. Moreover, it can be easily observed that the results "of economic regulation often differ considerably from the predictions of 'public interest' models" (Joskow and Rose, 1989), and, obviously regulation has a political, as well as, an economic dimensions (Baron, 1988). It is now recognized that "regulation and regulatory process respond to complex interactions among interests groups that stand to benefit or lose from various types of government intervention" (Joskow and Rose, 1989).

The idea of government or regulatory failure challenges the assumption that government is a disinterested champion of the public interest. It pretends to explain the pattern of government intervention in the economy in general and water-related activities in particular emphasizing the role that rent-seeking behaviour, interest groups and capture play in the formulation and conduct of government policies with respect to economic matters. Under these arguments the public sector is seen as either unwilling or unable to serve the public interest. Unwilling, because it might seek objectives of its own, separate

from the priorities of citizens, and unable, because it operates in an environment full of information asymmetries and under budgetary constraint.

The public choice theory views bureaucrats as seeking power and resources by increasing the scope and scale of government intervention beyond the extent justified by the interests of welfare maximization (Holtram and Kay, 1994). Political business-cycle theory, on the other hand, assumes that political parties are economic institutions which seek the support of electorates badly informed about the motives of politicians and on the economy at large. The capture or interest group theory draws attention to the role of interest groups in the formulation of public policy (Laffont and Tirole, 1991).

The possibility of government or regulatory failure means that the identification of market failures is only a necessary, but not a sufficient condition, for government intervention in water resource management or any other area. To be sufficient, the potential costs of government failure associated with intervention must be less than the expected costs of market failure, i.e. governments must be able to do better than markets (Helm, 1993 and 1994b). If this second condition is not met, government intervention will impair rather than restore economic efficiency.

A. Rent-seeking and regulatory capture

It is useful to distinguish between two broad forms of government or regulatory failure of relevance to the discussion of the regulation of private sector participation in the provision of public services. Rent-seeking is the pursuit of self-interest by politicians, regulators, public sector employees, and other groups while regulatory failure or capture occurs when the regulatory authority falls under the undue influence of some special interest group (Helm, 1993 and Stewart-Smith, 1995).

1. Rent-seeking

There are two diametrically opposite views on how to explain the apparent deficiencies in public sector management of public services. The traditional view identifies the public sector with the pursuit of the public good and attributes the generally poor financial and production record of most state-owned enterprises and their failure to provide decent quality service to a variety of financial, administrative and managerial problems.

An alternative view, in line with the public choice theory, attributes deficiencies in the public sector to the existence of the private objectives of politicians and bureaucrats that divert public sector companies from their stated objectives (Wirl, 1992). The traditional approach does not or only rarely acknowledges that politicians and bureaucrats may be pursuing other objectives than the maximization of social welfare through the

delivery of water-related services, and that these informal objectives, or rent-seeking, can possibly have important and pervasive implications for how water systems are actually designed, built, operated and maintained (Lovei and Whittington, 1991).

Rent-seeking and other similar activities relate to a subset of the broader class which are referred to collectively as "directly unproductive, profit-seeking activities" (Bhagwati, 1982 and 1987). A salient feature of these is that they are directly unproductive; i.e. they are privately profitable but their output is zero. Directly unproductive, profit-seeking activities are wasteful in their primary impact - they consume real resources to produce private profits but zero output - therefore they usually result in the immiserizing of total output.

In the water-related sector, the rent seekers are various. The first, and main group, consists of the politicians. Political parties have high costs of operation, high costs of maintaining their organization and competing in elections. They maintain this organization and their electoral appeal by the performance of services to potential voters at all times, not just before elections (Stigler, 1971). One part of the costs of services and organization are borne by putting a part of the party's sympathizers on the public payroll. By doing so, politicians impose a small marginal cost on the individual taxpayer to repay the elected official's supporters (Lambert, Dichev and Raffiee, 1993). This would result in an inefficient use of labour in publically-owned water-related utilities.

Another part of the costs of political parties' organization and operation can be recovered through the sale of regulation (Stigler, 1971). Since the objective of any regulated industry is to maximize profits and therefore to be confronted with the weakest regulatory constraints, there is an incentives to acquire regulation. When an industry acquires regulation, however, it can be expected that the benefit to the industry usually is less than the damage to the rest of the community (Stigler, 1971). Empirical studies of public utility industries suggest that although price regulation generally constraints prices below the level an unconstrained monopolist with a legal exclusive franchise would choose, they may not be lower than those which would be under a fundamentally different industry structure (Joskow and Rose, 1989).

A second group of interests is made up of bureaucrats, including those concerned with the regulation of private firms. Rent-seeking by regulators includes the pursuit of self-interest so as to increase their areas of power and responsibility, to maximize the resources at their disposal, and to cost inflate, an activity to which they might be even more prone than politicians.

Given that regulators usually: (i) do not have a clearly defined set of objectives against which to measure their performance because of conflict among policy objectives

and because an operational definition of welfare is lacking; (ii) have considerable scope for discretion; and (iii) regulatory offenses are usually poorly defined, there are grounds to believe that they may have ample scope to maximize their own interests and pursue private goals (on the basis of Helm, 1993 and 1994b). Moreover, it is usually hard to create incentives for effectiveness in regulatory agencies, and the failure of a regulatory agency to function effectively can undermine the potential benefits of competition and private sector participation (Triche, 1990).

The incentives to rent-seeking by regulators include both direct and indirect rewards (Helm, 1994b):

- The direct rewards are the maximization of lifetime income. Although they are usually low in the short run, they may be high in the long run.
- The indirect or non-pecuniary rewards include the consideration, on the one hand, that most regulators find their jobs interesting and intellectually satisfying, while on the other, some may have their own economic theories which they are likely to be tempted to apply to the industry they regulate

Vulnerability to capture and opportunity for rent-seeking increase where the regulatory regime provides high levels of discretion to regulators and entrusts them with open-ended powers while leaving their objectives ill-specified and duties vaguely defined (Helm, 1993). This may include setting duties independently of cost considerations, not establishing a clearly defined set of objectives and priorities against which to measure regulatory efficiency, defining regulatory responsibilities in an unduly complex or vague way, or adopting a piecemeal case-by-case methodology which makes every intervention a special case, with regulators given wide powers to adjudicate. It follows that, in designing regulatory regimes, there is a premium on clarity of objectives for regulators to limit discretion and the pursuit of their own or interested parties' informal agendas, on relying on general rules, on setting constraints to the scope of regulation, on limiting the total resources available to bureaucracies, and on simplicity where outcomes are closely defined through rules (Helm, 1993). It may also be useful to create opportunities for participation in the regulatory process by all interested parties (Levy and Spiller, 1994).

Other groups of rent-seekers can be readily identified. For example, workers employed in the water sector can be expected to capture a share from the possible monopoly rent either in the form of wages and other benefits, such as security of employment, or by not having to work too hard (Wirl, 1992). A further group are influential consumers who can use their influence with politicians to achieve favourable tariffs (this helps explain, at least in part, the prevalence of uniform tariffs and cross-subsidization for drinking water supply and sanitation) or to influence the composition of the investment programme. Empirical studies suggest that in public utility

industries, the structure of prices across classes of customers often reflect distributional and political objectives, rather than efficiency considerations (Joskow and Rose, 1989).

Another rent-seeking group is formed by special-interest lobbies which demand financially unviable services which will either tap general public sector revenues or receive a cross-subsidy from potentially profitable services. The major costs of rent-seeking in the latter case arise because of the need to use inefficient methods to transfer funds to the potential beneficiary, because efficient methods would be too open to public scrutiny (Tullock, 1987b).

2. Regulatory capture

Regulatory failure or capture occurs when the regulator falls under the undue influence of either government, the regulated firm, its competitor or rival, consumers, or some other interest group (Stewart-Smith, 1995 and Helm, 1994b). It occurs because government decision-making affects both the industries' and the consumers' welfare (Laffont and Tirole, 1991). "When government intervention, rather than actual market performance, determines which firms are winners and which are losers, corporate executives have an incentive to devote resources to lawyers and consultants rather than to scientists and engineers. … The hearing room rather than the industrial laboratory becomes the focus of attention" (Berg and Foreman, 1995). However, since interest groups try to capture the regulatory process in order to redistribute wealth, policies that reduce the total wealth available for redistribution - and hence the political pay-off from regulation - will tend to be avoided and those that increase wealth - preferred (Peltzman, 1989).

It is useful to distinguish two broad forms of regulatory capture: top-level regulatory capture, which occurs in the legislature as regulatory policy is formulated and legislation passed, and lower-level regulatory capture which occurs in the regulatory agency and the ministerial decision-making, as regulatory decisions are made once the regulatory framework is in place (Dnes, 1995).

Members of interest groups (frequently, but not always regulated firms) are better organized and have stronger incentives, than broad, amorphous and dispersed groups of consumers with a low individual stake, to exercise political pressure on regulators and legislators in order to affect regulatory outcomes. As a result, these compact, well-organized groups will tend to benefit more from regulation than broad, diffuse groups (Peltzman, 1989). As interest groups must compete with each other for influence, regulation will tend to preserve a politically optimal distribution of rents across this coalition of consumer and producer groups. On this view, regulation emerges when there is a large divergence between the political balance of pressures and the unregulated distribution of wealth. As a result, much regulation "may be the product of coalitions

between the regulated industry and customer groups, the former obtaining some monopoly profits from regulation, the latter obtaining lower prices (or better service) than they would in an unregulated market - all at the expense of unorganized, mostly consumer, groups" (Posner, 1974).

One obvious response to the possibility of capture is to reduce any interest groups stake in regulation (Laffont and Tirole, 1991). However, if interest groups also make a positive contribution to the regulatory process, e.g. bring new information about the firm's activity, it may be socially desirable to increase their stakes so as to induce them to acquire information (Laffont and Tirole, 1990a).

The major reasons for regulatory capture are informational asymmetries between the regulated firm and its regulators, between regulators and political authorities and between political authorities and voters. The basic informational asymmetry between firms and regulators gives rise to imperfect incentives, allows regulatees to extract informational rents from the monopoly of information that they enjoy, and therefore impairs economic efficiency.

Regulators have to make their decisions on the basis of the information available to them and the main source of this information is the regulated firm which control over the information it provides and understands that the regulatory constraints depend on this information (Helm, 1994b). Assuming that the regulated firm wants to intertemporally maximize its profits and hence seeks to be confronted with the weakest regulatory constraints, there is a strong incentive to try to bias the regulatory outcome in its favour through strategic manipulation of information. For example a far-sighted firm is likely to decide either not to maximize its cost reduction effort or to switch between high and low effort levels, because increases in the effort level today will lead to more stringent regulatory constraints in the future.

A collateral is that the incentive to exercise pressure in order to affect the regulatory outcomes would be weaker under low-powered incentive schemes than under high-powered incentive schemes because the latter leave high potential rents to the regulated industry and thus create high pay-offs to collusion and capture (Laffont and Tirole, 1991). This inference would be true for incentive schemes where the regulatory agency plays an active role in regulation. If the regulatory agency has little discretion, i.e. performs the role of an accounting office, then stakes in collusion may be reduced by the use of high-powered incentive schemes (Laffont and Tirole, 1991 and 1990b).

There is always asymmetry of information between regulators and their supervisors (political authorities), and between the latter and voters (consumers). All bureaucracies are characterized by the attenuation of control. Lower-ranking officials keep and control

virtually all of the information needed to assess their performance. Much of what they do is, therefore, unknown to those of higher rank (Tullock, 1987a). The higher the official, the less is known of what occurs at the lower level, as a result, high-ranking authorities usually receive only an "official" view of activities. They have neither the information nor expertise and resources to evaluate these reports against vaguely defined or unstated objects. Voters are never well informed about their votes because the effect of the vote on their well-being is small (Tullock, 1987a). The information at a voter's disposal tends to be biased in the direction of his or her own special interests. Only, in the absence of such informational asymmetries, would voters and political authorities be able to effectively control their agents, who thus could not implement policies favouring special interest groups at the expense of society as a whole (Laffont and Tirole, 1991).

Regulatory capture does not commonly include monetary payments. The more common forms include the fact that the regulated industry is an important source of future employment opportunities for the regulatory agencies' staff, personal relationships provide incentives for government officials to treat their partners from the regulated firms generously, the regulated industry may cater to the regulatory agency's bureaucratic desire for a quiet life or for larger resources, by refraining from publicly criticizing agency management, and it can make indirect transfers, such as monetary contributions to political campaigns, as well as the votes and lobbying of employees, shareholders, suppliers or the members of communities where regulated industries are located (Laffont and Tirole, 1991).

Generally, an industry will have better access to technical talent than the regulatory agency. This coupled with the tendency for the better trained technical staff from the public sector to emigrate to the regulated firms, due to fewer opportunities and often lower wages, creates a serious lack of qualified manpower for the regulator. The specialized nature of the duties exercised by regulators and of the skills they develop in the performance of their duties make them attractive employees for the regulated industry (Helm, 1993). Their obvious career path is to move to the regulated private sector where they can claim lucrative appointments. The nature of their business and social contacts reinforces this tendency. This phenomenon creates conflict of interest and distorts their incentives while working for the regulatory agency; it also undermines the independence of the regulating authorities and has a general debilitating effect on the effectiveness of regulation. Traditionally, public sector wages have been low in Latin American and Caribbean countries in comparison with those of the private sector. This had led in some countries to the removal of the regulators staff from the restraints of public sector salary scales.

Every regulatory agency is required to be closely involved with the regulated companies on a day-to-day basis, with a result to identify itself or the interests of the

public with the aims of the industry (McGowan and Seabright, 1995 and Booker, 1994). Such collusion between the regulator and the industry can frustrate the objective of controlling and diminishing marker failures. The regulator can become instead an advocate of the industry or even an instrument for the maintenance and reinforcement of monopoly power (Rees and Vickers, 1995). On this view, then, regulatory capture is revealed by weakness of regulatory policy towards effective competition, promotion of new entry, contestability and price and quality regulation. It leads to higher prices, lower quality and the protection of incumbents from competitive entry. Regulatory capture can also be revealed on the stock market: abnormally high returns associated with changes in the regulatory environment could indicate capture by the regulated industry, while abnormally low returns could indicate capture by consumer interests (Dnes, 1995).

To avoid these problems, regulatory personnel need not only be technically qualified, but also to be well paid relative to the regulated industry, and, if possible, prohibited from working in the regulated industry for a specified period after their appointments are terminated (Devlin, 1993). However, post-employment restrictions may be costly (Breyer and Steward, 1979), and even impossible. Other possible useful measures are panels of several regulators and the fullest degree of transparency including imposing the obligation on regulators to list their every encounter with the industries that they regulate, information that should be published regularly (The Times, 1995).

Given that in most Latin America and Caribbean countries there has been a long history of state interference in the provision of water-related services, the possibilities for establishing non-political regulatory systems seems to be fraught with many obstacles. For example, in many countries, the tariffs of water-based services have traditionally been unrealistically low and politically controlled. If they were to rise to reflect real economic costs, there is likely to be, at least, some political pressures to minimize any increases. In Chile, for example, the introduction of the new tariff system to make the companies self-financing has demanded a considerable increase in water and sewerage rates. To allow for a gradual readjustment of consumption patters and customers' expectations, its introduction was phased in during a transition period of up to four years (Chile/SSS, 1994). In part, privatization can aid in resolving this problem because it increases the transaction costs of government interference in the workings of the firms. The efficiencies of privatization stem fundamentally from the insulation it provides from inefficient political and self-serving influences (Willig, 1993).

In an ideal world, to be effective and to avoid the problem of regulatory capture, regulatory agencies would have the following characteristics:

- they would be staffed with people of unblemished reputation and with adequate technical skills capable of fulfilling their functions at the level of expertise and efficiency required to confront the private operator on, at least, an equal basis;
- they would enjoy consistent political support and, while subject to periodic evaluation, receive a minimum of day-to-day political interference;
- they would have adequate financial, human and informational resources and an independent budget;
- they would have generic responsibilities for environmental protection or price regulation, rather than responsibilities for the regulation of particular industries (this will make possible to realize administrative economies of scale in regulation and to avoid inconsistencies in regulatory decision-making) and, to minimize the risk of regulatory capture, only possess limited discretion in the discharge of their duties;
- they would open the regulatory process to public scrutiny and would explain and justify at least some decisions and publish the evidence on which they are based; and
- they would be invested with sufficient autonomy to limit the possibility of being captured by particular interest groups, including those within government.

It cannot be expected that regulatory systems in Latin America and the Caribbean or anywhere else will exhibit all these characteristics. It is, however, of fundamental importance in establishing a regulatory system to limit the scope for regulatory capture. This is so not only to prevent its negative consequences, but also to remove the incentive for the regulated industry and other interest groups to engage - and waste resources - in rent-seeking activities (Armstrong, Cowan and Vickers, 1994). To accomplish the objective of an effective and efficient regulatory process, a regulator has to be vested with the power to "get the job done" (IEA, 1994). It is particularly important for the regulator to have sufficient powers to compel the regulated firm to provide all information necessary for effective regulation and to comply with the regulatory framework.

There are strong arguments to move in the direction of further independence by constituting regulatory commissions that are not subordinated to the administration in power (Bitran and Sáez, 1994). A body with a high degree of autonomy and not dependent on any ministry for personnel and funding should be able to resist political interference more effectively (Mallon, 1994). Where regulatory entities have a strong dependence on ministries with political and technical responsibilities, they are not independent of the political system.

As there are incentives for the regulator to act in the interests of incumbents in the industry rather than those of consumers or potential rivals, there are grounds to argue that it could be desirable to introduce countervailing incentives for regulators to act in the

interests of society as a whole. Any reward, however, will probably have to be limited to official recognition, promotion, status and other similar incentives which are used to reward the performance of public servants in general. Other incentives - such as regulatory competition or linking pay to some aspects of the regulatees' performance, etc. - are difficult to implement and are likely to have perverse consequences for the regulated industry and consumers (see Armstrong, Cowan and Vickers, 1994 and Helm, 1994b). On the whole, "it is difficult to see an alternative superior to allowing a disinterested regulator to make a decision - provided that all reasonable precautions have been taken to ensure that the regulator is indeed disinterested" (Holtram and Kay, 1994).

B. The cost of regulation

Regulation imposes direct and indirect costs on the regulated firms as well as on the rest of the economy both in the terms of money and in terms of resource misallocation. Recent studies suggest that the costs of regulation can be economically significant. For example, in the United States, it has been estimated that the cost during 1991 of all the regulatory mandates in place for all industries was some US$ 542 billion (Abelson, 1993). It is also suggested that the United States has gained at least US$ 36-46 billion (1990 prices) annually from deregulation of various industries, about a 7 to 9 per cent improvement in the part of GNP affected by regulatory reforms (Winston, 1993). The lesson to be drawn from these examples should be to minimize regulation, not because it is bad, but because "regulatory technology is characterized by diminishing marginal benefits and increasing marginal costs" and that "appropriate regulation means maximizing the benefits from removing market failures in relation to the costs of government intervention" (Jones, 1994).

The direct costs of regulation include the opportunity cost of the public and private resources devoted to operating the regulatory process and to complying with the regulatory framework (Rees and Vickers, 1995 and Jones, 1994). These direct costs depend on the degree of regulatory supervision and the complexity of the regulatory agency's task, so that more rapid changes in the underlying technological and market conditions, greater importance of joint costs, and greater variety and complexity of goods and services, among other factors, should act to increase these costs (Schmalensee, 1974).

The direct cost of administering the regulatory process includes the budget of the regulatory agency and the costs born by the regulated industry. The former is usually the smaller of the two. For example, in Chile, in 1993, the budget of the Superintendency of Sanitation Services (Superintendencia de Servicios Sanitarios) was equivalent to approximately 0.6 per cent of the billing of the drinking water supply and sewerage companies (Chile/SSS, 1994). Under the proposed modifications to the water sector legislation which provide for the privatization of drinking water supply and sewerage

companies, the Superintendency would be financed by charges imposed on service providers which would not be able to exceed 2 per cent of billings (Libertad y Desarrollo, 1995).

The regulated industry rather than regulators tend to bear the main costs of regulatory administration (Helm, 1994b). For example, many regulated firms invest in large planning units whose responsibility is to monitor the conduct of regulators, to attempt to predict future regulatory decisions and changes in regulatory policy, to prepare documentation for regulatory reviews and to support the companies's claims at the time of regulatory reviews, etc. For example, the administrative costs of the regulatory supervision of water companies, in the state of New Jersey, averaged 0.87 per cent of total revenue for large companies, 5.25 per cent of revenue for small companies, and 0.92 per cent of revenue overall (Crew and Kleindorfer, 1985).

In addition to the direct costs of regulation, there are several indirect costs. These costs can arise where regulation encourages regulated "firms to (i) use transfer pricing … to take revenue out of and load costs into the regulated business from unregulated businesses; (ii) to expand … into unregulated activities; (iii) to use the regulated business as a method of subsidizing the funding of unregulated activities; and (iv) to transfer costs to those regulated businesses that enjoy a more liberal arrangement for passing on costs to consumers" (Bishop, Kay and Mayer, 1995). There are also considerable indirect costs incurred in rent-seeking and other behaviour to attempt to outmanoeuvre the strategy of the regulator and to influence regulatory outcomes in their favour. To this one should add the possibility that imperfect regulatory institutions operating with imperfect information and under budget constraint may be unable or unwilling to force prices to their correct levels introducing new distortions in the economy (Schmalensee, 1974 and Jones, 1994). The most insidious of these costs perhaps are regulation's adverse effects on radical process and product innovation and the tendency to increase production costs and to shield the regulated industry from competition (Schmalensee, 1974 and 1995). These costs of regulation are very difficult to quantify.

The administrative capacities of Latin American and Caribbean governments are already strained by the weight of existing activities. Regulation is not costless and efficient regulation is a complex and expensive task. The managerial and financial resources needed to carry out the regulation process, are scarce, particularly in the public sector. Given these considerations, a too elaborate and complex regulation not supported by adequate regulatory capacity and commitment and operating under budgetary constraints might well produce efficiency losses greater than those it is intended to avoid. It is not obvious that in a country without a strong and independent public administration and with little or no useful experience with regulation of private monopolies, the regulated private enterprise

form of organization will perform much better that the public enterprise form, from the perspective of the public interest.

This should not mean that some form of regulation should not be contemplated. It does mean, however, that in considering the establishment of regulatory systems governments should be open-minded in judging the various alternatives that are available and be cautious in developing too elaborate regulatory systems in environments without traditions of regulation. It also underlines the need to target regulation on the areas where market failures are most pronounced, to pay attention to the costs and benefits of regulation, and to design regulatory mechanisms to maximize the benefits in relation to the costs. Neither privatization or regulation regimes can, of themselves, resolve governments from the responsibilities to provide their population with reasonable and equable access to basic water-related services. This responsibility has to remain with government and in the area of public policy.

Regulating public utilities in Latin America and the Caribbean

The provision of water-related services has been marked in Latin America and the Caribbean by massive government failure. Government failure has not been universal in the region, in some countries and some services, there are examples of successful public sector operation, particularly in electricity generation, but also, in drinking water supply and sanitation. It is, however, by far the more common occurrence of serious and pervasive government failure that is the fundamental reason for the current widespread phenomena of the privatization of many aspects of the provision of water-related services.

In general, there are moves in all countries to increase private sector participation in the water sector. In irrigation such a tendency is all but universal, as former public irrigation districts are transferred to farmer management. This privatization process usually does not require regulation as irrigation farming is subject to market competition. In electricity generation there have been significant privatization exercises in Argentina, Bolivia, Chile and Peru with different regulatory approaches resulting in variations in industry structure. In addition, many countries in the region already have or plan to incorporate independent power producers in their electricity systems. The involvement of the private sector in drinking water supply and sanitation is more incipient, although there has been considerable franchising of systems in both Argentina and Mexico. Elsewhere, as in Chile and Venezuela, decentralization within the public sector has been the policy adopted with private sector participation limited to contractual arrangements.

In regulatory policy, nevertheless, there are two clear priorities for Latin American and Caribbean countries, the development of an effective regulatory capacity and the establishment of the independence of regulatory authorities, which should be free of direct political interference. At the same time, it is necessary for those defining regulatory policy to be absolutely clear as to what its real objectives must be. The objective of regulation is to ensure that in activities subject to natural monopolies there is the introduction of the maximum competitive pressure. Where competition is not feasible, regulator must act as a substitute for the market, taking on some of the functions of competitors, attempting to provide similar incentives to improve efficiency by regulating aspects of the firm’s conduct. It is not the objective of regulation to manage the companies which own or operate under franchising arrangements water-related public utilities. It is for this reason

that the functions of the regulator must be clearly defined and strictly limited to the absolutely necessary. In general, that is why, price regulation is the preferred basic approach to be recommended, leaving other decisions to the utility managers.

In defining the type of price regulation, notwithstanding the criticisms that have been made of its incentive properties, rate-of-return regulation does have some basic advantages which make it possibly attractive for application in Latin American and Caribbean countries. It can provide to potential investors a solid guarantee of a fair rate of return, it offers a type of long-run commitment which is crucial for investments with a high sunk cost component, as in hydroelectricity generation and drinking water supply and sewerage. It provides weaker incentives for cost reduction, but performs well under uncertainty, important in economies with histories of high inflation and general macroeconomic instability, and should have a downward impact on the cost of capital. At the same time, it reduces the ability of the regulated firm to profit from regulatory ignorance or favourable cost shocks, important in countries with little regulatory experience.

There are, however, strong reasons for preferring price-cap regulation, particularly, immediately following privatization. Productivity gains, which price-cap regulation encourages, are potentially largest at the moment. Gains are also potentially larger in cases where changes in the technology applied and in market conditions will be faster. Examples include the characteristics of the industry itself, as in electricity generation, as well as the prior existence of underinvestment and poor management creating a technological gap. It is also attractive in settings in which the role of competition is increasing. These considerations notwithstanding, it seems likely that the overall incentive effects of price-cap and rate-of-return approaches do not differ much because price-cap regulation, at least as typically implemented in practice, has some features of rate-of-return regulation and vice-versa.

Under the right conditions, commercial code regulation may be a useful complement to or substitute for other forms of regulation, particularly in smaller countries and in those industries where effective competition is feasible. This form of regulation is simple to implement, is very inexpensive, and provides a means to institute regulation gradually, all factors particularly important in countries with little experience in formal regulation. It would also be useful to strengthen the use of the commercial code or anti-monopoly legislation by encouraging consumer participation in the oversight process and by encouraging the organization of small groups of customers into larger, more effective bargaining units.

Adequate information is of paramount importance for effective regulation. The regulated company’s management always knows far more than the regulatory agency

about both industry costs and demand conditions. Asymmetric information allows a firm to extract rents from its monopoly of information resulting in an overall welfare loss. The existence of the informational asymmetry suggests that: (i) the regulatory goal should be to design incentive mechanisms for the regulated firm that will induce it to maximize society's objectives while pursuing its own self-interest; and (ii) the prospects of generating information for regulatory purposes should be an important consideration in a government's decision about the nature of the regulatory regime and the structure of the industry.

The most promising path for the countries of the region to formally address the problem of asymmetric information in the privatized water-related utilities seems to be some form of benchmark competition. The advantages of benchmark competition are part of the case for having a horizontally separated rather than national structure in water-related public utilities.

Given that competition is at present limited in the core transportation and distribution services of the water sector, that markets for its services are characterized by informational asymmetries between service providers and their customers, and that service providers usually operate under regimes of monopoly, it is extremely unlikely that price control alone would be capable of giving sufficient incentives to profit-maximizing firms to make socially optimum quality choices. Unfortunately, the regulation of service and product quality is one of the most neglected problems in the debate on private sector participation in the water sector. There is, therefore, a strong case for supplementing price regulation with the regulation of service quality. The most promising approach to this problem would seem to be customer compensation schemes, guaranteed standards of performance and minimum quality of service standards. Formal incorporation of quality of service measures in price regulation is another interesting approach but can be difficult to implement in practice, as is usually the case.

Where a public utility faces separate regulators for quality of service, pollution and other environmental aspects, and prices, whose preferences for the various possible actions typically conflict what is generally referred to as the common agency problem can arise. This can create tension between regulators and the danger of inefficient outcomes as well as of inconsistency and a lack of credibility. These considerations underline the need for closer cooperation between the regulatory agencies and collective decision-making, and for an explicit duty to be imposed on them to balance costs against benefits of regulatory decisions.

At present, most Latin American and Caribbean countries rely on administrative or "command and control" means for water resource and environmental management. The transfer of responsibilities from the state to the private sector will produce a need - this

need is already detectable in those countries which have advanced most on the road of privatization - for greater reliance on prices and other incentives to encourage efficient use and allocation of water. It will also require greater user participation in water resource management.

Many of the benefits of private sector participation in water-related pubic utilities result from the provision of protection to necessary, but politically dispensable, water-related investments from general budgetary pressures. It also provides a means of tapping the greater pool of private capital to help finance them. This implies that the effect of regulation on social welfare depends critically on the investment behaviour that it induces in regulated firms. An adequate supply of private finance to the privatized water sector will only be forthcoming, if investors are confident that their investment will not disappear though direct expropriation or through creeping regulation and that they will earn a rate of return on the capital invested in the sector which is commensurate with the risk they take. It can flow quickly as the examples of Argentina, Chile and Peru illustrate. Potential investors need government commitment to respect, over the long run, their property rights, the rules and regulations governing tariffs, entry conditions, and expansion plans. It is essential, therefore, to develop a stable regulatory environment to encourage and maintain private investment in water-related services. Unless there is a stable regulatory environment, the rational fear of *ex post* opportunism by governments will deter efficient investment in sunk cost assets. The only secure route to private sector confidence is a history of rational government committed to policies encouraging private investment in public services. Governments must demonstrate that they do not indulge in *ex post* opportunism.

One effect of privatization will be to increase significantly the discount rate applied to investment projects as the discount factors used by governments are usually low. This means that privatization can affect the choice of technology. For example a higher rate of discount implies a bias toward less capital-intensive technologies and fuel choices in electricity generation. Thermal power may become the technology of choice rather than hydroelectric generation. There are signs of this change both in the larger economies such as Argentina and Chile, as well as in smaller ones such as Central American countries. Change can be expected wherever there are less-capital intensive technological solutions and where there is competition from less-capital intensive substitutes. Irrigation *vis-à-vis* rain-fed agriculture, and to a lesser significance water transport, versus rail, road or air, are other areas where privatization could produce important changes in the structure of investment. If a government decides to use subsidies to encourage the private sector to follow a specific investment path, attention should be paid to the need to ensure that any subsidies are channelled to the most efficient companies and that they do not unduly interfere with the play of the market forcers.

Organising effective consumer involvement in the regulatory process will probably take time in most Latin American and Caribbean countries, as there is little experience of such participation. Water management has been characteristically highly centralized within the public sector and in central governments. One consequence has been highly centralized systems for service delivery which have a history of being unresponsive to customer demands and have been subject neither to market nor political tests of responsiveness. As a result, most of the population has never had to face the realities of the fact that water-based services are not free but have to be paid for. Moreover, it is not widely understood that the choice of service level should be made collectively and rationally in light of the costs and benefits to the community at large. Because decentralization shows that there is such an obvious need for consumer involvement, greater private sector participation stimulates greater consumer involvement. The experience of Mexico City is one example, but similar consumer participation is growing in Argentina with the granting of concessions in many cities.

Community participation is often an essential feature of the provision of drinking water supply and sanitation services in rural areas. Public authorities should provide an appropriate legal, institutional and policy framework to promote such participation. Studies clearly show that projects with high participation in project selection and design are much more likely to maintain the systems in good condition than those characterized by more centralized decision-making. Rural drinking water supply programmes should be demand-driven, any subsidies should not distort the community's choice, and beneficiaries should mobilize a considerable portion of the resources. Demand-side assistance, i.e. giving subsidies directly to households and not to utilities, should be encouraged because these ensure that the intended beneficiaries are properly targeted. There are grounds to believe that it may not be wise to assign responsibility for the provision of drinking water supply and sanitation services in rural and urban areas to a single private company.

Structural reforms should seek to isolate the natural monopoly elements in an industry and to prevent the firms entrusted with activities with natural monopoly characteristics from extending their monopoly powers beyond the segment of the market where these characteristics exist. Failures to isolate the natural monopoly elements and to create adequate competition can considerably complicate conduct regulation and make its task more demanding and its scope broader than necessary. Any failure will also impose on regulators the task of trying to compensate for the deficiencies in structure through more intrusive conduct regulation. Inappropriate industrial structure is one of the main causes of regulatory failure and competition is the best form of control.

In Latin American and Caribbean countries, centralization meant water-related utilities were usually heavily vertically integrated to a degree that they include all

operational and support functions, including those which do not exhibit natural monopoly characteristics. It is clear that many utilities could realize substantial cost savings and enhance efficiency through both horizontal and vertical separation by means of franchise arrangements with private firms. Many activities can and should be opened to direct competition. The examples are many, in fact almost everything except the overall coordination of activities could be contracted out in any system, although in practice this is not often done. The Mexico City franchises are an example, however, of what can be done in the separation of functions.

Horizontal separation into geographically discrete companies is almost always one of the accompanying features of any restructuring of any water-related service whether electricity generation, irrigation or drinking water supply and sanitation. None of the large national public utilities remain in South America and they are being reformed in all countries of the region with the exception of Cuba. Vertical separation is not so commonly found, but is growing both in those services which remain in the public sector and among those privatized. Argentina has established one of the most competitive and deregulated power markets in the world through the vertical and horizontal unbundling of the generation, transmission and distribution activities. The breaking up of large public entities into smaller public or private concerns can be considered a necessary requirement for improving efficiency and introducing competitive pressures if not actual market competition.

Functional separation is, however, by no means a panacea. Attempts to separate closely interdependent activities can impose high costs on the sector, including the loss of the economies of scale and scope, the costs of sector restructuring and the possible loss of some internalization of externalities, which need to be carefully weighted against the potential benefits of cost-minimizing behaviour under competitive pressure. If these factors are significant, there may be a case for the continuation of vertically integrated monopoly.

This paper has presented a review of the recent literature on regulation, including the experience elsewhere in the world and its applicability to the countries of Latin America and the Caribbean. As has already been said, changing the ownership of companies providing water-related services from the public to the private sector should be seen by governments as only one step in the necessary reform process to improve the efficiency of public utilities. The process of improving the efficiency in the provision of these services is much greater than merely transferring ownership, investment must be encouraged, costs must be minimized and standards raised, but above all adequate incentives should be incorporated in the regulatory framework to encourage efficient resource allocation. The regulatory environment can help or hinder this process and governments in the development of regulatory policy must ensure that it helps not hinders

and that, while protecting the consumer from monopoly, it provides a favourable environment for the activities of the private entrepreneur.

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Environmental Sanitation promotion: a social, institutional and legal challenge for the rural poor

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Introduction

Environmental degradation is a serious threat to the developing countries, hindering and undermining development. The rural poor in particular depend heavily on social, institutional and legal bindings for their livelihoods, and poor people especially women are most vulnerable to the effects of inadequate sanitation and hygienic practices. Safe sanitation is a greatest challenge to the people of Bangladesh. Around 2.4 billion people globally still lack adequate sanitation, of which 1.5 billion live in Asia. Safe Sanitation promotes health, improves the quality of the environment and thus, the quality of life in a community. Sanitation refers to the proper collection, transportation, treatment and disposal of human wastes. In developing countries, improvements in practices of disposing of human excreta are crucial to raising levels of public health. An increasing amount of literature suggests that health problems result from the lack of sanitation facilities. Invariably, it is the poor who suffer the most from the absence of safe water and sanitation because they lack not only the means to provide such facilities but also the information/messages on how to minimize the ill-effects of the unsanitary conditions in which they live. As a result, the negative effects of unsanitary living conditions lower the productive potential of the people who can least afford it. Poor communities in developing countries, the people rarely consider an inadequate excreta disposal system a problem. In the absence of sanitation systems, some communities rely on natural processes; defecation takes place in the open fields or on surface waters. In the latter option, human waste is directly disposed off into the rivers, canals for transport and eventual dilution leads towards a severe environmental problem.

Bangladesh has its own specific challenges, with only 33% of the population in the country having access to hygienic latrine facilities. Lack of or inadequate sanitation, impacts the economy by adversely affecting productivity loss due to sickness and the overall quality of life where poorer are the worst sufferers. Health Statistics indicate approximately 125,000 children below 5 years are dying each year, 342 children are dying everyday in Bangladesh for lack of proper sanitation.

In this milieu a pilot project was launched in December 2002 for the improvement of Environmental Sanitation and also study social, institutional and legal aspects in a village named South Masimpur of Noakahli District in Bangladesh. The study village selected represents where 90% households people defecate in an unhygienic condition polluting the entire environment. The study aimed to protect and improve the state of the environment through 100% sanitation in the program village, and to ensure that development activities take place in a manner that is environmentally sustainable, as a key contribution to the overall poverty reduction objective.

Study Objectives

The study was mainly to test whether some issues of environmental sanitation could be quickly promoted i.e. in one year with key sanitation behavioural change, which has environmental, social and economic impact on the rural poor community. Experts say that hygiene behaviour changes will take at least three years but on the other hand environmental implications to wait for such long time not economical for the developing country like Bangladesh. So, the outcome of the study will be an input to the sector stakeholders that how fast the environmental sanitation promotion can be done and what approaches needed to be followed for fast behavioural change to meet the social, institutional and legal challenges faced by the rural poor. The specific objectives are:

- To analyze sanitation and environmental conditions in low-income communities located on coastal village of Bangladesh.
- Community mobilization for promotion of key environmental sanitation behaviours in one year's approach in a coastal village of Bangladesh.
- To identify key considerations in the provision of hygiene promotion.
- Institutionalization and legal anchorage of activities with the local bodies for long-term sustenance.

Approaches and Strategy

The study on 100% Sanitation Promotion was undertaken as a unique approach and with some specific methodological measures. Both the approaches of the study and the methodological tools applied were structured considering the objectives of the study and at the same time keeping the nature of the study in mind. The overall approach was developed in a direction of formative research with an applied rationale.

Initial assumptions regarding the need for improved sanitation in the area as a whole and particularly in priority areas verified through baseline survey, contacts with key leaders and health workers. In particular, the incidence of excrete-related diseases, awareness of relationships between sanitation and disease and other disadvantages of existing excretes disposal practices were checked.

Care was taken to avoid raising unreasonable expectations. At the same time, the local people are made aware of the potential benefits of improved sanitation. Some idea of the readiness of the community to provide labour, money and materials for a latrine-construction programme also obtained. Considerable skills are required to find out the true aspirations and priorities of the people. Answers to the questions are often distorted because the interviewees wish to please the questioners. Small group discussions with minimum intervention by outsiders were used as an effective means of finding out the true local opinion.

The significant approaches were as follows.

- Reach consensus with the user's community on present sanitation problems and their causes. A comprehensive community plans to improve environmental sanitation.
- Small-steps approach towards achieving the desired situation.
- Allocation of tasks and responsibilities for action
- Identify support requirements for developing the plan.
- Local bodies will play advocacy role.

The community people are the key actors to execute all the activities in a flexible manner, where as project personnel act as a facilitator.

In studying fast behavioural change relating to 6 hygiene issues, some issues of investigation are readily observable after promotional activities or can be known by asking

any respondent direct questions. However, some behavioural aspects are beyond immediate observation or cannot be known just by asking questions in a structured manner. The readily investigable issues (e.g., latrine types, etc.) are regarded as "explicit" issues. In contrast, issues that are beyond immediate investigation are regarded as "implicit". These implicit issues (e.g., practices, etc.) relating to hygiene and sanitation are often difficult to understand but carry significant and meaningful behavioural information that underlay people's perceptions. This anthropological distinction between explicit and implicit issues was adopted in the study. Accordingly, monitoring formats developed which were mainly filled up through observation and empathy techniques.

The fieldwork for the study on accelerating 6 key hygiene behaviours was developed as a progressive field investigation. Instead of devising the study into 'typical' socio-economic study, great care was given in keeping the anthropological nature of the study and its objectives.

Capacity Building, Institutional and Legal Linkage

Capacity building is one of the critical aspects for sustenance of any activity. As a first step of capacity building, orientation session was organized. Village Sanitation committee, Youth Committee and Children Committee were formed and provided with formal/informal training. WatSan Committee Orientation/meeting held. Community action plan was drawn using PRA tools. Video show on sanitation promotion, rally, meeting with local elites, opinion leaders, Gram-sarkars and Union Parishad (lowest tier of local government) members together with R&D and DPHE (Department of Public Health Engineering) personnel held regularly. With a facilitated participatory approach, committees mainly youth group played vital advocacy role and communities were motivated to stop unhygienic defecation.

Finally, on completion of the pilot project all the achievements/ learning/ shortcomings were discussed with Upazilla Nirbahi Officer, who is the Chief Executive of the Sub-District administration, together with Union Parishad Chairman, Community representatives and DPHE, so that Union Parishad continues their institutional and legal support in this village to sustain efforts given to meet the sanitation challenge of the millennium.

Economic and financial factors

During study it was found that the priority of latrine installation is related to economic condition of the users. Especially the extreme poor they usually don't consider it as a priority issue over food, clothing, housing, water etc. During PRA exercise hygienic latrine issue was in 6/7 numbers and in some group it was least. Extreme poor for obvious reason are cautious to spend money in latrine constructions because of their deprived financial condition. Even while extreme poor are motivated they go for the cheapest one and all family members are going for fixed defecation but unfortunately the truth is that it do not sustain after one rainy season. There is a notion among the development activists that once habit is grown then they will never use unhygienic latrine or go for open defecation but in reality it did not work as affordability for the extreme poor stands as an impediment. During piloting it was found that some cross subsidy for the poor given by the affluent members of the community for latrine that were the cheapest one, which also may not sustain in long run.

Study findings and lessons learnt

The study revealed that with one year's behavioural change promotional package for 100 % sanitation coverage in terms of hygienic latrine use is possible and people stopped open defecation and defecation in unhygienic latrine. But in other issues the study results shows that behavioural changes have taken a steady way of diffusion.

The following table will give an overview on the findings:

Sl. No	Key Issues	Expected Change	Actual Change
1.	Use of hygienic latrines by all Members	100%	100%
2.	Use of sandal by all while using latrines	100%	86 %
3.	Disposed babies feces in latrines	100%	55%
4.	Washing hands with soap/ash/soil after cleaning children's bottom.	100%	81%
5.	Wash hands with soap/ash/soil after defecation	100%	81%
.6.	Cleaning of latrine and keep clean the surrounding of latrines	100%	76%

Table1: Behavioural change pattern in Environmental Hygiene and Sanitation

The above results no doubt have given remarkable and immensely important study findings as an input for the Water Supply and Sanitation program and for other stakeholders too. The study findings show that it almost required a year for 100% hygienic latrine coverage and interestingly the installation of latrines speeded up at the later months of one year package program that means users have gone slow first and faster later.

Further, the study has shown that about one fourth of the people preferred one slab one ring mainly due to financial constraint. But continuity of hygienic use of those built latrines by them in the high water table and flood prone area still needs to be investigated that how the users behave in sustaining or whether backfire to original position. Nevertheless this change from unhygienic defecation to hygienic defecation evaded many social and health problems.
In case of key hygienic behaviour issues the development followed rapid progression than national average due to unique approaches. The most important point of departure is to give authority (not mere involvement) to the *youth group* who helped to spread and scaling up the program. The study findings also suggests that effective planning requires a participatory, bottom up process to reflect community demand and choice where youth group can act as a constructive pressure group to activate Union Parishad, local opinion leaders and community people. Further more, the video show on sanitation in different circle tremendously influenced women and children especially drama/cartoon show on sanitation.

Another important point of departure is the bari (cluster of 5-10 households) based approach. Whenever meeting held, the achievement /activities focused bari and it enhanced peer pressure, positive competition and encouraged cross subsidy for the extreme poor.

The pivotal point of this piloting was also to observe how fast the 6 key hygiene behaviour could be promoted. The study has shown a very positive result although it did not follow the blue print as stipulated.

In case of 100 % hygienic latrine coverage it took one-year time and for other behaviours (although different in nature) ranged from 55 % to 86% in the same period and with an average increment of 51% over baseline. So, it is deemed that another one year will be required to diffuse/promote the behavioural change. As mentioned earlier the latrine installed by poor dwellers for the sake of fixed hygienic defecation, some may not sustain in the high water table area and may again add to the unsafe defecation list. These people will definitely need advocacy and follow up from local bodies and may require support to install latrines that sustains under local conditions. The important aspect is also to motivate poor people for

self-realization because solutions depend on a mix of social, institutional and legal approaches, most of them involving in changing established practices which itself is a challenge.

Conclusion

The major learning from the study findings that how fast behavioural changes can be made by the rural poor and the study result indicates that 100% hygienic latrine installation requires one-year time with 55% to 86% drift in other 5 key hygiene behaviours. Finally, the study has identified four major key indicators for successful environmental behaviour change strategy and as such concludes that environmental sanitation promotion strategy should:

- Educate, mobilize, and respond to the community, enabling greater environmental awareness and protection through community participation at least for two years;
- Be presented in a format, style and language that is accessible and attractive to the community;
- Stress concrete solutions and provide support to the community. Providing practical tools and assistance should ideally empower the community and highlight the positive contributions they can make to protect the environment;
- Be a partnership between a numbers of key partners. This includes local/ regional government,
- NGOs, business and the media. Such a partnership can also increase the quality of environmental coverage.

Health is the most important resource of the poorest of the poor particularly those who earn their livelihood through manual labor. Ill health is both the cause and effect of poverty. There is a huge loss of their productivity/ man-hour, which affects their earning due to water and sanitation related diseases. It not only affects the individual but national economic growth as well. In this context, the study has given extremely important findings for fast behavioral practices which can be directly adapted by other stakeholders or tailor made based on local socio-economic, institutional and legal frame work focusing poor children and women to get rapid access to safe sanitation to offer better life and self-esteem in the society.

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Rural Coastal Sewerage Concept in Papua New Guinea

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Introduction

About 1/3 of the communities which is about 1.5 million of population in Papua New Guinea are located on the coastal periphery of the mainland and the islands of PNG. In most cases, there are no proper sanitation facilities for the disposal of human feaces identified in those regions. A sample of 25% of such communities identified by ADRA in its program strategic locations of Morobe Province defecates in the nearby bushes, rivers or sea-side due to inappropriate and or lack of latrine facilities and also poor hygiene practices. The pit latrines are not suitable because of high water table and sand-soil strata that permit diffusion of ground water and erosion of pit walls, which affect the durability of the pit latrine system and its contentment.

Consideration for the design of coastal rural sewerage system in Morobe Province

The type of sanitation facility to be modified and implemented for the coastal rural communities in Morobe Province should embark on environmental impacts, hence, that the latrine or sewerage system be geographically suitable and quantifiable to the rural population settling along sea-side and also on high water table areas who are experiencing high water log and other weathering situations all year around. A pre-intervention analysis of two appropriate and simple rural sewerage system will be look at to improve this situation in the coastal rural population of Morobe Province.

a) Improved Version – Asian Water Closet

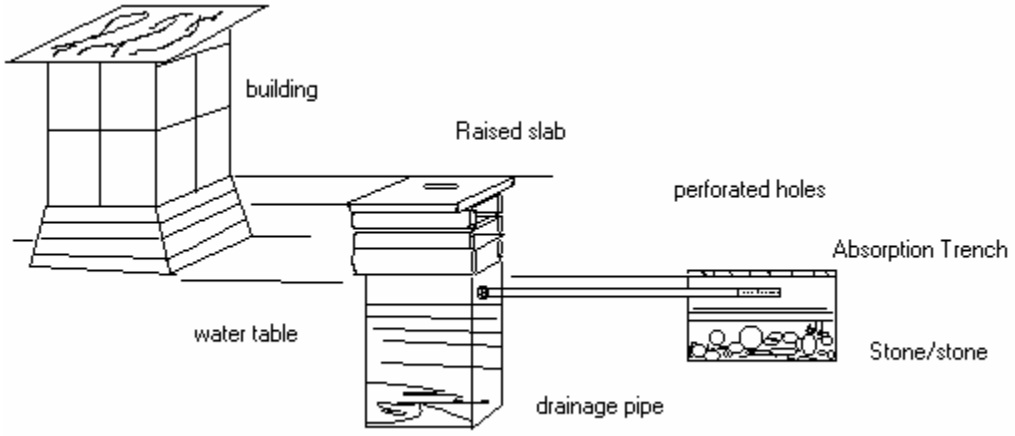


Figure 1: A design of the IV-Asian Water Closet

Figure 2
Pre-intervention Matrix for IV-Asian Water Closet

Features	Specification	Reliability	Risk Factors
Building Structure -Timber for the walls and raised platform can be collected from the bush free of charge - Roof, walls and raised platform can also be constructed using the local bush materials	Roof materials can be of sago leaves or kunai grass Walling and framing can be made from bamboo or local bush timbers	All households can afford one A four wall cabin, which gives the patron privacy and shelter	Local bush materials can be easily burned by bush fire Moderately reliable to strong winds and thunder storms
Slab Can be constructed at a cost of a cement bag and a quarter of a reinforcement mesh wire The raised basement for the slab can be an empty 44 gallon drum or other similar hard fix materials and should be placed at 0.3m around the pit hole	Slab dimension can be 1.2m x 1.2m x 0.06m Reinforcement G5 weld mesh of 1.1m x1.1m has a strong interior bonding capacity to cement and sand mix Tongue and grove timbers or hard facia - board timbers can make a strong wooden slab	An household can afford to meet the cost of a cement bag 4 x Households can share the cost of a G5 mesh wire for a piece each Concrete slab are proven to be more permanent and can be reused afterwards	Moderately reliable to strong winds and thunder storms
Pit Empty 44 gallon drums can be inserted as a wall lining for the pit and as chambers for the water table	3 x empty 44 gallon drums can be cut with 5 openings tied to the tip of each other and have an enclosed end raised 50m – 80m above ground level	Communities who cannot afford to find empty 44 gallon drums can either use local bush timbers, bamboos or such reinforcement to make a wall lining to the pit	Heavy rain and flood can soak down the soil wall Earthquake can also destroy the soil strata
	Pit dimension should be 0.3m square less than the slab size	Water in the pit helps the decomposition of feacal matters and other organic substances	
Absorption Trench	Trench dimension may be 1.5m x 1.5m x 1.5m	Increase in water table will be drained to the absorption trench. The absorption trench may have a sealed off lid from tin sheet or other hard local materials	
		Excessive wastewater in the absorption trench is filtered into the soil through the sand/pebbles and stones.	
Drainage Pipe The inlet should have a strainer and the outlet with a perforated holes on the sides with an UPVC End Cap	UPVC DWV 100mm x 6.5m Fly Strainer with a screw clamp Perforated Holes with UPVC 100mm DWV End Cap	Hard and permanent and can be used again	

b) Improved Version – Water Seal Latrine

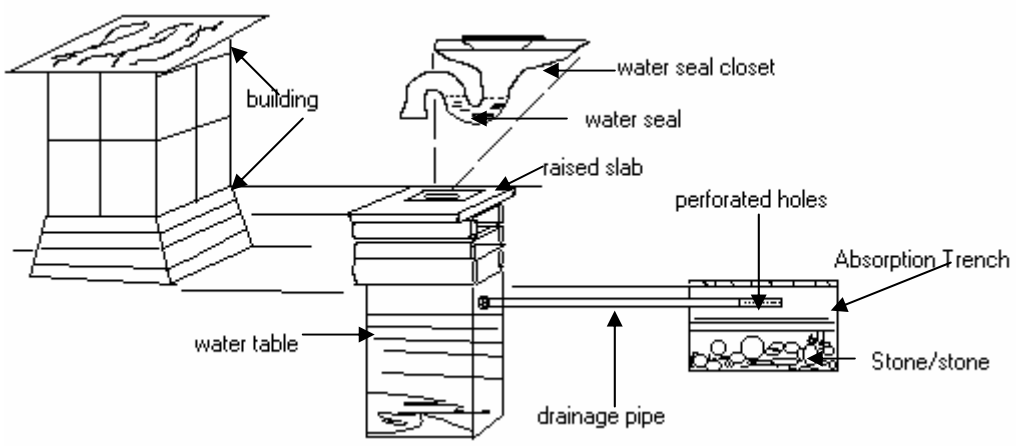


Figure 3: A design of the IV- Water Seal Latrine

Figure 4: Pre-intervention Matrix for IV-Water Seal Latrine			
Features	**Specification**	**Reliability**	**Risk Factors**
Building Structure -Timber for the walls and raised platform can be collected from the bush free of charge - Roof, walls and raised platform can also be constructed using the local bush materials	Roof materials can be of sago leaves or kunai grass Walling and framing can be made from bamboo or local bush timbers	All households can afford one A four wall cabin, which gives the patron privacy and shelter	Local bush materials can be easily burned by bush fire Moderately reliable to strong winds and thunder storms
Slab Can be constructed at a cost of a cement bag and a quarter of a reinforcement mesh wire The raised basement for the slab can be an empty 44 gallon drum or other similar hard fix materials and should be placed at 0.3m around the pit hole	Slab dimension can be 1.2m x 1.2m x 0.06m Reinforcement G5 weld mesh of 1.1m x1.1m has a strong interior bonding capacity to cement and sand mix Tongue and grove timbers or hard facia - board timbers can make a strong wooden slab	An household can afford to meet the cost of a cement bag 4 x Households can share the cost of a G5 mesh wire for a piece each Concrete slab are proven to be more permanent and can be reused afterwards	Moderately reliable to strong winds and thunder storms
Pit Empty 44 gallon drums can be inserted as a wall lining for the pit and as chambers for the water table	3 x empty 44 gallon drums can be cut with 5 openings tied to the tip of each other and have an enclosed end raised 50m – 80m above ground level	Communities who cannot afford to find empty 44 gallon drums can either use local bush timbers, bamboos or such reinforcement to make a wall lining to the pit	Heavy rain and flood can soak down the soil wall Earthquake can also destroy the soil strata
	Pit dimension should be 0.3m square less than the slab size	Water in the pit helps the decomposition of feacal matters and other organic substances	
Absorption Trench	Trench dimension may be	Increase in water table will	

Figure 4: Pre-intervention Matrix for IV-Water Seal Latrine			
Features	**Specification**	**Reliability**	**Risk Factors**
	1.5m x 1.5m x 1.5m	be drained to the absorption trench. The absorption trench may have a sealed off lid from tin sheet or other hard local materials	
Drainage Pipe The inlet should have a strainer and the outlet with a perforated holes on the sides with an UPVC End Cap	UPVC DWV 100mm x 6.5m Fly Strainer with a screw clamp Perforated Holes with UPVC 100mm DWV End Cap	Hard and permanent and can be used again	
Water Seal Closet	Can be fabricated from concrete using appropriate clay and waste paper mold portraying the shape of the water seal closet Needs chicken wire reinforcement in the concrete layer. A quarter of a cement bag and 0.3m square chicken wire is enough to do one Enough supply of water is needed to keep the system in operation. Water can be collected from water Taps, springs, creeks or seawater to pour flush the human faeces in the closet.	Very simple technology and can be afforded by many Easily Maintained	

Community Structure and Social Issues

Households clustering together in a village community shift the focus of an individual sewerage system to a communal system where similar principles tabled in Fig 2 and Fig 4 of both VI-Asian Water Closet and VI-Water Seal Latrine applies respectively. As such women and children must be given the privilege to decide on the relevancy and suitability of each system before making it become part of the community. Cultural and traditional values should also be considered on a sanitary merit to avoid culture - clash in the societies.

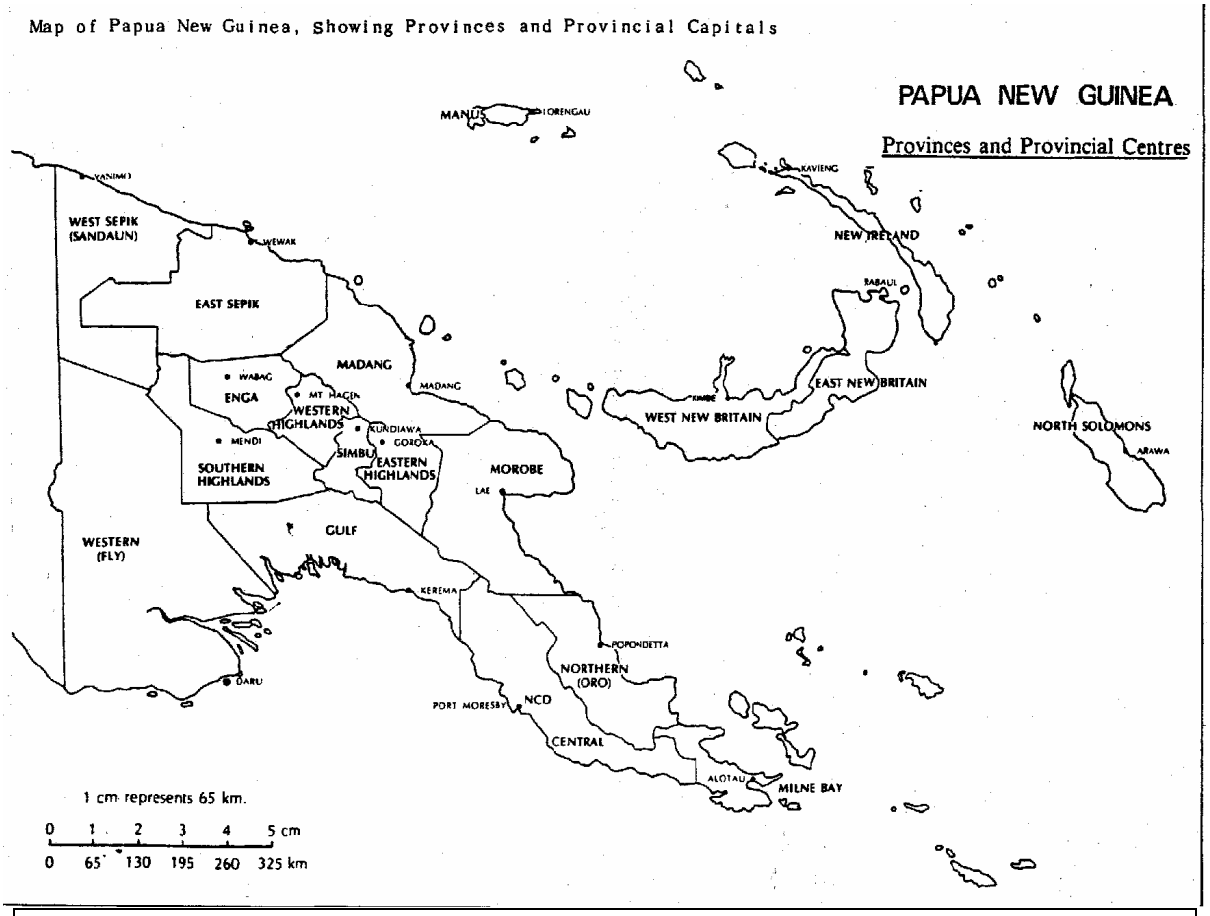
Population and beneficiary

The people who should be benefiting from this approach are the rural population settling along the coastal periphery of the PNG mainland and its islands (See Annex 1). Local authorities, planners and NGOs and funding agencies who are interested to carry out or fund water and sanitation programs in rural coastal communities can consider this approach in their program.

Communities who have excess to sufficient water for domestication will be benefiting a lot because the system needs water to operate, hence, for communities who live near the sea, rivers or any water points. ADRA PNG is currently working closely with the 50 000 rural population in Morobe Province by providing safe drinking water and sanitation facilities and will be implementing this concept in its second phase of program which begins in 2006. Post intervention of this concept will also apply to the successfully completed 88 water projects in Morobe Province.

ANNEX. 1

The Map of PNG showing potential coastal areas around the land mass and island areas needing funding to implement the rural coastal sewerage program concept.



Chapter 2: Minimum Standards in Water Supply, Sanitation and Hygiene Promotion

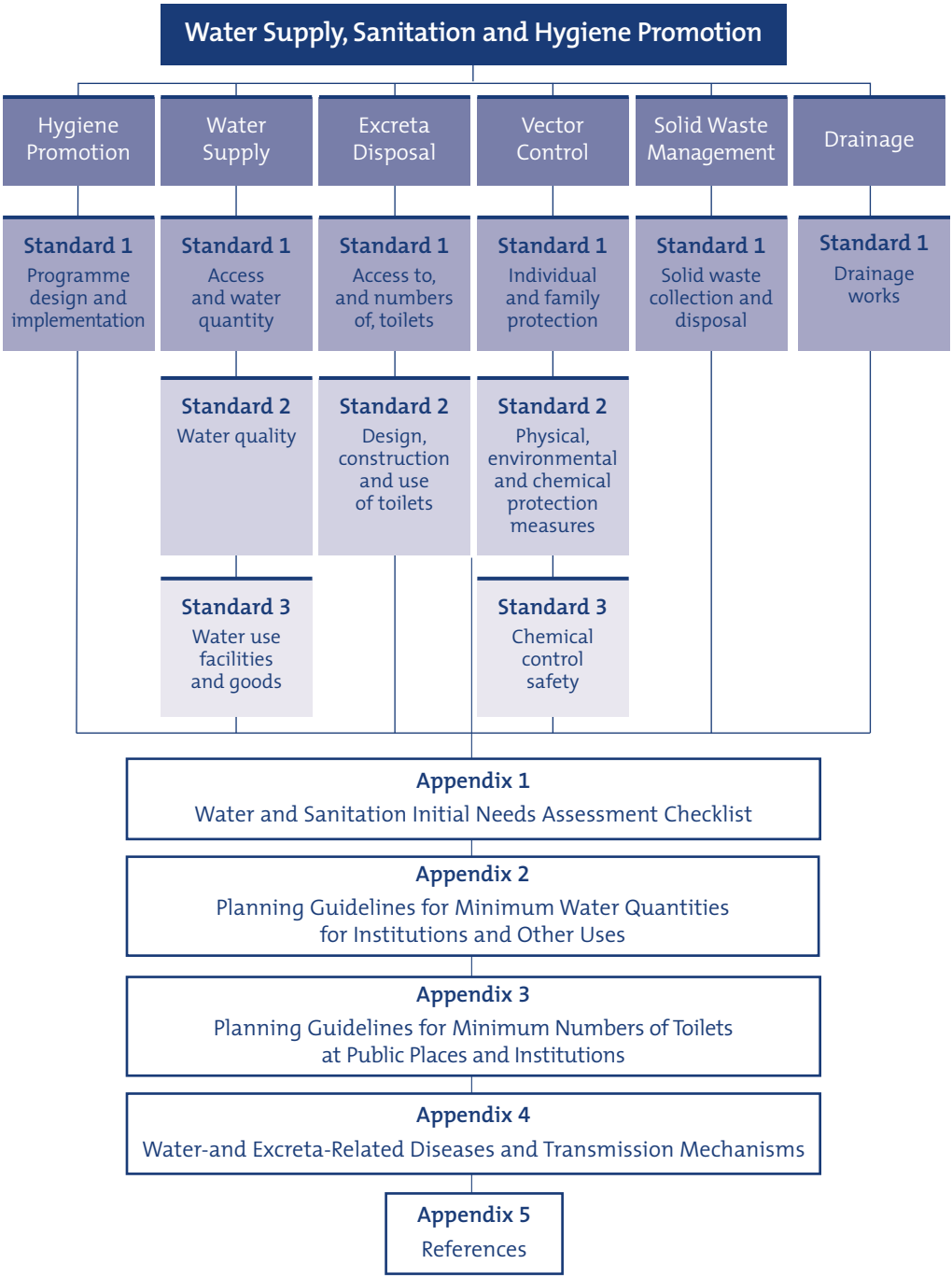
How to use this chapter

This chapter is divided into six main sections: Hygiene Promotion, Water Supply, Excreta Disposal, Vector Control, Solid Waste Management and Drainage. Each contains the following:

- *the minimum standards:* these are qualitative in nature and specify the minimum levels to be attained in the provision of water and sanitation responses;
- *key indicators:* these are 'signals' that show whether the standard has been attained. They provide a way of measuring and communicating the impact, or result, of programmes as well as the process, or methods, used. The indicators may be qualitative or quantitative;
- *guidance notes:* these include specific points to consider when applying the standard and indicators in different situations, guidance on tackling practical difficulties, and advice on priority issues. They may also include critical issues relating to the standard or indicators, and describe dilemmas, controversies or gaps in current knowledge.

The appendices include a select list of references, which point to sources of information on both general issues and specific technical issues relating to this chapter.

Contents


Water Supply, Sanitation and Hygiene Promotion
Hygiene Promotion
Water Supply
Excreta Disposal
Vector Control
Solid Waste Management
Drainage
Standard 1 Programme design and implementation
Standard 1 Access and water quantity
Standard 1 Access to, and numbers of, toilets
Standard 1 Individual and family protection
Standard 1 Solid waste collection and disposal
Standard 1 Drainage works
Standard 2 Water quality
Standard 2 Design, construction and use of toilets
Standard 2 Physical, environmental and chemical protection measures
Standard 3 Water use facilities and goods
Standard 3 Chemical control safety
Appendix 1 Water and Sanitation Initial Needs Assessment Checklist
Appendix 2 Planning Guidelines for Minimum Water Quantities for Institutions and Other Uses
Appendix 3 Planning Guidelines for Minimum Numbers of Toilets at Public Places and Institutions
Appendix 4 Water-and Excreta-Related Diseases and Transmission Mechanisms
Appendix 5 References

Introduction

Links to international legal instruments

The Minimum Standards in Water, Sanitation and Hygiene Promotion are a practical expression of the principles and rights embodied in the Humanitarian Charter. The Humanitarian Charter is concerned with the most basic requirements for sustaining the lives and dignity of those affected by calamity or conflict, as reflected in the body of international human rights, humanitarian and refugee law.

Everyone has the right to water. This right is recognised in international legal instruments and provides for sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic uses. An adequate amount of safe water is necessary to prevent death from dehydration, to reduce the risk of water-related disease and to provide for consumption, cooking, and personal and domestic hygienic requirements.

The right to water is inextricably related to other human rights, including the right to health, the right to housing and the right to adequate food. As such, it is part of the guarantees essential for human survival. States and non-state actors have responsibilities in fulfilling the right to water. In times of armed conflict, for example, it is prohibited to attack, destroy, remove or render useless drinking water installations or irrigation works.

The Minimum Standards in this chapter are not a full expression of the Right to Water. However, the Sphere standards reflect the core content of the Right to Water and contribute to the progressive realisation of this right globally.

The importance of water supply, sanitation and hygiene promotion in emergencies

Water and sanitation are critical determinants for survival in the initial stages of a disaster. People affected by disasters are generally much more susceptible to illness and death from disease, which are related to a large extent to inadequate sanitation, inadequate water supplies and poor hygiene. The most significant of these diseases are diarrhoeal diseases and infectious diseases transmitted by the faeco-oral route (see Appendix 4). Other water- and sanitation-related diseases include those carried by vectors associated with solid waste and water.

The main objective of water supply and sanitation programmes in disasters is to reduce the transmission of faeco-oral diseases and exposure to disease-bearing vectors through the promotion of good hygiene practices, the provision of safe drinking water and the reduction of environmental health risks and by establishing the conditions that allow people to live with good health, dignity, comfort and security. The term 'sanitation', throughout Sphere, refers to excreta disposal, vector control, solid waste disposal and drainage.

Simply providing sufficient water and sanitation facilities will not, on its own, ensure their optimal use or impact on public health. In order to achieve the maximum benefit from a response, it is imperative to ensure that disaster-affected people have the necessary information, knowledge and understanding to prevent water- and sanitation-related disease, and to mobilise their involvement in the design and maintenance of those facilities.

In most disaster situations the responsibility for collecting water falls to women and children. When using communal water and sanitation facilities, for example in refugee or displaced situations, women and adolescent girls can be vulnerable to sexual violence or exploitation. In order to minimise these risks, and to ensure a better quality of response, it is important to encourage women's participation in water supply and sanitation programmes wherever possible. An equitable participation of women and men in planning, decision-making and local management will help to ensure that the entire affected population has safe and easy access to water supply and sanitation services, and that services are equitable and appropriate.

Links to other chapters

Many of the standards in the other sector chapters are relevant to this chapter. Progress in achieving standards in one area often influences and even determines progress in other areas. For a response to be effective, close coordination and collaboration are required with other sectors. Coordination with local authorities and other responding agencies is also necessary to ensure that needs are met, that efforts are not duplicated, and that the quality of water and sanitation responses is optimised.

For instance, where nutritional standards have not been met, the urgency to improve the standard of water and sanitation increases, as people's vulnerability to disease will have significantly increased. The same applies to populations where HIV/AIDS prevalence is high or where there is a large proportion of older or disabled people. Priorities should be decided on the basis of sound information shared between sectors as the situation evolves. Reference to specific standards or guidance notes in other technical chapters is made where relevant.

Links to the standards common to all sectors

The process by which an intervention is developed and implemented is critical to its effectiveness. This chapter should be utilised in conjunction with the standards common to all sectors, which cover participation, initial assessment, response, targeting, monitoring, evaluation, aid worker competencies and responsibilities, and the supervision, management and support of personnel (see chapter 1, page 21). In particular, in any response the participation of disaster-affected people – including the vulnerable groups outlined below – should be maximised to ensure its appropriateness and quality.

Vulnerabilities and capacities of disaster-affected populations

The groups most frequently at risk in emergencies are women, children, older people, disabled people and people living with HIV/AIDS (PLWH/A). In certain contexts, people may also become vulnerable by reason of ethnic origin, religious or political affiliation,

or displacement. This is not an exhaustive list, but it includes those most frequently identified. Specific vulnerabilities influence people's ability to cope and survive in a disaster, and those most at risk should be identified in each context.

Throughout the handbook, the term 'vulnerable groups' refers to all these groups. When any one group is at risk, it is likely that others will also be threatened. Therefore, whenever vulnerable groups are mentioned, users are strongly urged to consider all those listed here. Special care must be taken to protect and provide for all affected groups in a non-discriminatory manner and according to their specific needs. However, it should also be remembered that disaster-affected populations possess, and acquire, skills and capacities of their own to cope, and that these should be recognised and supported.

The Minimum Standards

1 Hygiene Promotion

The aim of any water and sanitation programme is to promote good personal and environmental hygiene in order to protect health. Hygiene promotion is defined here as the mix between the population's knowledge, practice and resources and agency knowledge and resources, which together enable risky hygiene behaviours to be avoided. The three key factors are 1) a mutual sharing of information and knowledge, 2) the mobilisation of communities and 3) the provision of essential materials and facilities. Effective hygiene promotion relies on an exchange of information between the agency and the affected community in order to identify key hygiene problems and to design, implement and monitor a programme to promote hygiene practices that will ensure the optimal use of facilities and the greatest impact on public health. Community mobilisation is especially pertinent during disasters as the emphasis must be on encouraging people to take action to protect their health and make good use of facilities and services provided, rather than on the dissemination of messages. It must be stressed that hygiene promotion should never be a substitute for good sanitation and water supplies, which are fundamental to good hygiene.

Hygiene promotion is integral to all the standards within this chapter. It is presented here as one overarching standard with related indicators. Further specific indicators are given within each standard for water supply, excreta disposal, vector control, solid waste management and drainage.

Hygiene promotion standard 1: programme design and implementation

All facilities and resources provided reflect the vulnerabilities, needs and preferences of the affected population. Users are involved in the management and maintenance of hygiene facilities where appropriate.

Key indicators (to be read in conjunction with the guidance notes)

- Key hygiene risks of public health importance are identified (see guidance note 1).
- Programmes include an effective mechanism for representative and participatory input from all users, including in the initial design of facilities (see guidance notes 2, 3 and 5).
- All groups within the population have equitable access to the resources or facilities needed to continue or achieve the hygiene practices that are promoted (see guidance note 3).
- Hygiene promotion messages and activities address key behaviours and misconceptions and are targeted for all user groups. Representatives from these groups participate in planning, training, implementation, monitoring and evaluation (see guidance notes 1, 3 and 4 and Participation standard on page 28).
- Users take responsibility for the management and maintenance of facilities as appropriate, and different groups contribute equitably (see guidance notes 5-6).

Guidance notes

1. ***Assessing needs:*** an assessment is needed to identify the key hygiene behaviours to be addressed and the likely success of promotional activity. The key risks are likely to centre on excreta disposal, the use and maintenance of toilets, the lack of hand washing with soap or an alternative, the unhygienic collection and storage of water, and unhygienic food storage and preparation. The assessment should look at resources available to the population as well as local behaviours, knowledge and

practices so that messages are relevant and practical. It should pay special attention to the needs of vulnerable groups. If consultation with any group is not possible, this should be clearly stated in the assessment report and addressed as quickly as possible (see Participation standard, page 28 and the assessment checklist in Appendix 1).

2. ***Sharing responsibility:*** the ultimate responsibility for hygiene practice lies with all members of the affected population. All actors responding to the disaster should work to enable hygienic practice by ensuring that both knowledge and facilities are accessible, and should be able to demonstrate that this has been achieved. As a part of this process, vulnerable groups from the affected population should participate in identifying risky practices and conditions and take responsibility to measurably reduce these risks. This can be achieved through promotional activities, training and facilitation of behavioural change, based on activities that are culturally acceptable and do not overburden the beneficiaries.

3. ***Reaching all sections of the population:*** hygiene promotion programmes need to be carried out with all groups of the population by facilitators who can access, and have the skills to work with, different groups (for example, in some cultures it is not acceptable for women to speak to unknown men). Materials should be designed so that messages reach members of the population who are illiterate. Participatory materials and methods that are culturally appropriate offer useful opportunities for groups to plan and monitor their own hygiene improvements. As a rough guide, in a camp scenario there should be two hygiene promoters/community mobilisers per 1,000 members of the target population. For information on hygiene items, see Non-food items standard 2 on page 232.

4. ***Targeting priority hygiene risks and behaviours:*** the objectives of hygiene promotion and communication strategies should be clearly defined and prioritised. The understanding gained through assessing hygiene risks, tasks and responsibilities of different groups should be used to plan and prioritise assistance, so that misconceptions (for example, how HIV/AIDS is transmitted) are addressed and information flow between humanitarian actors and the affected population is appropriate and targeted.

5. ***Managing facilities:*** where possible, it is good practice to form water and/or sanitation committees, made up of representatives from the various user groups and half of whose members are women. The functions of these committees are to manage the communal facilities such as water points, public toilets and washing areas, be involved in hygiene promotion activities and also act as a mechanism for ensuring representation and promoting sustainability.

6. ***Overburdening:*** it is important to ensure that no one group is overburdened with the responsibility for hygiene promotional activities or management of facilities and that each group has equitable influence and benefits (such as training). Not all groups, women or men have the same needs and interests and it should be recognised that the participation of women should not lead to men, or other groups within the population, not taking responsibility.

2 Water Supply

Water is essential for life, health and human dignity. In extreme situations, there may not be sufficient water available to meet basic needs, and in these cases supplying a survival level of safe drinking water is of critical importance. In most cases, the main health problems are caused by poor hygiene due to insufficient water and by the consumption of contaminated water.

Water supply standard 1: access and water quantity

All people have safe and equitable access to a sufficient quantity of water for drinking, cooking and personal and domestic hygiene. Public water points are sufficiently close to households to enable use of the minimum water requirement.

Key indicators (to be read in conjunction with the guidance notes)

- Average water use for drinking, cooking and personal hygiene in any household is at least 15 litres per person per day (see guidance notes 1-8).
- The maximum distance from any household to the nearest water point is 500 metres (see guidance notes 1, 2, 5 and 8).
- Queuing time at a water source is no more than 15 minutes (see guidance note 7).
- It takes no more than three minutes to fill a 20-litre container (see guidance notes 7-8).
- Water sources and systems are maintained such that appropriate quantities of water are available consistently or on a regular basis (see guidance notes 2 and 8).

Guidance notes

1. ***Needs:*** the quantities of water needed for domestic use may vary according to the climate, the sanitation facilities available, people's normal habits, their religious and cultural practices, the food they cook, the clothes they wear, and so on. Water consumption generally increases the nearer the water source is to the dwelling.

Simplified table of basic survival water needs		
Survival needs: water intake (drinking and food)	2.5-3 litres per day	Depends on: the climate and individual physiology
Basic hygiene practices	2-6 litres per day	Depends on: social and cultural norms
Basic cooking needs	3-6 litres per day	Depends on: food type, social as well as cultural norms
Total basic water needs	7.5-15 litres per day	

See Appendix 2 for guidance on minimum water quantities needed for institutions and other uses.

2. ***Water source selection:*** the factors that need to be taken into account are the availability and sustainability of a sufficient quantity of water; whether water treatment is required and, if so, the feasibility of this; the availability of the time, technology or funding required to develop a source; the proximity of the source to the affected population; and the existence of any social, political or legal factors concerning the source. Generally, groundwater sources are preferable as they require less treatment, especially gravity-flow supplies from springs, which require no pumping. Disasters often require a combination of approaches and sources in the initial phase. All sources need to be regularly monitored to avoid over-exploitation.

3. ***Measurement:*** measuring solely the volume of water pumped into the reticulation system or the time a handpump is in operation will not give an accurate indication of individual consumption. Household surveys,

observation and community discussion groups are a more effective method of collecting data on water use and consumption.

4. ***Quality and quantity:*** in many emergency situations, water-related disease transmission is due as much to insufficient water for personal and domestic hygiene as to contaminated water supplies. Until minimum standards for both quantity and quality are met, the priority should be to provide equitable access to an adequate quantity of water even if it is of intermediate quality, rather than to provide an inadequate quantity of water that meets the minimum quality standard. It should be taken into account that people living with HIV/AIDS need extra water for drinking and personal hygiene. Particular attention should be paid to ensuring that the water requirements of livestock and crops are met, especially in drought situations where lives and livelihoods are dependent on these (see Appendix 2).

5. ***Coverage:*** in the initial phase of a response the first priority is to meet the urgent survival needs of all the affected population. People affected by an emergency have a significantly increased vulnerability to disease and therefore the indicators should be reached even if they are higher than the norms of the affected or host population. In such situations it is recommended that agencies plan programmes to raise the levels of water and sanitation facilities of the host population also, to avoid provoking animosity.

6. ***Maximum numbers of people per water source:*** the number of people per source depends on the yield and availability of water at each source. For example, taps often function only at certain times of day and handpumps and wells may not give constant water if there is a low recharge rate. The rough guidelines (for when water is constantly available) are:

250 people per tap	based on a flow of 7.5 litres/minute
500 people per handpump	based on a flow of 16.6 l/m
400 people per single-user open well	based on a flow of 12.5 l/m.

These guidelines assume that the water point is accessible for approximately eight hours a day only; if access is greater than this, people can collect more than the 15 litres per day minimum requirement. These

targets must be used with caution, as reaching them does not necessarily guarantee a minimum quantity of water or equitable access.

7. ***Queuing time:*** excessive queuing times are indicators of insufficient water availability (either due to an inadequate number of water points or inadequate yields of water points). The potential negative results of excessive queuing times are: 1) reduced per capita water consumption; 2) increased consumption from unprotected surface sources; and 3) reduced time for water collectors to tend to other essential survival tasks.

8. ***Access and equity:*** even if a sufficient quantity of water is available to meet minimum needs, additional measures may be needed to ensure that access is equitable for all groups. Water points should be located in areas that are accessible to all regardless of e.g. sex or ethnicity. Some handpumps and water carrying containers may need to be designed or adapted for use by people living with HIV/AIDS, older and disabled people and children. In urban situations, it may be necessary to supply water into individual buildings to ensure that toilets continue to function. In situations where water is rationed or pumped at given times, this should be planned in consultation with the users. Times should be set which are convenient and safe for women and others who have responsibility for collecting water, and all users should be fully informed of when and where water is available.

Water supply standard 2: water quality

Water is palatable, and of sufficient quality to be drunk and used for personal and domestic hygiene without causing significant risk to health.

Key indicators (to be read in conjunction with the guidance notes)

- A sanitary survey indicates a low risk of faecal contamination (see guidance note 1).
- There are no faecal coliforms per 100ml at the point of delivery (see guidance note 2).
- People drink water from a protected or treated source in preference to other readily available water sources (see guidance note 3).

- Steps are taken to minimise post-delivery contamination (see guidance note 4).
- For piped water supplies, or for all water supplies at times of risk or presence of diarrhoea epidemic, water is treated with a disinfectant so that there is a free chlorine residual at the tap of 0.5mg per litre and turbidity is below 5 NTU (see guidance notes 5, 7 and 8).
- No negative health effect is detected due to short-term use of water contaminated by chemical (including carry-over of treatment chemicals) or radiological sources, and assessment shows no significant probability of such an effect (see guidance note 6).

Guidance notes

1. ***A sanitary survey*** is an assessment of conditions and practices that may constitute a public health risk. The assessment should cover possible sources of contamination to water at the source, in transport and in the home, as well as defecation practices, drainage and solid waste management. Community mapping is a particularly effective way of identifying where the public health risks are and thereby involving the community in finding ways to reduce these risks. Note that while animal excreta is not as harmful as human excreta, it can contain cryptosporidium, giardia, salmonella, campylobacter, caliciviruses and some other common causes of human diarrhoea and therefore does present a significant health risk.
2. ***Microbiological water quality:*** faecal coliform bacteria (>99% of which are *E. coli*) are an indicator of the level of human/animal waste contamination in water and the possibility of the presence of harmful pathogens. If any faecal coliforms are present the water should be treated. However, in the initial phase of a disaster, quantity is more important than quality (see Water supply standard 1, guidance note 4).
3. ***Promotion of protected sources:*** merely providing protected sources or treated water will have little impact unless people understand the health benefits of this water and therefore use it. People may prefer to use unprotected sources, e.g. rivers, lakes and unprotected wells, for reasons such as taste, proximity and social convenience. In such cases

technicians, hygiene promoters and community mobilisers need to understand the rationale for these preferences so that consideration of them can be included in promotional messages and discussions.

4. ***Post-delivery contamination:*** water that is safe at the point of delivery can nevertheless present a significant health risk due to re-contamination during collection, storage and drawing. Steps that can be taken to minimise such risk include improved collection and storage practices, distributions of clean and appropriate collection and storage containers (see Water supply standard 3), treatment with a residual disinfectant, or treatment at the point of use. Water should be routinely sampled at the point of use to monitor the extent of any post-delivery contamination.

5. ***Water disinfection:*** water should be treated with a residual disinfectant such as chlorine if there is a significant risk of water source or post-delivery contamination. This risk will be determined by conditions in the community, such as population density, excreta disposal arrangements, hygiene practices and the prevalence of diarrhoeal disease. The risk assessment should also include qualitative community data regarding factors such as community perceptions of taste and palatability (see guidance note 6). Piped water supply for any large or concentrated population should be treated with a residual disinfectant and, in the case of a threat or the existence of a diarrhoea epidemic, all drinking water supplies should be treated, either before distribution or in the home. In order for water to be disinfected properly, turbidity must be below 5 NTU.

6. ***Chemical and radiological contamination:*** where hydrogeological records or knowledge of industrial or military activity suggest that water supplies may carry chemical or radiological health risks, those risks should be assessed rapidly by carrying out chemical analysis. A decision that balances short-term public health risks and benefits should then be made. A decision about using possibly contaminated water for longer-term supplies should be made on the basis of a more thorough professional assessment and analysis of the health implications.

7. ***Palatability:*** although taste is not in itself a direct health problem (e.g. slightly saline water), if the safe water supply does not taste good, users may drink from unsafe sources and put their health at risk. This may also be a risk when chlorinated water is supplied, in which case promotional activities are needed to ensure that only safe supplies are used.

8. ***Water quality for health centres:*** all water for hospitals, health centres and feeding centres should be treated with chlorine or another residual disinfectant. In situations where water is likely to be rationed by an interruption of supply, sufficient water storage should be available at the centre to ensure an uninterrupted supply at normal levels of utilisation (see Appendix 2).

Water supply standard 3: water use facilities and goods

People have adequate facilities and supplies to collect, store and use sufficient quantities of water for drinking, cooking and personal hygiene, and to ensure that drinking water remains safe until it is consumed.

Key indicators (to be read in conjunction with the guidance notes)

- Each household has at least two clean water collecting containers of 10-20 litres, plus enough clean water storage containers to ensure there is always water in the household (see guidance note 1).
- Water collection and storage containers have narrow necks and/or covers, or other safe means of storage, drawing and handling, and are demonstrably used (see guidance note 1).
- There is at least 250g of soap available for personal hygiene per person per month.
- Where communal bathing facilities are necessary, there are sufficient bathing cubicles available, with separate cubicles for males and females, and they are used appropriately and equitably (see guidance note 2).
- Where communal laundry facilities are necessary, there is at least one washing basin per 100 people, and private laundering areas are available for women to wash and dry undergarments and sanitary cloths.
- The participation of all vulnerable groups is actively encouraged in the siting and construction of bathing facilities and/or the

production and distribution of soap, and/or the use and promotion of suitable alternatives (see guidance note 2).

Guidance notes

1. ***Water collection and storage:*** people need vessels to collect water, to store it and to use it for washing, cooking and bathing. These vessels should be clean, hygienic and easy to carry and be appropriate to local needs and habits, in terms of size, shape and design. Children, disabled people, older people and PLWH/A may need smaller or specially designed water carrying containers. The amount of storage capacity required depends on the size of the household and the consistency of water availability e.g. approximately 4 litres per person would be appropriate for situations where there is a constant daily supply. Promotion and monitoring of safe collection, storage and drawing provide an opportunity to discuss water contamination issues with vulnerable groups, especially women and children.

2. ***Communal washing and bathing facilities:*** people may need a space where they can bathe in privacy and dignity. If this is not possible at the household level, central facilities may be needed. Where soap is not available or commonly used, alternatives can be provided such as ash, clean sand, soda or various plants suitable for washing and/or scrubbing. Washing clothes is an essential hygiene activity, particularly for children, and cooking and eating utensils also need washing. The numbers, location, design, safety, appropriateness and convenience of facilities should be decided in consultation with the users, particularly women, adolescent girls and any disabled people. The location of facilities in central, accessible and well-lit areas can contribute to ensuring the safety of users.

3 Excreta Disposal

Safe disposal of human excreta creates the first barrier to excreta-related disease, helping to reduce transmission through direct and indirect routes. Safe excreta disposal is therefore a major priority, and in most disaster situations should be addressed with as much speed and effort as the provision of safe water supply. The provision of appropriate facilities for defecation is one of a number of emergency responses essential for people's dignity, safety, health and well-being.

Excreta disposal standard 1: access to, and numbers of, toilets

People have adequate numbers of toilets, sufficiently close to their dwellings, to allow them rapid, safe and acceptable access at all times of the day and night.

Key indicators (to be read in conjunction with the guidance notes)

- A maximum of 20 people use each toilet (see guidance notes 1-4).
- Use of toilets is arranged by household(s) and/or segregated by sex (see guidance notes 3-5).
- Separate toilets for women and men are available in public places (markets, distribution centres, health centres, etc.) (see guidance note 3).
- Shared or public toilets are cleaned and maintained in such a way that they are used by all intended users (see guidance notes 3-5).
- Toilets are no more than 50 metres from dwellings (see guidance note 5).
- Toilets are used in the most hygienic way and children's faeces are disposed of immediately and hygienically (see guidance note 6).

Guidance notes

1. ***Safe excreta disposal:*** the aim of a safe excreta disposal programme is to ensure that the environment is free from contamination by human faeces. The more all groups from the disaster-affected population are involved, the more likely the programme is to succeed. In situations where the population has not traditionally used toilets, it may be necessary to conduct a concerted education/promotion campaign to encourage their use and to create a demand for more toilets to be constructed. Disasters in urban areas where the sewerage system is damaged may require solutions such as isolating parts of the system that still work (and re-routing pipes), installing portable toilets and using septic tanks and containment tanks that can be regularly desludged.

2. ***Defecation areas:*** in the initial phase of a disaster, before any toilets can be constructed, it may be necessary to mark off an area to be used as a defecation field or for trench latrines. This will only work if the site is correctly managed and maintained.

3. ***Public toilets:*** in some initial disaster situations and in public places where it is necessary to construct toilets for general use, it is very important to establish systems for the proper regular cleaning and maintenance of these facilities. Disaggregated population data should be used to plan the ratio of women's cubicles to men's (of approximately 3:1). Where possible, urinals should be provided for men (see Appendix 3).

4. ***Communal toilets:*** for a displaced population where there are no existing toilets, it is not always possible to provide one toilet per 20 people immediately. In such cases, a figure of 50 people per toilet can be used, decreasing to 20 as soon as possible, and changing the sharing arrangements accordingly. Any communal toilet must have a system in place, developed with the community, to ensure that it is maintained and kept clean. In some circumstances, space limitations make it impossible to meet this figure. In this case, while advocating strongly for extra space to be made available, it should be remembered that the primary aim is to provide and maintain an environment free from human faeces.

5. ***Shared facilities:*** where one toilet is shared by four or five families it is generally better kept, cleaner and therefore regularly used when the families have been consulted about its siting and design and have the

responsibility and the means to clean and maintain it. It is important to organise access to shared facilities by working with the intended users to decide who will have access to the toilet and how it will be cleaned and maintained. Efforts should be made to provide people living with HIV/AIDS with easy access to a toilet as they frequently suffer from chronic diarrhoea and reduced mobility.

6. ***Children's faeces:*** particular attention should be given to the disposal of children's faeces, which are commonly more dangerous than those of adults, as the level of excreta-related infection among children is frequently higher and children lack antibodies. Parents or care givers need to be involved, and facilities should be designed with children in mind. It may be necessary to provide parents or care givers with information about safe disposal of infant faeces and nappy (diaper) laundering practices.

Excreta disposal standard 2: design, construction and use of toilets

Toilets are sited, designed, constructed and maintained in such a way as to be comfortable, hygienic and safe to use.

Key indicators (to be read in conjunction with the guidance notes)

- Users (especially women) have been consulted and approve of the siting and design of the toilet (see guidance notes 1-3).
- Toilets are designed, built and located to have the following features:

  – they are designed in such a way that they can be used by all sections of the population, including children, older people, pregnant women and physically and mentally disabled people (see guidance note 1);

  – they are sited in such a way as to minimise threats to users, especially women and girls, throughout the day and night (see guidance note 2);

  - they are sufficiently easy to keep clean to invite use and do not present a health hazard;
  - they provide a degree of privacy in line with the norms of the users;
  - they allow for the disposal of women's sanitary protection, or provide women with the necessary privacy for washing and drying sanitary protection cloths (see guidance note 4);
  - they minimise fly and mosquito breeding (see guidance note 7).

- All toilets constructed that use water for flushing and/or a hygienic seal have an adequate and regular supply of water (see guidance notes 1 and 3).
- Pit latrines and soakaways (for most soils) are at least 30 metres from any groundwater source and the bottom of any latrine is at least 1.5 metres above the water table. Drainage or spillage from defecation systems must not run towards any surface water source or shallow groundwater source (see guidance note 5).
- People wash their hands after defecation and before eating and food preparation (see guidance note 6).
- People are provided with tools and materials for constructing, maintaining and cleaning their own toilets if appropriate (see guidance note 7).

Guidance notes

1. ***Acceptable facilities:*** successful excreta disposal programmes are based on an understanding of people's varied needs as well as on the participation of the users. It may not be possible to make all toilets acceptable to all groups and special toilets may need to be constructed for children, older people and disabled people e.g. potties, or toilets with lower seats or hand rails. The type of toilet constructed should depend on the preferences and cultural habits of the intended users, the existing infrastructure, the ready availability of water (for flushing and water seals), ground conditions and the availability of construction materials.

2. ***Safe facilities:*** inappropriate siting of toilets may make women and girls more vulnerable to attack, especially during the night, and ways must be found to ensure that women feel, and are, safe using the toilets provided. Where possible, communal toilets should be provided with lighting or families provided with torches. The input of the community should be sought with regard to ways of enhancing the safety of users.

3. ***Anal cleansing:*** water should be provided for people who use it. For other people it may be necessary to provide toilet paper or other material for anal cleansing. Users should be consulted on the most culturally appropriate cleansing materials and on their safe disposal.

4. ***Menstruation:*** women and girls who menstruate should have access to suitable materials for the absorption and disposal of menstrual blood. Women should be consulted on what is culturally appropriate (see Non-food items standard 2 on page 232).

5. ***Distance of defecation systems from water sources:*** the distances given above may be increased for fissured rocks and limestone, or decreased for fine soils. In disasters, groundwater pollution may not be an immediate concern if the groundwater is not consumed. In flooded or high water table environments, it may be necessary to build elevated toilets or septic tanks to contain excreta and prevent it contaminating the environment.

6. ***Hand washing:*** the importance of hand washing after defecation and before eating and preparing food, to prevent the spread of disease, cannot be over-estimated. Users should have the means to wash their hands after defecation with soap or an alternative (such as ash), and should be encouraged to do so. There should be a constant source of water near the toilet for this purpose.

7. ***Hygienic toilets:*** if toilets are not kept clean they may become a focus for disease transmission and people will prefer not to use them. They are more likely to be kept clean if users have a sense of ownership. This is encouraged by promotional activities, having toilets close to where people sleep and involving users in decisions about their design and construction, rules on proper operation, maintenance, monitoring and use. Flies and mosquitoes are discouraged by keeping the toilet clean, having a water seal, Ventilated Improved Pit (VIP) latrine design or simply by the correct use of a lid on a squat hole.

4 Vector Control

A vector is a disease-carrying agent and vector-borne diseases are a major cause of sickness and death in many disaster situations. Mosquitoes are the vector responsible for malaria transmission, which is one of the leading causes of morbidity and mortality. Mosquitoes also transmit other diseases, such as yellow fever and dengue haemorrhagic fever. Non-biting or synanthropic flies, such as the house fly, the blow fly and the flesh fly, play an important role in the transmission of diarrhoeal disease. Biting flies, bed bugs and fleas are a painful nuisance and in some cases transmit significant diseases such as murine typhus and plague. Ticks transmit relapsing fever and human body lice transmit typhus and relapsing fever. Rats and mice can transmit diseases such as leptospirosis and salmonellosis and can be hosts for other vectors e.g. fleas, which may transmit Lassa fever, plague and other infections.

Vector-borne diseases can be controlled through a variety of initiatives, including appropriate site selection and shelter provision, appropriate water supply, excreta disposal, solid waste management and drainage, the provision of health services (including community mobilisation and health promotion), the use of chemical controls, family and individual protection and the effective protection of food stores. Although the nature of vector-borne disease is often complex and addressing vector-related problems may demand specialist attention, there is much that can be done to help prevent the spread of such diseases with simple and effective measures, once the disease, its vector and their interaction with the population have been identified.

Vector control standard 1: individual and family protection

All disaster-affected people have the knowledge and the means to protect themselves from disease and nuisance vectors that are likely to represent a significant risk to health or well-being.

Key indicators (to be read in conjunction with the guidance notes)

- All populations at risk from vector-borne disease understand the modes of transmission and possible methods of prevention (see guidance notes 1-5).
- All populations have access to shelters that do not harbour or encourage the growth of vector populations and are protected by appropriate vector control measures.
- People avoid exposure to mosquitoes during peak biting times by using all non-harmful means available to them. Special attention is paid to protection of high-risk groups such as pregnant and feeding mothers, babies, infants, older people and the sick (see guidance note 3).
- People with treated mosquito nets use them effectively (see guidance note 3).
- Control of human body lice is carried out where louse-borne typhus or relapsing fever is a threat (see guidance note 4).
- Bedding and clothing are aired and washed regularly (see guidance note 4).
- Food is protected at all times from contamination by vectors such as flies, insects and rodents.

Guidance notes

1. ***Defining vector-borne disease risk:*** decisions about vector control interventions should be based on an assessment of potential disease risk,

as well as on clinical evidence of a vector-borne disease problem. Factors influencing this risk include:

- immunity status of the population, including previous exposure, nutritional stress and other stresses. Movement of people (e.g. refugees, IDPs) from a non-endemic to an endemic area is a common cause of epidemics;
- pathogen type and prevalence, in both vectors and humans;
- vector species, behaviours and ecology;
- vector numbers (season, breeding sites, etc.);
- increased exposure to vectors: proximity, settlement pattern, shelter type, existing individual protection and avoidance measures.

2. ***Indicators for vector control programmes:*** commonly used indicators for measuring the impact of vector control activities are vector-borne disease incidence rates (from epidemiological data, community-based data and proxy indicators, depending on the response) and parasite counts (using rapid diagnostic kits or microscopy).

3. ***Individual malaria protection measures:*** if there is a significant risk of malaria, the systematic and timely provision of protection measures, such as insecticide-treated materials, i.e. tents, curtains and bednets, is recommended. Impregnated bednets have the added advantage of giving some protection against body and head lice, fleas, ticks, cockroaches and bedbugs. Long-sleeved clothing, household fumigants, coils, aerosol sprays and repellents are other protection methods that can be used against mosquitoes. It is vital to ensure that users understand the importance of protection and how to use the tools correctly so that the protection measures are effective. Where resources are scarce, they should be directed at individuals and groups most at risk, such as children under five years old, non-immunes and pregnant women.

4. ***Individual protection measures for other vectors:*** good personal hygiene and regular washing of clothes and bedding is the most effective protection against body lice. Infestations can be controlled by personal treatment (powdering), mass laundering or delousing campaigns and by treatment protocols as newly displaced people arrive in a settlement. A

clean household environment, together with good waste disposal and good food storage, will deter rats and other rodents from entering houses or shelters.

5. ***Water-borne diseases:*** people should be informed of health risks and should avoid entering water bodies where there is a known risk of contracting diseases such as schistosomiasis, Guinea worm or leptospirosis (transmitted by exposure to mammalian urine, especially that of rats: see Appendix 4). Agencies may need to work with the community to find alternative sources of water or ensure that water for all uses is appropriately treated.

Vector control standard 2: physical, environmental and chemical protection measures

The numbers of disease vectors that pose a risk to people's health and nuisance vectors that pose a risk to people's well-being are kept to an acceptable level.

Key indicators (to be read in conjunction with the guidance notes)

- Displaced populations are settled in locations that minimise their exposure to mosquitoes (see guidance note 1).
- Vector breeding and resting sites are modified where practicable (see guidance notes 2-4).
- Intensive fly control is carried out in high-density settlements when there is a risk or the presence of a diarrhoea epidemic.
- The population density of mosquitoes is kept low enough to avoid the risk of excessive transmission levels and infection (see guidance note 4).
- People infected with malaria are diagnosed early and receive treatment (see guidance note 5).

Guidance notes

1. ***Site selection*** is important in minimising the exposure of the population to the risk of vector-borne disease; this should be one of the key factors when considering possible sites. With regard to malaria control, for example, camps should be located 1-2km upwind from large breeding sites, such as swamps or lakes, whenever an additional clean water source can be provided (see Shelter and settlement standards 1-2 on pages 211-218).

2. ***Environmental and chemical vector control:*** there are a number of basic environmental engineering measures that can be taken to reduce the opportunities for vector breeding. These include the proper disposal of human and animal excreta (see Excreta Disposal section), proper disposal of refuse to control flies and rodents (see Solid Waste Management section), and drainage of standing water to control mosquitoes (see Drainage section). Such priority environmental health measures will have some impact on the population density of some vectors. It may not be possible to have sufficient impact on all the breeding, feeding and resting sites within a settlement or near it, even in the longer term, and localised chemical control measures or individual protection measures may be needed. For example, space spraying may reduce the numbers of adult flies and prevent a diarrhoea epidemic, or may help to minimise the disease burden if employed during an epidemic.

3. ***Designing a response:*** vector control programmes may have no impact on disease if they target the wrong vector, use ineffective methods, or target the right vector in the wrong place or at the wrong time. Control programmes should initially aim to address the following three objectives: 1) to reduce the vector population density; 2) to reduce the human-vector contact; and 3) to reduce the vector breeding sites. Poorly executed programmes can be counter-productive. Detailed study, and often expert advice, are needed and should be sought from national and international health organisations, while local advice should be sought on local disease patterns, breeding sites, seasonal variations in vector numbers and incidence of diseases, etc.

4. ***Environmental mosquito control:*** environmental control aims primarily at eliminating mosquito breeding sites. The three main species of mosquitoes responsible for transmitting disease are *Culex* (filariasis),

Anopheles (malaria and filariasis) and *Aedes* (yellow fever and dengue). *Culex* mosquitoes breed in stagnant water loaded with organic matter such as latrines, *Anopheles* in relatively unpolluted surface water such as puddles, slow-flowing streams and wells, and *Aedes* in water receptacles such as bottles, buckets, tyres, etc. Examples of environmental mosquito control include good drainage, properly functioning VIP latrines, keeping lids on the squatting hole of pit latrines and on water containers, and keeping wells covered and/or treating them with a larvicide (e.g. for areas where dengue fever is endemic).

5. ***Malaria treatment:*** malaria control strategies that aim to reduce the mosquito population density by eliminating breeding sites, reducing the mosquito daily survival rate and restricting the human biting habit should be carried out simultaneously with early diagnosis and treatment with effective anti-malarials. Campaigns to encourage early diagnosis and treatment should be initiated and sustained. In the context of an integrated approach, active case finding by trained outreach workers and treatment with effective anti-malarials is more likely to reduce the malaria burden than passive case finding through centralised health services (see Control of communicable diseases standard 5 on page 281).

Vector control standard 3: chemical control safety

Chemical vector control measures are carried out in a manner that ensures that staff, the people affected by the disaster and the local environment are adequately protected, and avoids creating resistance to the substances used.

Key indicators (to be read in conjunction with the guidance notes)

- Personnel are protected by the provision of training, protective clothing, use of bathing facilities, supervision and a restriction on the number of hours spent handling chemicals.
- The choice, quality, transport and storage of chemicals used for vector control, the application equipment and the disposal of the

substances follow international norms, and can be accounted for at all times (see guidance note 1).

- Communities are informed about the potential risks of the substances used in chemical vector control and about the schedule for application. They are protected during and after the application of poisons or pesticides, according to internationally agreed procedures (see guidance note 1).

Guidance note

1. ***National and international protocols:*** there are clear international protocols and norms, published by WHO, for both the choice and the application of chemicals in vector control, which should be adhered to at all times. Vector control measures should address two principal concerns: efficacy and safety. If national norms with regard to the choice of chemicals fall short of international standards, resulting in little or no impact or endangering health and safety, then the agency should consult and lobby the relevant national authority for permission to adhere to the international standards.

5 Solid Waste Management

If organic solid waste is not disposed of, major risks are incurred of fly and rat breeding (see Vector Control section) and surface water pollution. Uncollected and accumulating solid waste and the debris left after a natural disaster or conflict may also create a depressing and ugly environment, discouraging efforts to improve other aspects of environmental health. Solid waste often blocks drainage channels and leads to environmental health problems associated with stagnant and polluted surface water.

Solid waste management standard 1: collection and disposal

People have an environment that is acceptably uncontaminated by solid waste, including medical waste, and have the means to dispose of their domestic waste conveniently and effectively.

Key indicators (to be read in conjunction with the guidance notes)

- People from the affected population are involved in the design and implementation of the solid waste programme.
- Household waste is put in containers daily for regular collection, burnt or buried in a specified refuse pit.
- All households have access to a refuse container and/or are no more than 100 metres from a communal refuse pit.
- At least one 100-litre refuse container is available per 10 families, where domestic refuse is not buried on-site.

- Refuse is removed from the settlement before it becomes a nuisance or a health risk (see guidance notes 1, 2 and 6).
- Medical wastes are separated and disposed of separately and there is a correctly designed, constructed and operated pit, or incinerator with a deep ash pit, within the boundaries of each health facility (see guidance notes 3 and 6).
- There are no contaminated or dangerous medical wastes (needles, glass, dressings, drugs, etc.) at any time in living areas or public spaces (see guidance note 3).
- There are clearly marked and appropriately fenced refuse pits, bins or specified areas at public places, such as markets and slaughtering areas, with a regular collection system in place (see guidance note 4).
- Final disposal of solid waste is carried out in such a place and in such a way as to avoid creating health and environmental problems for the local and affected populations (see guidance notes 5-6).

Guidance notes

1. ***Burial of waste:*** if waste is to be buried on-site in either household or communal pits, it should be covered at least weekly with a thin layer of soil to prevent it attracting vectors such as flies and rodents and becoming their breeding ground. If children's faeces/nappies are being disposed of they should be covered with earth directly afterwards. Disposal sites should be fenced off to prevent accidents and access by children and animals; care should be taken to prevent any leachate contaminating the ground water.
2. ***Refuse type and quantity:*** refuse in settlements varies widely in composition and quantity, according to the amount and type of economic activity, the staple foods consumed and local practices of recycling and/or waste disposal. The extent to which solid waste has an impact on people's health should be assessed and appropriate action taken if necessary. Recycling of solid waste within the community should be encouraged, provided it presents no significant health risk. Distribution of commodities that produce a large amount of solid waste from packaging or processing on-site should be avoided.

3. ***Medical waste:*** poor management of health-care waste exposes the community, health-care workers and waste handlers to infections, toxic effects and injuries. In a disaster situation the most hazardous types of waste are likely to be infectious sharps and non-sharps (wound dressings, blood-stained cloth and organic matter such as placentas, etc.). The different types of waste should be separated at source. Non-infectious waste (paper, plastic wrappings, food waste, etc.) can be disposed of as solid waste. Contaminated sharps, especially used needles and syringes, should be placed in a safety box directly after use. Safety boxes and other infectious waste can be disposed of on-site by burial, incineration or other safe methods.

4. ***Market waste:*** most market waste can be treated in the same way as domestic refuse. Slaughterhouse waste may need special treatment and special facilities to deal with the liquid wastes produced, and to ensure that slaughtering is carried out in hygienic conditions and in compliance with local laws. Slaughter waste can often be disposed of in a large pit with a hole cover next to the abattoir. Blood, etc. can be run from the abattoir into the pit through a slab-covered channel (reducing fly access to the pit). Water should be made available for cleaning purposes.

5. ***Controlled tipping/sanitary landfill:*** large-scale disposal of waste should be carried out off-site through either controlled tipping or sanitary landfill. This method is dependent upon sufficient space and access to mechanical equipment. Ideally waste that is tipped should be covered with soil at the end of each day to prevent scavenging and vector breeding.

6. ***Staff welfare:*** all solid waste management staff who collect, transport or dispose of waste should be provided with protective clothing, at minimum gloves and ideally overalls, boots and protective masks. Water and soap should be available for hand and face washing. Staff who come into contact with medical waste should be informed of the correct methods of storage, transport and disposal and the risks associated with improper management of the waste.

6 Drainage

Surface water in or near emergency settlements may come from household and water point wastewater, leaking toilets and sewers, rainwater or rising floodwater. The main health risks associated with surface water are contamination of water supplies and the living environment, damage to toilets and dwellings, vector breeding and drowning. Rainwater and rising floodwaters can worsen the drainage situation in a settlement and further increase the risk of contamination. A proper drainage plan, addressing stormwater drainage through site planning and wastewater disposal using small-scale, on-site drainage, should be implemented to reduce potential health risks to the population. This section addresses small-scale drainage problems and activities. Large-scale drainage is generally determined by site selection and development (see Shelter, Settlement and Non-Food Items, chapter 4 on page 203).

Drainage standard 1: drainage works

People have an environment in which the health and other risks posed by water erosion and standing water, including stormwater, floodwater, domestic wastewater and wastewater from medical facilities, are minimised.

Key indicators (to be read in conjunction with the guidance notes)

- Areas around dwellings and water points are kept free of standing wastewater, and stormwater drains are kept clear (see guidance notes 1, 2, 4 and 5).
- Shelters, paths and water and sanitation facilities are not flooded or eroded by water (see guidance notes 2-4).

- Water point drainage is well planned, built and maintained. This includes drainage from washing and bathing areas as well as water collection points (see guidance notes 2 and 4).
- Drainage waters do not pollute existing surface or groundwater sources or cause erosion (see guidance note 5).
- Sufficient numbers of appropriate tools are provided for small drainage works and maintenance where necessary (see guidance note 4).

Guidance notes

1. ***Site selection and planning:*** the most effective way to control drainage problems is in the choice of site and the layout of the settlement (see Shelter and settlement standards 1-4 on pages 211-224).
2. ***Wastewater:*** sullage or domestic wastewater is classified as sewage when mixed with human excreta. Unless the settlement is sited where there is an existing sewerage system, domestic wastewater should not be allowed to mix with human waste. Sewage is difficult and more expensive to treat than domestic wastewater. At water points and washing and bathing areas, the creation of small gardens to utilise wastewater should be encouraged. Special attention needs to be paid to prevent wastewater from washing and bathing areas contaminating water sources.
3. ***Drainage and excreta disposal:*** special care is needed to protect toilets and sewers from flooding in order to avoid structural damage and leakage.
4. ***Promotion:*** it is essential to involve the affected population in providing small-scale drainage works as they often have good knowledge of the natural flow of drainage water and of where channels should be. Also, if they understand the health and physical risks involved and have assisted in the construction of the drainage system, they are more likely to maintain it (see Vector Control section). Technical support and tools may then be needed.
5. ***On-site disposal:*** where possible, and if favourable soil conditions exist, drainage from water points and washing areas should be on-site rather than via open channels, which are difficult to maintain and often clog. Simple and cheap techniques such as soak pits can be used for on-site

disposal of wastewater. Where off-site disposal is the only possibility, channels are preferable to pipes. Channels should be designed both to provide flow velocity for dry-weather sullage and to carry stormwater. Where the slope is more than 5%, engineering techniques must be applied to prevent excessive erosion. Drainage of residuals from any water treatment processes should be carefully controlled so that people cannot use such water and it does not contaminate surface or groundwater sources.

Appendix 1

Water and Sanitation Initial Needs Assessment Checklist

This list of questions is primarily for use to assess needs, identify indigenous resources and describe local conditions. It does not include questions to determine external resources needed in addition to those immediately and locally available.

1 General

- How many people are affected and where are they? Disaggregate the data as far as possible by sex, age, disability etc.
- What are people's likely movements? What are the security factors for the people affected and for potential relief responses?
- What are the current or threatened water- and sanitation-related diseases? What are the extent and expected evolution of problems?
- Who are the key people to consult or contact?
- Who are the vulnerable people in the population and why?
- Is there equal access for all to existing facilities?
- What special security risks exist for women and girls?
- What water and sanitation practices were the population accustomed to before the emergency?

2 Water supply

- What is the current water source and who are the present users?
- How much water is available per person per day?
- What is the daily/weekly frequency of the water supply?
- Is the water available at the source sufficient for short-term and longer-term needs for all groups in the population?

- Are water collection points close enough to where people live? Are they safe?
- Is the current water supply reliable? How long will it last?
- Do people have enough water containers of the appropriate size and type?
- Is the water source contaminated or at risk of contamination (microbiological or chemical/radiological)?
- Is treatment necessary? Is treatment possible? What treatment is necessary?
- Is disinfection necessary, even if the supply is not contaminated?
- Are there alternative sources nearby?
- What traditional beliefs and practices relate to the collection, storage and use of water?
- Are there any obstacles to using available supplies?
- Is it possible to move the population if water sources are inadequate?
- Is it possible to tanker water if water sources are inadequate?
- What are the key hygiene issues related to water supply?
- Do people have the means to use water hygienically?

3 Excreta disposal

- What is the current defecation practice? If it is open defecation, is there a designated area? Is the area secure?
- What are current beliefs and practices, including gender-specific practices, concerning excreta disposal?
- Are there any existing facilities? If so, are they used, are they sufficient and are they operating successfully? Can they be extended or adapted?
- Is the current defecation practice a threat to water supplies (surface or ground water) or living areas?

- Do people wash their hands after defecation and before food preparation and eating? Are soap or other cleansing materials available?
- Are people familiar with the construction and use of toilets?
- What local materials are available for constructing toilets?
- Are people prepared to use pit latrines, defecation fields, trenches, etc.?
- Is there sufficient space for defecation fields, pit latrines, toilets, etc.?
- What is the slope of the terrain?
- What is the level of the groundwater table?
- Are soil conditions suitable for on-site excreta disposal?
- Do current excreta disposal arrangements encourage vectors?
- Are there materials or water available for anal cleansing? How do people normally dispose of these materials?
- How do women manage issues related to menstruation? Are there appropriate materials or facilities available for this?

4 Vector-borne disease

- What are the vector-borne disease risks and how serious are these risks?
- What traditional beliefs and practices relate to vectors and vector-borne disease? Are any of these either useful or harmful?
- If vector-borne disease risks are high, do people at risk have access to individual protection?
- Is it possible to make changes to the local environment (by drainage, scrub clearance, excreta disposal, refuse disposal, etc.) to discourage vector breeding?
- Is it necessary to control vectors by chemical means? What programmes, regulations and resources exist for vector control and the use of chemicals?

- What information and safety precautions need to be provided to households?

5 Solid waste disposal

- Is solid waste a problem?
- How do people dispose of their waste? What type and quantity of solid waste is produced?
- Can solid waste be disposed of on-site, or does it need to be collected and disposed of off-site?
- What is the normal practice of solid waste disposal for the affected population? (compost/refuse pits? collection system? bins?)
- Are there medical facilities and activities producing waste? How is this being disposed of? Who is responsible?

6 Drainage

- Is there a drainage problem (e.g. flooding of dwellings or toilets, vector breeding sites, polluted water contaminating living areas or water supplies)?
- Is the soil prone to waterlogging?
- Do people have the means to protect their dwellings and toilets from local flooding?

Appendix 2

Planning Guidelines for Minimum Water Quantities for Institutions and Other Uses

Health centres and hospitals	5 litres/out-patient 40-60 litres/in-patient/day Additional quantities may be needed for laundry equipment, flushing toilets, etc.
Cholera centres	60 litres/patient/day 15 litres/carer/day
Therapeutic feeding centres	30 litres/in-patient/day 15 litres/carer/day
Schools	3 litres/pupil/day for drinking and hand washing (use for toilets not included: see below)
Mosques	2-5 litres/person/day for washing and drinking
Public toilets	1-2 litres/user/day for hand washing 2-8 litres/cubicle/day for toilet cleaning
All flushing toilets	20-40 litres/user/day for conventional flushing toilets connected to a sewer 3-5 litres/user/day for pour-flush toilets
Anal washing	1-2 litres/person/day
Livestock	20-30 litres/large or medium animal/day 5 litres/small animal/day
Small-scale irrigation	3-6mm/m^2/day, but can vary considerably

Appendix 3

Planning Guidelines for Minimum Numbers of Toilets at Public Places and Institutions in Disaster Situations

Institution	Short term	Long term
Market areas	1 toilet to 50 stalls	1 toilet to 20 stalls
Hospitals/medical centres	1 toilet to 20 beds or 50 out-patients	1 toilet to 10 beds or 20 out-patients
Feeding centres	1 toilet to 50 adults 1 toilet to 20 children	1 toilet to 20 adults 1 toilet to 10 children
Reception/transit centres	1 toilet per 50 people 3:1 female to male	
Schools	1 toilet to 30 girls 1 toilet to 60 boys	1 toilet to 30 girls 1 toilet to 60 boys
Offices		1 toilet to 20 staff

Source: *adapted from Harvey, Baghri and Reed (2002)*

Appendix 4

Water- and Excreta-Related Diseases and Transmission Mechanisms

Water-borne or water-washed	Cholera, shigellosis, diarrhoea, salmonellosis, etc. Typhoid, paratyphoid, etc. Amoebic dysentery, giardiasis Hepatitis A, poliomyelitis, rotavirus diarrhoea	**Faecal-oral bacterial** **Faecal-oral non-bacterial**	Water contamination Poor sanitation Poor personal hygiene Crop contamination
Water-washed or water-scarce	Skin and eye infections Louse-borne typhus and louse-borne relapsing fever		Inadequate water Poor personal hygiene
Excreta-related helminths	Roundworm, hookworm, whipworm, etc.	**Soil-transmitted helminths**	Open defecation Ground contamination
Beef and pork tape worms	Taeniasis	**Man-animal**	Half-cooked meat Ground contamination
Water-based	Schistosomiasis, Guinea worm, clonorchiasis, etc.	**Long stay in infected water**	Water contamination
Water-related insect vectors **Excreta-related insect vectors**	Malaria, dengue, sleeping sickness, filariasis, etc. Diarrhoea and dysentery	**Biting by mosquitoes, flies** **Transmitted by flies and cockroaches**	Bite near water Breed in water Dirty environment

Appendix 5

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Thanks to the Forced Migration Online programme of the Refugee Studies Centre at the University of Oxford, many of these documents have received copyright permission and are posted on a special Sphere link at: http://www.forcedmigration.org

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Notes

Notes

Notes

Life Cycle Considerations for selection of Wastewater Treatment Alternatives

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1. Introduction

Water quality-monitoring studies carried out by various agencies regularly identify that the organic and microbial pollutants are the major contaminants of freshwater bodies in India. Domestic wastewater generated from urban areas of the country is the major contributor of these pollutants as less than 25% is treated before disposal. While efforts are on to improve the quality of water bodies by providing sewerage collection and sewage treatment plants for small towns located on riverbanks.

Urbanization is by for the most important social change that has taken place in India in recent times. From a modest base of 25.8 million in 1901, the urban population has grown to 285 million in 2001, signalling an astonishing eleven-fold increase in one century. More than 60% of this urban growth, however, has occurred within the last three decades. Unregulated urbanisation with inadequate infrastructure for water supply and sanitation has led to an alarming deterioration of environmental quality and worsening quality of life in both rural and urban India. Presently more than 85% of an estimated 16,662 MLD of domestic wastewater generated in the country is being discharged into the environment without any treatment. Consequently, a majority of the surface water sources has been contaminated with organic and microbial pollutants. However, pollution due to industrial discharges are controlled, monitored and regulated by the pollution control authorities. Regulations are made more stringent based on the specific site requirements.

The status and growth of wastewater generation, collection and treatment in towns over the years indicates that the wastewater treatment capacity has not taken pace with the increase in wastewater generation. The main constrain in establishment of sewerage collection and sewage treatment plant is the initial capital cost and operation and maintenance cost for sustaining the treatment. With the implementation of the National River Conservation Programme (NRCP) for major rivers in India, about 70% of the capital cost is financed by the Central Government (Ministry of Environment and Forests) to towns situated on the bank of the river for establishment of sewerage collection of network and sewage treatment plant as subsidy. For successful and sustained operation of sewage treatment, the operation and maintenance cost shall be minimum and bearable by the municipality of the town. Similarly in industrial effluent treatment plant also, the operation and maintenance cost shall be minimum and bearable by the industries.

3. Wastewater Treatment alternatives

In this study, different proven technologies for wastewater treatment were considered. The treatment system includes primary treatment with and without chemical addition for

removal of suspended solids, secondary treatment using aerobic and anaerobic process for reduction of Biochemical oxygen demand (BOD) and tertiary treatment or polishing treatment for reduction of pathogenic organisms in case of domestic sewage. Based on the characteristics of the wastewater and requirement of treated wastewater quality, the different alternatives are to be selected based on the performance. Different possible treatment configurations for wastewater treatment plant are given below in Table 1:

Table 1 Various wastewater treatment alternatives

Alternative – I	Physio-Chemical Treatment (PCT)+ Activated Sludge Process (ASP) + Chlorination
Alternative – II	Physio-Chemical Treatment (PCT)+ Activated Sludge Process (ASP) + Waste Stabilization Pond (WSP)
Alternative – III	Pre-settler (PS)+ Upflow Anaerobic Sludge Blanket (UASB) Reactor + Activated Sludge Process (ASP) + Chlorination
Alternative – IV	Pre-settler (PS)+ Upflow Anaerobic Sludge Blanket (UASB) Reactor + Activated Sludge Process (ASP) + Waste Stabilization Pond (WSP)
Alternative – V	Upflow Anaerobic Sludge Blanket (UASB) Reactor + Waste Stabilization Pond (WSP)
Alternative – VI	Physio-Chemical Treatment (PCT)+ Anaerobic lagoon (AL) + Activated sludge process + Waste Stabilization Pond (WSP)
Alternative – VII	Anaerobic lagoon (AL) + Waste Stabilization Pond (WSP)

4. Life Cycle Consideration factors

The above alternatives were compared considering life cycle impact and other factors like chemical and energy consumption, quantity of sludge generation, emission of green house gases, capital cost (civil construction and mechanical installation), maintenance cost, and land requirement. For the above various treatment alternatives, the weightage for each factor has been given four scales viz., no, low, medium and high impact and the same are shown in Table 2.

5. Selection of Wastewater Treatment Alternative

For selection of wastewater treatment alternative, the appropriate alternatives are to chosen based on the characteristics of the influent wastewater and requirement of quality of the treated wastewater to be disposed. Within the appropriate alternatives, number of no, low, medium and high factors are to counted and the total impact value is to be calculated by assigning values 0, 1, 2, 3 for no, low, medium and high impact factors respectively. The effective alternative is the one with lowest total impact value.

5.1 Sewage treatment Plant

In the case of sewage treatment, the alternatives I, II, V and VII will be able to meet environmental performance requirements. For the four alternatives, total impact value are to calculated based on the life cycle factors given in Table 2.

Table 2 Life Cycle considerations factors on various wastewater treatment alternatives

Life cycle impact and other factors	Wastewater Treatment Alternatives (I to VII)						
	PCT + ASP+ Chlorination (I)	PCT + ASP+ WSP (II)	PS+ UASB +ASP+ Chlorination (III)	PS+ UASB+ ASP + WSP (IV)	UASB + WSP (V)	PCT + AL+ASP+ WSP (VI)	AL + WSP (VII)
Chemical requirement	High	Medium	Medium	No	No	Medium	No
Energy requirement	High	High	Medium	Medium	Low	High	Low
Green house gas emissions	Medium	Medium	Medium	Medium	Low	High	High
Sludge generation	High	High	Medium	Medium	Low	High	Low
Capital cost	Medium	Medium	High	High	Medium	Medium	Low
Land requirement	Low	Medium	Low	Medium	Medium	High	High
Chemical Hazard/ Risk	High	No	High	No	No	No	No

For Alternative I, High -4; Medium -2; Low-1 and No: 0;
Total impact value =4x3 + 2x2+ 1x1 + 1x0 = 17
For Alternative II, High -2; Medium -4; Low-0 and No: 1
Total impact value =2x3 + 4x2+ 0x1 + 1x0 = 14
For Alternative V, High -0; Medium -2; Low-3 and No: 2
Total impact value =0x3 + 2x2+ 3x1 + 2x0 = 7
For Alternative VII, High -2; Medium -0; Low-3 and No: 2
Total impact value =2x3 + 0x2+ 3x1 + 2x0 = 9

Treatment alternative for sewage treatment plant with lowest total impact value 7 (Alternative V) i.e., UASB followed by wastewater stabilization pond is the best alternative considering the life cycle approach.

5.2 Industrial Wastewater Treatment Plant

In the case of tannery wastewater treatment, the alternatives II, IV and VI will be able to meet environmental performance requirements. In industrial wastewater, it is not mandatory to reduce the pathogens by adopting chlorination or waste stabilization ponds and hence both factors need not taken into account while calculating the total impact factor. For the three alternatives, total impact value are to be calculated based on the life cycle factors given in Table 2 without impact due to land requirement and chemical hazard.

For Alternative II, High -2; Medium -3; Low-0 and No: 0
Total impact value =2x3 + 3x2+ 0x0+0x0 = 12
For Alternative IV, High -1; Medium -3; Low-0 and No:1
Total impact value =1x3 + 3x2+ 0x1 +1x0 =9
For Alternative VI, High -3; Medium -2; Low-0 and No: 0
Total impact value =3x3 + 2x2+ 0x1+0x0 = 13

For tannery wastewater treatment plant, treatment alternative with lowest total impact value 9 (Alternative IV) i.e., UASB followed by activated sludge process is the best alternative considering the life cycle approach.

6. Conclusion

In addition to capital cost, wastewater treatment plant consumes energy, materials in the form of chemicals, emits green house gases and generates solid waste in the form of sludge. A simple methodology has been developed for selection of wastewater treatment alternative incorporating life cycle impact and other factors. For two typical wastewater i.e., sewage and tannery wastewater, it has been established that closed anaerobic system is better compared to open anaerobic and aerobic treatment process. This approach for selection of wastewater alternative can be further improved by giving weightage for each factor and also by adding secondary parameters depending upon the site-specific requirements.

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Toward a Strategic Sanitation Approach:

Improving the Sustainability of Urban Sanitation in Developing Countries

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Foreword

Providing poor urban dwellers with adequate sanitation facilities is a challenge of enormous importance—over half a billion people in urban areas have no services, and much larger numbers have services that provide little protection and degrade the environment. The consequences in terms of health and environmental degradation are enormous with the poor, as always, suffering most severely.

The traditional approach to addressing this problem has been one in which planners and engineers assess the needs of the poor, and then decide what type of service will be provided. This supply-driven approach has seldom been successful.

In recent decades many different approaches have been taken to address the problems of sanitation for the poor. Most approaches calling for radically different technologies have failed. There have, however, been some successes such as the Orangi Pilot Project in Karachi, and field experiences with condominial sewers in Brazil. Surprisingly these have, to a large degree, not involved major departures from traditional technologies. They have been radical in terms of relating to people as consumers, and paying greater attention to the importance of process and institutions.

As documented in this book, these successes have the following common elements:

- paying attention to users' preferences and providing users with the services that they want and for which they are willing to pay;
- unbundling sanitation services into discrete parts (such as household services and trunk services) and providing these components in the sequence that the users prefer (typically starting from the household level);
- involving the creative use of both non-formal institutions (such as neighborhood associations and nongovernmental organizations) and formal institutions (such as municipalities and utilities) in co-producing services, with each institution providing that part of the service for which it has a comparative advantage (typically feeder services managed by informal institutions, and trunk infrastructure by formal institutions).

The strategic sanitation approach described in this document draws on the experiences and inspiration of a number of "activist technicians"—individuals whose technical training enables them to deliver services, whose creative minds enable them to make projects work in the real world, and whose human commitment makes them the servants of those they serve. Prominent among these are Arif Hasan from Pakistan, José Carlos de Melo from Brazil, and Albert Wright, author of the innovative approaches in Kumasi, Ghana. This document by Albert Wright is an attempt to draw out some of the lessons from the successful sanitation experiences of these and other pioneers, and to make them understandable and, hopefully, replicable by those of us who follow in their footsteps. I hope that we are up to the task.

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PART 1: PAST APPROACHES AND FUTURE DIRECTIONS

Inadequate Urban Sanitation

During the past several decades, effective strategies have been developed for delivering affordable sanitation services to people living in urban areas in developing countries. In developing countries worldwide, it is becoming increasingly urgent that these strategies be put into practice to close the growing gap between those who have sanitation services and those who do not. The urban poor, the largest group lacking sanitation services, make up more than half the population in many cities of the developing world. The unhealthy conditions of those lacking sanitation cannot be ignored because sanitation-related diseases and polluted water sources often have devastating social, economic, and environmental effects on all urban residents.

The growing gap

Developing country governments and city authorities face a sanitation crisis that is becoming more critical every year. Despite a spotlight on the plight of the urban poor and on provision of clean water for over a decade, both the number and the percentage of people without access to sanitation services continue to increase. In 1990, at the end of the International Drinking Water Supply and Sanitation Decade, 453 million urban people—33 percent of the urban population in developing countries—had no sanitation services. During the next four years investment programs brought new or improved sanitation to 70 million city dwellers, or 48,000 people a day. But in the same four years the urban population in developing countries rose from nearly 1.4 billion to nearly 1.6 billion people. By 1994 the number of unserved people had risen to 589 million, or 37 percent of the urban population (see Box 1).[1]

While overall urban sanitation coverage (63 percent) may appear high and strides have been made in the past two decades, coverage rates are much lower for the urban poor. Inadequate sanitation is one of the key indicators of urban poverty, and overcrowded and unhealthy living conditions of the urban poor in developing countries are made even more degrading and life-threatening by the lack of adequate systems to dispose of human wastes (see Box 2).

Other characteristics of life in areas where the urban poor live—also known as peri-urban areas, informal settlements, squatter areas, slums, and shantytowns—make the provision of sanitation services particularly difficult. In many cases the poor live in neighborhoods without legal tenure on land that authorities have deemed unfit for habitation. Thus peri-urban neighborhoods often remain officially invisible. Their illegal status means that many of the urban poor are excluded from census counts and live with the daily threat of eviction or slum clearance. The urban poor often are not taken into account in municipal programs to improve or extend services such as water, sanitation, garbage collection, roads, flood protection, fire fighting, health care, and education.

Cramped and precariously constructed housing also creates physical problems in infrastructure development. For example, construction of latrines or conventional sewers is much more difficult in the congested narrow streets and alleys of many peri-urban settlements. Often the land is flood-prone or threatened by landslides, adding to the construction risks.

BOX 1 GLOBAL SANITATION COVERAGE 1990-1994

	1990 (POPULATION IN MILLIONS)				1994 (POPULATION IN MILLIONS)			
	Total Pop.	Pop. Served	Pop. Unserved	% Coverage	Total Pop.	Pop. Served	Pop. Unserved	% Coverage
URBAN SANITATION	1389	936	453	67	1594	1005	589	63
RURAL SANITATION	2682	536	2146	20	2789	505	2284	18
TOTAL	**4071**	**1472**	**2599**	**36**	**4383**	**1510**	**2873**	**34**

Source: World Health Organization, Water Supply and Sanitation Collaborative Council, and United Nations Children's Fund, *Water Supply and Sanitation Sector Monitoring Report 1996: Sector Status as of 31 December 1994* (Geneva: World Health Organization, 1996).

Disease and environmental pollution

Living conditions in most peri-urban areas put people's health at much higher risk than people living in middle- and upper-class urban neighborhoods. Coping strategies adopted by poor people excluded from public services can increase the health risks and the spread of disease. More than 50 communicable diseases are associated with poor sanitation, resulting in disease and premature death to millions of people, especially children, every year. With no facilities for disposing of garbage and excreta, and limited access to water for basic hygiene, the urban poor are especially vulnerable to epidemics of water-related and vector-borne diseases.

Death rates in urban slums are substantially higher than in wealthier city suburbs or even among the rural poor. Wherever they have been measured separately, health indicators such as infant mortality and the incidence of diarrhea have been shown to be much worse in crowded tenements and squatter settlements than in other urban areas. For example, statistics from Bangladesh suggest twice as many infant deaths per 1,000 live births in urban slums than in urban areas as a whole.[2]

But the effects of unsanitary conditions in peri-urban areas are not confined to people living in peri-urban neighborhoods. Middle- and high-income residents also have been excluded from public services and have taken matters into their own hands (see Box 3).

Human and domestic waste from any area has the potential to contaminate not just the local environment, but also groundwater, lakes, and rivers used by many others for supplies of freshwater. Thus the sanitary crisis can take its toll on all city residents, and on the national freshwater resources of developing countries.

Pollution of the urban environment is now seen as one of the major obstacles to sustained economic growth. As agricultural and industrial demand for water continues to grow, the progressive degradation of water resources and the inability to treat and recycle water mean that demand is outpacing supply at an accelerating rate. In industrial countries where treatment is routine, river water may well be reused many times on its journey from the source to the ocean. In most developing countries treatment is minimal or nonexistent and polluted wastewater can render rivers unusable once they have passed through the first city.

Most inland cities have some sewer networks, but few have functioning treatment plants. In Latin America, for example, only about 2 percent of collected sewage receives any treatment. In Mexico more than 90 percent of wastewater treatment plants are nonfunctional, and in cities like Bogota, Buenos Aires, Mexico City, and Santiago some 50 to 60 million cubic meters of

BOX 2 MEASURING THE SANITATION TOLL

The impact of inadequate sanitation on health is illustrated by the findings from a study by the Water and Sanitation for Health Project (now the Environmental Health Project) of the U.S. Agency for International Development. Six diseases were examined that are either widespread in developing countries or are serious problems where they exist.

The results showed that each year there are:

- 875 million cases of diarrhea diseases, of which 4.6 million end in death, mostly among children.
- 900 million cases of ascariasis, of which 20,000 end in death.
- 500 million cases per year of trachoma, of which 8 million end in blindness.

In addition, each year there are 800 million cases of hookworm, 200 million cases of schistosomiasis (bilharzia), and 4 million cases of Guinea worm.

Source: Steven A. Esrey, James B. Potash, Leslie Roberts, and Clive Shiff, *Health Benefits from Improvements in Water Supply and Sanitation: Survey and Analysis of the Literature on Selected Diseases.* WASH Technical Report 66. (Arlington, Virginia: Water and Sanitation for Health Project, July 1990).

mostly untreated sewage is discharged every day into nearby bodies of water.[3] Wastewater disposal and sanitation projects for peri-urban populations are often given low priority (see Box 4).

In China, inadequate sewerage and a meager 4.5 percent coverage of municipal wastewater plants have resulted in widespread water quality deterioration. In Jinzhou, Liaoning Province, pollution rendered water from the existing wells undrinkable, necessitating the construction of new well fields at a cost of $18 million.[4] Shanghai had to move its water supply intake 40 kilometers upstream at a cost of US$300 million because of degradation of river water quality around the city.[5] In Mexico City and Amman (Jordan) new water supply sources have been located far from service areas because nearby sources are polluted.

Investment shortfalls

While the costs of sewerage systems and treatment plants are high, not investing in basic sanitation and wastewater treatment can be extremely expensive. Inadequate sanitation can greatly impact industries like tourism and seafood. Along with overfishing, pollution of coastal waters in northern China is thought to be responsible for a sharp drop in prawn and shellfish harvests. Contamination of seafood by sewage has been implicated in a serious outbreak of hepatitis A in Shanghai and in the 1991 outbreak of cholera in Peru. In just ten weeks following this outbreak of cholera, Peru lost US$1 billion from reduced agricultural exports to the United States and from the collapse of tourism. This loss was more than three times what Peru invested in water supply and sanitation during the 1980s.[6]

The challenge is to invest in programs that bring maximum benefits in health, productivity, and sustainability. In Chile the principal justification for an investment in sewerage in Santiago was to reduce the city's extraordinarily high incidence of typhoid fever in the city and to maintain access to the markets of industrial countries for Chile's increasingly important exports of fruits and vegetables. This paid off. By the time cholera arrived in nearby Peru, Santiago had 95 percent coverage with sewerage and was able to avoid the epidemic.

Access to a convenient source of safe water is often one of the top priorities for the urban poor, and demand for improved sanitation often follows soon afterwards, including ways to dispose of wastewater. Willingness to pay for basic

BOX 3 DAMAGING IMPACT OF SELF-SERVICE

Manila (Philippines) and Jakarta (Indonesia) both have populations of about 10 million. Faced with an inadequate supply of public sewers, middle-income households in both cities have been putting in their own septic tanks. Building regulations require that septic tanks have soil adsorption systems, but this regulation is not enforced. Septic tank owners discharge their effluent into inland waterways through storm drainage systems.

About 1 million septic tanks serve about 6 million people in each city. The capital costs of these systems are high: assuming that each tank costs US$100, an estimated US$200 million is invested in these alternatives to public services. The environmental costs are also high. Overflows from septic tanks have polluted the waterways in both cities. In Jakarta, where many industries rely on groundwater supply, there is an increasing risk of groundwater pollution.

While self-provision has addressed private sanitation needs, it has also created costly environmental pollution. Both cities are struggling to find cost-effective solutions to their sanitation problems.

Sources: (Manila) The World Bank, "Manila Second Sewerage Project," Draft Staff Appraisal Report (Washington, DC: The World Bank, February 20, 1996); (Jakarta) Vijay Jagannathan, World Bank, personal communication, 1994.

water and sanitation services is often high in peri-urban neighborhoods, provided that the services are appropriate, effective, and affordable. However, in many developing countries, poorly run urban water utilities have invested in sewerage schemes that do not have any of these characteristics and are unable to operate and maintain services with the inadequate revenues generated.

Lessons from the Past

While past efforts to solve urban sanitation problems have had mixed results, both positive and negative experiences have been used to develop a strategic sanitation approach that is demand-based and incentive-driven.

The supply-driven approach

The most common failing of urban sanitation programs in the past has been failure to take into account the expressed needs of the users (see Box 4). Traditionally, utility planners developed demand projections based on demographic and economic progress indicators. Sector professionals then translated these projections into hypothetical demand for new services and converted this hypothetical demand into project designs based on sewerage and treatment technologies commonly used in industrial cities of Europe and the United States.

Reliance on this supply-driven approach has too often led to investments by governments and donor agencies that suffer from several critical defects:

- The investments are costly both in absolute terms and in relation to the number of people served.
- The main beneficiaries are the richer neighborhoods that can afford the high connection charges, sometimes with the help of subsidies; poorer communities tend to be excluded for both cost and technical reasons.
- The environmental and water resources implications of planned investments are not compared with those of other options, and this can lead to unsustainable projects or projects that are not environmentally sound.
- Investment costs are not recovered, with the result that operations and maintenance, and expansion of services to meet future needs, become impractical.

Central or local management

Institutional approaches have also been dominated by inappropriate models from industrial countries. City water and sewerage utilities in developing countries generally suffer from lack of financial or managerial autonomy, are often overstaffed and underskilled, show unacceptable financial performance, and have little contact with their customers. Budgets are often restricted by central or city governments and agencies may not have the freedom to make use of their own revenues.

Emerging alternatives involve much greater participation of users and other stakeholders in the planning and implementation of water and sanitation projects. For the urban poor, formal or informal partnerships among service providers, nongovernmental organizations (NGOs), community groups, and private sector enterprises offer other ways to develop more realistic and more sustainable programs. The Orangi Pilot Project in Karachi, Pakistan, and experiences with service provision in the *favelas* of Brazil demonstrate the potential for adequately supported communities to introduce, sustain, and expand effective sanitation improvements.

Macro versus micro projects

A major handicap hindering progress in meeting sanitation needs, especially those of the urban poor, has been the scale of projects addressing urban sanitation problems. The high initial cost of such large-scale projects restricts competition for construction contracts to large-scale operators and may inhibit private sector participation.

Costs for connections, sewers, and treatment tend to be bundled together, with cost recovery depending on cost-sharing across many different categories of beneficiaries. The result of bundling together all the elements of sewage collection, treatment, and disposal is that only a small proportion of the investment is used to meet the immediate needs of the unserved. The bulk of the investment is used for trunk sewers or treatment plants that are often underutilized. To recover these costs, charges are high or unsustainable subsidies are sometimes used to stimulate additional requests for connections. The peri-urban poor are often omitted from such schemes since they cannot afford the high charges.

Urban sanitation programs can be "unbundled" so that smaller-scale projects can bring benefits at an affordable cost to those in greatest need. Investments in expensive trunk sewers can then be financed more equitably through general taxation, sometimes in conjunction with user charges. In addition to benefits in expanded coverage, smaller projects tend to open up competition to more contractors and therefore encourage lower prices.

This does not mean that the macro picture should not be considered. On the contrary, the unbundling should take place after an adaptable strategic macro framework has been defined to sketch out the overall direction for sanitation service provision in the project area. It is important that the strategic plan be done within the context of overall development in order to safeguard the sustainability of vital environmental and socioeconomic resources. It is within such an overall flexible sketch of the future that the unbundling should take place, with sequencing and details of investments in different service zones driven by demand.

Poor system performance

An inevitable result of past approaches to project design and investment patterns has been poor sanitation system performance. Central governments have not had the outreach capacity to handle local operations and maintenance of installed systems. Municipal water and sewerage agencies lack the power and the resources to manage systems effectively on their own. Local users, having been excluded from the planning process, have no vested interest in looking after the systems. Thus well-intentioned projects fall into disrepair and disuse. Through neglect of maintenance, blockages, and breakdowns make services unreliable. Customer complaints cannot be properly handled because of lack of resources, so payments are hard to recover. The

BOX 4 WHOSE SCHEME IS IT?

The supply-driven approach of the traditional sanitation agenda means that investments are wasted because intended consumers simply ignore the resulting systems. For example in Accra, Ghana, after 20 years, only 130 connections were made to a sewerage system designed for 2,000 connections; in Howrah, India, no one was connected to a sewerage system built for workers; in Ma'an, Jordan, there have been only 690 connections to a system designed for 6,000 connections; and in Addis Ababa, Ethiopia, after 10 years, only 10 percent of the expected connections have been made to the new sewerage system.

Sources: Vijay Jagannathan, World Bank, personal communication, 1995; and E.K.V. Dovlo, Managing Director, Ghana Water and Sewerage Corporation, personal communication, 1995.

end result is a downward spiral in service quality, cost recovery, and attention to maintenance, which makes many schemes practically worthless only a short time after completion

Unsustainable investments and illusory benefits

In most urban sanitation programs the combination of inappropriate designs, neglect of user requirements, inadequate maintenance, and ill-equipped operating agencies create a continuous drain on government resources and a disincentive to governments and donors contemplating further sector investment. Users become disillusioned when promised improvements fail to materialize. Malfunctioning or inappropriate systems are unlikely to yield optimum results; disenchanted users who revert back to unhygienic practices because improvements are unreliable will not enjoy optimum health benefits; and projects that continue to drain national resources long after completion will not contribute to economic growth.

But there are some urban sanitation improvement programs that have provided dependable services to a satisfied group of beneficiaries and that have proven sustainable and self-financing. Successful programs have generally relied on extensive user involvement in planning, choice of service levels, scale of investments, charges, and cost recovery structures. These experiences show the way to developing a new agenda. Sustained community involvement should begin at the initial planning phase and should continue through implementation, monitoring, and evaluation. Lessons should be fed back into ongoing projects so that corrective changes and adjustments can be made. Women need to be included in all discussions about water, sanitation, and hygiene in order to have an impact at the most important level of all—the household.

The Way Forward

The urgency of the urban sanitation crisis, past failures to respond to the crisis, and the emergence of some successes in the water and sanitation sector have prompted the United Nations Development Programme (UNDP)-World Bank Water and Sanitation Program to consider how to address urban sanitation problems in the future.

Rethinking the approach

The strategic sanitation approach promoted by the Water and Sanitation Program is meant to be flexible and adaptive so it can incorporate lessons from new experiences and innovations in the sanitation sector worldwide. This strategic sanitation approach involves:

- a wider choice of technology options;
- recognition and analysis of consumers' willingness to pay for perceived benefits;
- methods of matching service levels to affordability so as to achieve optimum coverage with economic efficiency;
- innovative financing mechanisms and institutional frameworks, including unbundling of investments into affordable parts; and

• capacity-building initiatives to enable all levels of government and other stakeholders to implement responsive and sustainable programs.

Adoption of strategic sanitation principles has already been seen to deliver results. The examples highlighted in this publication demonstrate that adoption of strategic sanitation principles can generate better projects. As well as enhancing communities' capacities for self-help, the successes achieved have helped build capacity within implementing agencies. Development of skills in participatory approaches equips these agencies to mobilize support in more communities, motivates staff and community members, enhances job satisfaction for agency staff, and helps people to obtain sustainable sanitation services.

Goals of a strategic sanitation approach

The primary goal of a strategic sanitation approach is the sustainable expansion of sanitation coverage. Expansion of coverage has been a major goal of sector investments from the start of the water and sanitation decade in 1981. By adding the word sustainable, strategic sanitation draws immediate attention to a major problem of past approaches—the pursuit of rapid improvements in coverage statistics with little regard for how facilities would be operated and maintained in the long term.

To achieve sustainability, a strategic sanitation approach adds two objectives to sanitation coverage: investment efficiency and operational efficiency. By demonstrating investment efficiency, implementing agencies are more likely to be successful in seeking investments from governments, donors, and private sector financing institutions. To improve investment efficiency, agencies need to transform their procedures to be responsive to customer needs. The starting point is often to recognize that the users of improved sanitation systems are indeed customers. Operational efficiency also requires substantial reform in order to meet targets for cost recovery and produce expected benefits. With operational efficiency, resources can go farther and coverage can be extended.

Underlying principles

Strategic sanitation differs from past approaches in that it is demand-based and incentive-driven. These two key principles reflect experiences in the World Bank and elsewhere that the old supply-driven agenda followed by governments and donors cannot meet the challenges created by rapid urbanization, population growth, industrial development, and concern for the environment. A demand-based approach requires implementing agencies to find out what potential users want and what resources they have to finance and manage installed systems, and to design systems, financing mechanisms, and support structures that are best suited to their needs.

Users may be motivated to select a particular level of service because they are aware of perceived benefits in terms of health, convenience, or environmental improvement; they may also be encouraged through local credit systems, grants, or cross-subsidies. Incentives for operators include a range of rewards and penalties linked to system performance. These may include financial, institutional, or regulatory measures designed to bring success and operator satisfaction and to motivate performance improvements.

Expected benefits

Adoption of demand and incentive principles improves the prospects for enhanced and sustainable coverage, mobilizing previously untapped resources and stimulating productive partnerships among a wide range of stakeholders. By relating project investments to users' expressed needs, implementing agencies can expect better returns. Users who have been involved in making decisions and choosing service levels will contribute their own resources to projects and will pay for reliable services. Subsidies can then be directed at those who need them most, rather than benefiting the rich at the expense of the poor. Greater cost recovery improves the sustainability of the investments and makes it easier to justify further investments for upgrading or expansion.

User involvement also helps foster behavioral changes such as increased hygiene awareness and

BOX 5 THE CASE FOR USER PARTICIPATION

User participation in design, implementation, and management of water and sanitation programs is seen by the World Bank as a way of increasing efficiency, equity, and cost recovery and of facilitating extension of service coverage to poor communities. The Bank's rationale for user participation is summarized as follows:

- User participation makes services and service providers more responsive and accountable to beneficiaries.
- Cost recovery and the sustainability of services improve when technology choices and services correspond with what users want and are willing to pay for.
- Management of services is more effective when institutional arrangements are tailored to local practices.

A Water Supply and Sanitation Collaborative Council Working Group on Services for the Urban Poor highlights other positive aspects, including:

- Creation of new citizens organizations may lead to further independent self-help projects.
- Involvement of nongovernmental organizations can be an effective way of reaching and providing credit to the urban poor.
- Intermediaries can establish links between local stakeholders and water utilities or municipalities, whose function is to manage projects and secure user consensus.

Sources: Gabrielle Watson and Vijay Jagannathan, "Participation in the Water and Sanitation Sector," *Environment Department Dissemination Notes*, Number 15 (Washington DC: The World Bank, June 1995); Water Supply and Sanitation Collaborative Council Working Group on Urbanization "Citizen's Participation," Working Document No. 2 (Geneva: Water Supply and Sanitation Collaborative Council, March 1993).

better sanitation practices that lead to greater health benefits. Local environmental, social, and economic benefits are more likely to result when the intended beneficiaries use the facilities responsibly and ensure that they are properly maintained (see Box 5).

Applicability to rural areas

Do these strategic sanitation principles, developed by analyzing experience with urban sanitation, also apply to rural areas? The answer is a qualified yes. Differences may arise in the application of the approach to rural areas, but in the details rather than the principles themselves. For example, in small villages, the use of sophisticated techniques such as contingent valuation methods for ascertaining demand may not be necessary. The use of other techniques such as focus groups might be used instead. Potential beneficiaries of improved sanitation should still be given an opportunity to decide whether to participate in an improved sanitation project, and they should be offered a range of feasible technologies with price tags so that they can express their preferences and their willingness to pay.

PART 2: TOWARD A STRATEGIC SANITATION APPROACH

A strategic sanitation approach provides a package of measures that help implementors and funders of urban sanitation programs get the best results from their investments. Such an approach provides guidelines on how to assess the true demand for services—what people want and are willing to pay for. It also stresses the importance of incentives to motivate and direct consumers, service providers, and regulators to act in ways that lead to more effective and efficient investments. Adoption of a demand-based, incentive-driven approach changes the design of finance, technology, and institutional arrangements for sustainable urban sanitation programs.

Goals: Sustainability and Efficiency

The main goal of a strategic sanitation approach is the sustainable expansion of sanitation coverage. The prerequisites for attaining this goal are investment efficiency and operational efficiency. Investment efficiency is a powerful argument for gaining funding support, while operational efficiency helps ensure that available resources are used to expand coverage as widely as possible.

The strategic measures for achieving investment efficiency are:

- Unbundling sanitation investments such as property connections, feeder sewers, trunk sewers, and treatment.
- Utilizing a demand orientation based on what users want and the resources they are willing to use to finance and manage installed systems.
- Designing and installing facilities so that they function according to the designs and cost-sharing arrangements agreed upon with users.

The strategic measures for achieving operational efficiency are:

- Helping to ensure that the installed facilities are used as they were intended so that beneficiaries gain optimum health and other benefits. This may require awareness raising and hygiene education to modify behaviors and to encourage proper usage.
- Providing for long-term and effective management of the facilities. This includes ensuring that sufficient resources will be available to cover operations and maintenance during the active life of the physical infrastructure.

The driving force for the strategic measures is the incentive structure defined through the institutional arrangements and the overall enabling environment. When all these measures are in place then benefits should match expectations and the expansion of coverage is most likely to be sustainable. In other words, sanitation projects should have the expected health, social, environmental, and economic impacts both for the community and for the public good. Even with optimum cost recovery, benefits should continue to be felt, justifying the cost of sanitation investments and ensuring that they have positive impacts for users and for the environment in which they live.

Distinctive Features

The two key principles of a strategic sanitation approach are that it is demand-based and incentive-driven. In operational terms, the demand-based approach requires stakeholder participation, and the incentive-driven approach requires rules, referees, and rewards.

Stakeholder participation

A demand-based approach is responsive rather than prescriptive. In successful urban sanitation programs, the users and the service agency have

BOX 6 NEW ROLES FOR WOMEN AND FOR MEN

Considerable work has been done during the last ten years on gender issues in water and sanitation. Guidelines from the Promotion of the Role of Women in Water and Sanitation Services (PROWWESS), the United Nations International Research and Training Institute for the Advancement of Women (INSTRAW), and others emphasize that full benefits only accrue when women have more influential roles in management committees, financial arrangements, and maintenance of installed facilities, and men are encouraged to become more involved in activities such as hygiene education and sanitation. A key point here is that extending women's influence should not also increase their burden. Project contributions in time, labor, and money need to be shared fairly and not expected just of women.

Because it is the potential scope of women's involvement and influence that has been neglected in the past, programs need to concentrate on ways of stimulating and facilitating greater participation by women in decisionmaking, planning, and management. At the same time, the appropriate roles of men need to be taken into account.

Source: Water Supply and Sanitation Collaborative Council, *People and Water: Partners for Life, Meeting Report,* Third Global Forum, Barbados: 30 October - 3 November 1995 (Geneva: Water Supply and Sanitation Collaborative Council, March 1996).

common goals, developed through a consultative process involving all stakeholders. Stakeholders may include local, regional, or national government, public utilities, private service providers, NGOs, local community associations, industrialists, special interest groups, and users of different types of sanitation services. The challenge for governments and donor agencies is to motivate and build the capacity of the different stakeholders to participate in appropriate and productive ways.

For example, peri-urban residents know the problems of inadequate sanitation since they live with them daily, but they may need intermediaries to work with municipal authorities in order to develop trust in other stakeholders and to overcome the fear that formal recognition will lead to sanctions or other institutional interference. With clear guidance on technological options, and freedom to make arrangements for payments and local management of facilities, residents are usually able to help develop affordable and effective solutions.

Women, in particular, need to be involved. They are the principal users and managers of household water and sanitation services. Their nearly universal responsibility for family health and hygiene makes women critical change agents, but only if they are fully involved in the decisionmaking process. If women are excluded, or involved only indirectly, programs are usually not sustainable and the installed facilities will not be used or maintained in the intended way. Thus gender considerations need to be thought through carefully (see Box 6).

There is growing field experience with successful projects emerging from such participatory approaches. The Orangi Pilot Project in Pakistan (see Box 7) was an early example. The history of the *favelas* of São Paulo, Brazil, also provides evidence that there is a strong intrinsic demand for water and sanitation services among the poor and that with the right financing and institutional arrangements, sustainable services can be provided at affordable costs. The World Bank has provided funding for a growing number of other relevant case studies from countries in Africa, Asia, and Latin America.

Incentives and the three Rs

The second underlying principle of the strategic approach is that incentives can stimulate the

behaviors required from key actors—including users, suppliers, service providers, and government staff—to achieve sustainable expansion of sanitation coverage. Incentives work because they shape the reasons why individuals behave the way they do. Behavior is driven by a perception that the benefits obtained from an action exceed the costs of the resources required to perform it or that the risk of suffering from the behavior is negligible compared to the benefits, so the risk is worth taking.

Incentives can involve the promise of financial rewards or the threat of penalties. They can also involve delivery of new information to change people's perceptions about the benefits of investing in sanitation improvements or about the costs and benefits of breaking rules and regulations. In some instances, they may include opportunities for an individual or community to gain distinction, prestige, or power.

By putting together an incentives package that helps ensure investment and operational efficiency, governments or municipal agencies create an enabling environment for the primary goal: sustainability. The tools used to do this are the three Rs:

- *Rules* governing the interactions within and between enterprises;
- *Referees* who monitor and enforce compliance with the rules; and
- *Reward* and sanctions systems for rewarding compliance and penalizing infringement of the rules.

All three are part of the institutional framework. The challenge of developing a suitable framework for managing investments in urban sanitation improvements is to make sure that each of the three Rs is adequately reflected in the institutional framework and that the combined effect of all three is consistent with the goals of strategic sanitation. Through the three Rs, incentives need to be developed to encourage:

- participation of users at all stages;
- involvement of all stakeholders in appropriate ways;
- competition and private sector participation;
- optimum cost recovery through a sense of ownership;
- management at the lowest appropriate level; and
- transparency and accountability.

Demand-based eligibility criteria for communities include rules that create incentives to participate in government-sponsored projects, as do required commitments by governments, users, communities, and regulations governing the formation of non-formal institutions and access of private and public service providers to sanitation markets. Removing barriers to participation by small private sector enterprises increases competition and creates a financial incentive to reduce complacency and the lack of responsiveness often found with monopolies. This also lowers costs.

Favorable risk-sharing arrangements between government and private enterprises may be seen as a helpful incentive to keeping down costs, but need to be accompanied by appropriate sanctions to maintain the accountability of suppliers to users. Regular reporting of achievements, perhaps accompanied by annual awards or other types of rewards, should not be underestimated as an incentive. The achievement indicators need to be carefully chosen, to avoid the pursuit of coverage at the expense of sustainability.

Lessons of Perverse Incentives

Since the right three Rs package with its incentives depends on local conditions and culture, strategic sanitation does not try to produce a blueprint for universal use. Institutional arrangements, career structures, eligibility criteria, and management approaches should be checked individually and as a whole to ensure that they foster sustainability and economic and operational efficiency. Some guidance may be found in past failures, many of which can be attributed to behaviors driven by perverse incentives.

Incentives are said to be perverse when they are incompatible with the goals of an enterprise or program, and they include misdirected subsidies, unrealistic coverage targets, career struc-

tures based on high-technology designs, credit restrictions on the poor, and bureaucratic and institutional barriers to stakeholder participation. They cease to be perverse once they are corrected, as the following examples show.

- *Misdirected subsidies:* Well-intentioned subsidized tariffs, meant to make it easier for low-income groups to obtain access to improved services, often end up favoring higher-income people who are better equipped to take advantage of them. *Corrective action:* If subsidies are considered necessary, they should be closely targeted, demand-based, and temporary. There will sometimes be a role for subsidies in sanitation programs, for example, if one community's improved services would yield secondary benefits to other communities or contribute to wider goals of health or environmental improvements.
- *Free riders:* Individuals who benefit from public or shared facilities may avoid contributing their fair share to the costs of those facilities, especially when it is difficult or costly to prevent non-payers from gaining access. *Corrective action:* User fees may be charged to the beneficiaries of trunk sewers or treatment plants. If individuals cannot be denied the service when their neighborhood sewers are connected, other sanctions are needed for non-payment. Where sanctions are impractical or costly, the upkeep of common services may be better financed through general taxation than user fees.
- *Shirking*: Similar in its effect to free riding, shirking occurs when some individuals do not contribute their fair share of effort or resources. The result is underinvestment, or, in the case of operations and maintenance activities, a threat to sustainability. *Corrective action:* The shirking problem may be curtailed by creating small work teams and an element of competition. Regular monitoring can encourage careful record keeping and penalties in the form of fines that are assessed at public meetings.
- *Bureaucratic inflexibility:* Public monopolies often have little incentive to improve performance. The result can be poor economic efficiency and lack of responsiveness to consumer needs. *Corrective action:* By applying commercial principles, broadening competition, and involving the formal or informal private sector, governments have the opportunity to reduce costs, improve productivity and generate a demand-driven expansion of service capacity. However, the business approach needs to be tempered with accountability, regulation, and regular reassessment of service quality and price.

Operational Implications

In using strategic sanitation as an approach for urban sanitation investments, central and municipal governments need to review the way that they work with urban communities in five areas:

- providing technical support;
- widening technological options;
- assessing sanitation demand;
- unbundling sanitation investments; and
- financing and cost recovery.

Providing technical support

To participate fully in a demand-oriented community-based approach, communities need information, guidance, organizational support, and capacity building. Communities need a clear explanation of the scope of proposed programs, the eligibility criteria, the technical options, the achievable benefits, the financial implications, and the maintenance commitments expected from sanitation system users. Technical support to communities should include organization of community meetings to discuss sanitation problems, allowing residents to reach their own conclusions about the importance of those problems, what they want to do about them, and how the proposed project can help them.

Support agencies also need to explain the range of technology options and the implications of each option in terms of what benefits users will get from each option, the financial and organizational costs, and how their decisions may affect wider environmental improvements on a district- or city-wide basis. Criteria for support must be clear, as must the conditions and period

BOX 7 PAKISTAN: ORANGI'S PEOPLE POWER

The Orangi Pilot Project (OPP) in Pakistan has become a famous example of people empowerment. With the help of an innovative community organizer, Akhtar Hameed Khan, the OPP has built up local organizations able to plan and finance their own latrines and house drains and also to bring pressure on the Karachi municipality to provide funds for secondary and primary sewers.

Initially, the project focused on developing low-cost solutions to the people's strongly expressed wish to rid their environment of excreta and wastewater. Aided by committed OPP architects and engineers, and by providing their own labor, the communities installed in-house sanitary latrines, house drains, and shallow sewers in the lanes and streets at an average cost of about US$25 per household. Householders contribute their share of the costs, participate in construction, and elect a "lane manager" to represent about 20 to 30 households.

The OPP has led to the provision of sewerage for over 90 percent of the households in Orangi, the largest squatter settlement (900,000 people) in Karachi. It has also and demonstrated how people's demands for improvements grow incrementally as the benefits of each step are realized.

Source: Arif Hasan, *Working with Government: The story of OPP's collaboration with state agencies for replicating its Low Cost Sanitation Programme.* (Karachi: City Press:, 1997). Copies available from the UNDP-World Bank Water and Sanitation Program, Regional Water and Sanitation Group-South Asia (RWSG-SA), Pakistan Office (P.O. Box No. 1025, Islamabad, Pakistan), or RWSG-SA Regional Office (c/o The World Bank, P.O. Box 416, New Delhi 10003, India).

of any incentives or subsidies. Then it is up to the community, using its own decisionmaking processes, to decide whether to participate and how.

A key message to be communicated to the community at this stage is that incremental improvement is often the most reasonable and realistic option. A choice of a latrine or septic tank is not necessarily a permanent decision. For example, while individual connections into a neighborhood sewer system may not be affordable to community members initially, residents may be interested in and willing to pay for this option in the future.

The importance of understanding operations and maintenance needs is illustrated by the problems experienced by the acclaimed low-cost sanitation project in the Baldia settlement near Karachi. Residents found that the open drains provided to dispose of sullage water were also a convenient outlet for the contents of the vaults of their pour-flush latrines. By discharging these foul wastes into the open drains, households saved on emptying costs, but created an odoriferous public health nuisance—a high cost to pay.

Once communities understand the options available and the upkeep commitments expected from them, the support team will normally need to help build the capacity for users to look after the installed facilities. This may include helping with the organizational arrangements for local management committees, training local artisans in latrine construction and basic plumbing, sensitizing health workers to the operational needs of household sanitation systems and the behavioral changes needed to obtain optimum health benefits, and providing guidance on financial management to ensure accountability and transparency.

In many cases, government agencies may not be equipped to provide the type of support communities need throughout this process. Experience is needed in community development, low-cost technologies, innovative financing, and participatory approaches. Those skills are more likely to be found in intermediaries such as NGOs or specialist consultants. Many NGOs are

used to working in a participatory way. They can play a useful role in bringing together agency staff, private sector representatives, funding institutions, and community members in focus groups and other community-based fora. The potential of NGOs as supporters of community action has been well demonstrated in the Orangi Pilot Project (see Box 7). The Dominican Institute of Integral Development's neighborhood improvement program in La Zurza, Santo Domingo is another example of the pivotal role of NGOs (see Box 8).

There is a growing and welcome trend for governments and donors to collaborate with NGOs on peri-urban improvement programs and to be willing to adjust their own procedures to accommodate a partnership approach. The World Bank increasingly views NGOs as effective intermediaries on projects that depend on participation and capacity building at the community level. The intermediary functions include:

- facilitating communication between project beneficiaries and government;
- helping to identify and voice community needs;
- supporting participation and group formation;
- training and building the capacity of community groups; and
- helping to channel resources to the community level.

Box 9 lists criteria that can be used to help determine whether a particular NGO is likely to be a suitable intermediary for governments and donors seeking to implement sanitation programs.

Widening technological options

It was once thought that if lower-cost alternatives to conventional sewerage could be found, the problems of sanitation would be solved. One of the lessons from the last two decades is that a lower-cost technology by itself is not sufficient for sustainable investments in sanitation services. There are examples of successful sanitation projects involving high-cost technologies like conventional sewerage, intermediate-cost technologies such as simplified sewerage, and low-cost technologies such as ventilated improved pit (VIP) and pour-flush latrines. There are also unsuccessful sanitation projects covering the same range of technologies.

Strategic sanitation's emphasis on demand requires consideration not only of lower-cost technologies, but also a wider choice of technological options across the full cost range than was generally the case in the past. A wide range of technologies is already available. The World Bank, bilateral agencies, national governments in industrial and developing countries, and research organizations have done considerable work on innovative technologies, leading to options spanning a broad cost range and with recognized merits and disadvantages depending on local conditions. The comparative cost implications of the three levels of sanitation infrastructure (in-house, feeder, and trunk) and the levels at which demand needs to be assessed and investment decisions taken are shown in Box 10.

Within these categories are some innovative technologies, like the condominial system of small, shallow neighborhood sewers that are being replicated on a large scale in Brazil, and the solids-free sewerage systems used in a number of developing countries, and in countries such as Australia and the United States to reduce sewer diameters, gradients, and consequent costs.

Low-cost options include on-site systems such as VIP latrines, pour-flush latrines, and septic tanks. Communal latrines reduce the land area required and can be sighted where geology is most favorable. Pay-per-use communal latrines do operate successfully in some places, though they generally require a subsidy and can present maintenance problems unless responsibilities are clearly defined. In addition to being comparatively inexpensive in capital and running costs, these technologies are well-suited to community management. Latrines remain a popular option where land is available and there is no risk of contaminating groundwater.

However, the congested nature of many peri-urban settlements restricts the space available for pits and soakaways. Geological condi-

BOX 8 DOMINICAN REPUBLIC: NGO DRIVES LA ZURZA IMPROVEMENTS

La Zurza (population 50,000) is a low-income settlement built along the river banks of Santo Domingo, the capital of the Dominican Republic. As in many other low-income neighborhoods, its residents suffer from poor water quality, lack of sanitation, and inadequate food supplies. In addition, a ravine in La Zurza is used as the dumping ground for chemical wastes by 54 industries.

The residents have migrated into the city from all over the Dominican Republic, presenting a real challenge in terms of collective action and community organization. That challenge has been taken up by the Dominican Institute of Integral Development (IDDI), the largest NGO working in urban development in the country. With IDDI's help, the La Zurza residents created their own organization for integrated development of the neighborhood, SODIZUR. A democratically elected non-profit organization, SODIZUR has become a channel for support to self-help activities. It undertakes training and institution building and manages revolving funds on behalf of income-generating micro-enterprises.

IDDI and SODIZUR have mobilized and supported La Zurza residents in a three-stage program to improve their basic services and infrastructure. Based on the residents' own priorities, the program began by consolidating the physical environment, stabilizing slopes, improving pedestrian walkways and storm sewers, and cleaning the ravines. The second stage was physical improvements, including water supply, drainage, waste disposal, housing, and latrines. In the current third stage, new sanitary services are being provided, including communal latrines, showers, clothes washing facilities and public taps.

SODIZUR is coordinating sewer construction and the government has agreed to increase the number of hook-ups for water services and to improve garbage collection. The joint activities of IDDI and SODIZUR have led to the first serious attempt in the Dominican Republic to control and treat industrial wastes. Pressure from the La Zurza collective has resulted in the government agreeing to build a large-scale waste treatment plant near the neighborhood. Industrialists will be forced by a new law to treat their wastes before discharging them into the rivers, under threat of closure for non-compliance.

Alongside the construction program, SODIZUR has its own health program built around the efforts of 86 health promoters from the community. Its objectives include improving environmental sanitation conditions and preventive health care which includes education on personal hygiene.

Source: David Scott Luther, "IDDI: Integral Urban Development in the Dominican Republic," *Voices from the City*, (Arlington, Virginia: Environmental Health Project March 1993).

BOX 9 NGOS AS INTERMEDIARIES

Partnerships involving NGOs, governments, and donors depend on several preconditions. NGOs are often called upon to help implement participatory approaches. Indicators that a particular NGO meets this precondition include:

- a flat management structure with decentralized authority;
- organizational structures at the community level for decisionmaking;
- use of iterative planning, involving consultations with local communities;
- contributions of cash, labor, raw materials, or local facilities by community members and organizations, making them clients rather than beneficiaries of the NGO;
- staff recruitment criteria, incentives, and training that support participation;
- strong field presence outside metropolitan areas with a high proportion of staff of local origin;
- positive perceptions of the NGO by community leaders and members; and
- turnover of client groups as they "graduate" over time and intensive field attention is turned to new groups.

In some cases the qualities that make NGOs suitable as intermediaries are incompatible with government and/or donor requirements. In the Zambia Squatter Upgrading Project, for example, it was agreed in principle to pursue long-term community development goals by promoting active beneficiary participation. However, a stipulation was included that if the collective self-help approach to be used by the two intermediary NGOs interfered with the predetermined project schedule, then contractors would be employed to carry out the work.

Unless procedures are made more flexible and both the government and its donors are committed to supporting participatory processes, the NGO is pressed into a service delivery rather than a capacity-building role. Project priorities need to be changed to provide greater flexibility in the timing and scale of implementation and alternative procurement procedures which allow NGOs to design and implement their own programs.

Source: Thomas Carroll, Mary Schmidt, and Tony Bebbington, "Participation and Intermediary NGOs," The World Bank, *Environment Department Dissemination Notes*, Number 22 (Washington, DC: The World Bank, June 1995).

tions such as rocky ground, steep slopes, too much clay, or a high water table, may also mean that on-site household systems are inappropriate. In some cases, it may be possible to organize an effective system of latrine emptying and waste disposal (see Box 11). However latrine emptying technologies are generally not appropriate for peri-urban areas and the handling and transport of fresh excreta can be a public health hazard.

In crowded low-income areas, conventional sewer construction is difficult and costly. Few peri-urban communities can afford it, and there are many examples of well-intentioned sewer schemes that have proven ineffective. Alternative, intermediate cost sewers are increasingly seen as the most appropriate choice for carrying away the effluent from household systems such as pour-flush toilets or septic tanks.

Innovative technologies include the condominial systems (see Box 12) that have proven highly successful in northeast Brazil and are being replicated on a large scale. Other innovative options include simplified sewerage in which modified design parameters allow the use of

	In-house Infrastructure	Feeder Infrastructure	Trunk Infrastructure
Examples	In-house plumbing Pour-flush toilets Septic tank systems House sewers	Public sanitation facilities Street sewers (lateral or feeder sewers) Single neighborhood treatment plants	Trunk sewers Interceptor sewers Multi-neighborhood sewage treatment plants
Ownership	Households	Public or neighborhood	Public
Beneficiaries	Households	Households served or connected Neighborhood served	Neighborhood served or connected Local government, city, or municipality
Trans-action costs	Low	Medium	High
Economies of scale	Low	Medium	High
Relative level of sunk costs	Low	Medium	High
Level for demand assessment	Household, independently	Neighborhood, collectively	City-wide, by local government
Level for investment decisions	Household, independently	Neighborhood, collectively; or local government	Local government

BOX 11 KENYA: LATRINE EMPTYING IN NAIROBI

The Kenyan Water for Health Organization (KWAHO) helped poor residents in a Nairobi informal settlement to establish a latrine emptying service for which they were willing to pay in advance.

Kibera is Nairobi's largest peri-urban settlement, with a population of 400,000 located on 110 hectares of high-density rental housing. With KWAHO's help, residents built ventilated improved pit (VIP) latrines and needed a way to dispose of the resulting waste. The Norwegian Agency for Development Cooperation (NORAD) provided support for a special suction truck able to maneuver its way through the narrow streets and empty the pit latrines regularly. A 13-member community management team oversees the operation. During the first half of 1991, more than 6,000 households paid the US$9 advance fee to have their home latrines emptied.

Source: David Kinley, "KWAHO's Urban Challenge." *Source*, (New York: United Nations Development Programme, July 1992).

smaller, shallower pipes, and buried boxes to replace manholes, as well as solids-free sewerage in which an interceptor tank, designed like a septic tank, discharges only liquid waste into pipes that can therefore be small and use shallow gradients. Regular upkeep of these systems is as critical as for low-cost options. Simplified sewer systems do become blocked and need periodic clearing out; solids-free sewerage involves regular emptying of the interceptor tanks.

Assessing sanitation demand

A demand-based approach to planning is responsive rather than prescriptive. Stakeholders must be drawn into all stages of the decisionmaking process, starting with the assessment of sanitation demand. Instead of governments or service utilities deciding which peri-urban communities should be provided with what type and level of service, the decision is made jointly. The initiative may come from the communities, the utilities, or the government; but, as a rule, the decisions on investment choices are best reached through consultations and negotiations among all interested beneficiaries. Even where the investment costs are entirely borne by a private entity or by users, local government consent is imperative to ensure that vital public interests are safeguarded by ensuring that adequate downstream structures are installed to avoid environmental pollution.

The desired end result of the participatory planning phase is that all stakeholders agree on a package of investments that they are convinced will be sustainable. The Kumasi Sanitation Project (see Box 13) and many other programs have shown that users are willing to make significant contributions to programs that they have helped to design and that meet their needs.

In one scenario, implementing agencies set demand-based eligibility criteria. For example, communities may be required to contribute to project costs and to finance or manage operations and maintenance. Other need-based criteria such as health and poverty indicators or distance to water sources may be used to prioritize regions, but only for communities that have indicated a willingness to meet the demand-based criteria. Incentives may also be used to stimulate demand in less enthusiastic communities if there is a wider public interest in improving sanitation services.

To gain fully from the participatory process, all participants have to understand the implications of the options open to them. The implementing agency should be the one responsible for making clear what technology options are feasible, at what costs, the financing packages that may be appropriate, and the kinds of institutional arrangements needed to manage the different options. The first step is to identify which tech-

BOX 12 CONDOMINIAL SEWERAGE

Developed by the Brazilian engineer José Carlos de Melo, the condominial system saves on both household and trunk sewer costs. It replaces the conventional house connections into deep main sewers with shallow feeder sewers running through the backyards of neighborhoods.Because the feeder sewers are shallow and there is only one main sewer connection per block, the main sewers can also be much more shallow, saving on time and costs.

In northeast Brazil, families are being offered choices to continue their present system (usually a holding tank discharging into an open street drain) or to connect to the conventional waterborne sewerage system, or to connect to the condominial system. Charges for the conventional system are about three times those for the condominial system. The business-as-usual option tends to become unworkable as more and more residents join the condominial system, because once connected, the residents fill in their sections of the open drain and the outlet for holding tank waste is no longer available.

A big attraction of the system is that it has a self-motivating element in terms of system operations and maintenance. If one household drain blocks, neighbors quickly bring it to the attention of the user and the blockage is quickly cleared. In fact, actions such as putting solid waste down the toilets become much less frequent as users get used to the system. The formal sewerage agency remains responsible for looking after the trunk sewers, but in northeast Brazil, where the condominial system is being widely replicated, users are well able to look after the plot systems. That brings the agencies' operational costs down substantially.

Source: The World Bank, *World Development Report 1992: Development and the Environment* (New York: Oxford University Press, 1992).

nologies are technically feasible and what each feasible option would cost. Fortified with details of each possible technology package, the implementing agency needs to guide and motivate target communities through participatory consultations. The question of how the costs may be shared is also critical. Circumstances often vary widely across a project area and judgments on the affordability of the project depend on how much intended beneficiaries are thought to be willing to pay for various potential levels of service.

Well-designed willingness-to-pay (WTP) surveys in representative communities can help answer these questions, although they do require considerable expertise. People are asked to compare and put values on services of which they may have little or no experience; views may vary widely between and within areas of cities. Researchers have to be sure that they are obtaining realistic responses rather than optimistic aspirations. Care is needed in sampling and in extrapolating the results to the city beyond the communities surveyed. As experience with WTP surveys grows in sanitation and other sectors, it is becoming more clear that a range of methods can be used to produce dependable results. For small homogeneous communities, a formal WTP survey may not be needed. Other community consultation methods such as focus groups, key informant interviews, and participatory evaluations may be used to obtain this type of information more economically.

From the WTP data, stakeholders can develop an overall sanitation plan covering household services, neighborhood services (feeder sewers), and city-wide services (trunk sewers). Within that plan, proposals for individual communities can be based on cost options for discussion with

intended users. The next part of the process is to enable the users to determine for themselves which options they want to see implemented, accepting the financial and institutional implications of that choice. It is not enough to discuss investment options with local civic leaders. All members of the community need to have input into the discussions.

Unbundling sanitation investments

One major constraint hindering expansion of conventional sewerage services is the "lumpiness" of the necessary investments—property connections, feeder sewers, trunk sewers, and treatment. Big projects incorporating all elements of the process also restrict competition to large-scale operators and may inhibit private sector participation. Unbundling is a way of dividing investments into more realistic and more manageable components. A balance is needed between achieving economies of scale and benefiting from increased competition, but the evidence is that unbundling can lead to progress on different elements of a city-wide sanitation program that would likely have been stalled if financed and implemented as a single package.

There are two forms of unbundling: horizontal and vertical. In horizontal unbundling, services are subdivided geographically. A large city may be divided into two or more zones, each with its own self-contained sanitation services. Unbundled systems may also be linked, for example, at a treatment works or long outfall. Decentralized sewerage is an example of horizontal unbundling that is particularly appropriate in areas with flat terrain and high groundwater tables. Dividing such areas into self-contained zones eliminates the need for expensive pumping stations and interceptor sewers required to serve the whole area with a conventional sewerage system.

An example of horizontal unbundling occurs in the Philippines. In the course of privatizing water supply and sewerage services for the capital city of Manila, the metropolitan area has recently been horizontally unbundled into two parts for the supply of both water and sewerage services. The bid documents stipulated that bidders were free to submit bids for both service zones; however, only one of the two service areas would be awarded to any one bidder. Accordingly, the concessions have been awarded to two different companies. In another World Bank-financed sanitation project in the Philippines, it has been stipulated that the sewerage systems should be horizontally unbundled in order to reduce the number of pumping stations and pumping costs (see Box 19).

In other sectors, the principal benefit of unbundling is creating more competition in a free market. In the sanitation sector, there is another big advantage of horizontal unbundling: division into zones reduces the average diameters and average depths of sewers when compared with a single centralized system. As these are the two major cost elements (along with the length of sewers), it follows that horizontal unbundling is likely to be sound economically wherever it is technically feasible. The example of sanitation districts in Los Angeles County in the United States demonstrates both horizontal and vertical unbundling (see Box 14).

In vertical unbundling, programs are divided according to the scale and cost of the components. Vertical unbundling has been used successfully in other types of infrastructure such as electricity supply and telecommunications. In the sanitation sector, a good example is the condominial sewerage schemes in Brazil (see Box 12). Items such as trunk sewers, which have high sunk costs, are financed separately from lower-cost neighborhood feeder sewers. The division may apply both to the design and construction phase and to the operations and maintenance of the systems. There may be further subdividing to permit community-managed schemes to connect into publicly or privately operated sewerage systems. This type of unbundling can add considerable flexibility to the methods of financing urban sanitation, and make connection affordable for poor communities through an equitable form of cross-

BOX 13 GHANA: STRATEGIC SANITATION IN ACTION

Since 1991, the Kumasi Sanitation Project in Ghana has applied a strategic sanitation approach to develop a flexible strategy for urban sanitation in a city of 770,000 people in which 75 percent lack adequate sanitation services. With assistance from the regional UNDP-World Bank Water and Sanitation Program office in Abidjan, the Kumasi Metropolitan Assembly has adopted a demand-oriented approach that differs from previous agency-led initiatives by:

- tailoring recommendations on technical options to each type of housing in the city;
- considering user preferences and willingness to pay;
- using a relatively short planning horizon (10-15 years), emphasizing actions that can be taken now; and
- breaking the overall plan into projects that can be implemented separately but incrementally providing total coverage.

The starting point was a pioneering survey on willingness to pay for improved sanitation services. The survey showed that most Kumasi households were willing to pay more for improved services, but that potential revenues were not large. Massive subsidies would be needed for conventional sewerage, but relatively large coverage could be achieved with modest subsidies by installing KVIPs (Kumasi Ventilated Improved Pit latrines). The survey also revealed that the poorest people, who used public latrines, were paying more for sanitation than those with household systems. They were willing to pay even more to have improved home sanitation.

The resulting US$28 million sanitation plan (1991-2000) includes US$15 million for home latrines (10 percent financed by users), US$9 million for sewers in tenement areas (no user finance), US$3 million each for school and public facilities, and US$1 million for support to the Waste Management Department. Unit costs are US$31 per capita in the lower density housing area (population 470,000) and US$53 per capita in the tenement housing area (population 170,000). Public latrines are to be under private sector management franchises.

Source: Dale Whittington, Donald T. Lauria, Albert M. Wright, Kyeongae Choe, Jeffrey A. Hughes, and Venkateswarlu Swarna, *Household Demand for Improved Sanitation Services: A Case Study of Kumasi, Ghana,* UNDP-World Bank Water and Sanitation Program (Washington, DC: The World Bank, May 1992).

subsidy. Residents of low-income peri-urban communities need not share in the costs of a trunk sewer system when their immediate priority is the privacy, convenience, and amenity value of household sanitation.

In strategic sanitation, vertical unbundling is particularly useful in reaching the urban poor with affordable sanitation services in an incremental way. By separating decisions on in-house improvements from those on neighborhood feeder systems and on city-wide trunk systems, unbundling allows a clear link to be made between immediate benefits and costs. Investment can be made one step at a time, starting with the home. Three vertical technology levels exist in an urban sanitation project (see Box 15).

Financing and cost recovery

User charges are at the core of strategic sanitation finance. That does not necessarily mean that user charges provide the bulk of the financing. It means that users are encouraged to contribute according to their willingness and ability to pay for the services that they have chosen as best meeting their needs.

In contrast, past approaches to urban sanitation improvements have usually been based on city-wide, donor-financed megaprojects that

attempt to address all the problems at once with little recognition of true priorities or user demands. In such projects the assumption that users do not have the means to pay for the full costs has generally gone untested and widespread subsidies have been provided in order to get projects off the ground. The result has been unsustainable programs achieving only minimal increases in coverage. When users were charged, expected levels of user payment were often based on rules of thumb, for example, that households could afford to pay up to 5 percent of their income for water and sanitation services combined. Experience and research have shown that such rules of thumb are unreliable and do not provide a sound basis for estimating revenues or residual financial requirements.

The demand-driven approach of strategic sanitation provides a way to think through how the costs of sanitation can best be shared. It also provides reliable information on the value that users place on sanitation improvements and on their willingness to pay for those benefits. This information generally shows that individual households place a relatively high value on sanitation services that provide them with a private, convenient, and odor-free facility that removes excreta and wastewater from the property or confines it conveniently within the property. Because of this, many peri-urban residents are willing to pay to cover the costs of on-site systems or a combination of private sanitary facilities and connection to a sewer close to the dwelling. There is also frequently sufficient value attached to removing the waste from blocks and neighborhoods for groups to justify organizing collective payments for these improvements or even for treatment to render the wastes innocuous. Similar reasoning applies at the city and water basin level.

This way of thinking about cost recovery leads to a model for financing sanitation improvements.

- Households pay the bulk of the costs incurred in providing on-site facilities such as bathrooms, toilets, septic tanks, and on-site sewer connections.
- Residents of a block collectively pay the additional cost incurred in collecting the wastes from individual houses and transporting these to the boundary of the block.
- Residents of a neighborhood collectively pay the additional cost incurred in collecting the wastes from blocks and transporting these to the boundary of the neighborhood (or in treating the neighborhood wastes).
- Residents of a city collectively pay the additional cost incurred in collecting the wastes from blocks and neighborhoods and transporting these to the boundary of the city (or in treating the city wastes).
- The stakeholders in a river basin or groundwater source—cities, farmers, industries, and environmentalists—collectively assess the value of different levels of water quality they wish to pay for, and agree on the assignment of financial responsibility for treatment and water quality management costs.

These financing principles are now being closely followed and selectively implemented in a number of countries. Most frequently, the financing challenge is to identify appropriate cost-sharing arrangements for strategic sanitation plans for some neighborhoods in a city. Examples of such investment programs for service provision and for broader river basin management of water quality are in place in Brazil, Ghana, Pakistan, the Ruhr River Basin in Germany, and in all major river basins in France.

Direct user payments. Are users willing to pay for sanitation improvements? Experience and research give a qualified yes to this question. The major qualification is that user willingness to pay extends to those benefits that users perceive and are able to internalize. User willingness to pay may not be sufficient to pay the full costs of systems, including trunk sewers and treatment. In these cases, complementary finance will be required to ensure the sustainability of services.

In urban areas where users have played a significant role in the determination of costs through their own choice of levels of service—

BOX 14 UNITED STATES: UNBUNDLING

The Sanitation Districts of Los Angeles County (SDLAC) is an alliance of 27 special districts under one administration. The basis of the special districts is the county Sanitation Districts Act of 1923, which provides that geographic drainage areas, rather than political boundaries, should be the determining factor delineating sanitation districts. A sanitation district may include single or multiple municipalities and unincorporated areas, or combinations of both. The sewer service area of the SDLAC is about 770 square miles (1970 sq. km) and encompasses 79 cities and unincorporated areas. It has a population of five million and wastewater flows ranging from 0.1 mgd (million gallons per day) to 365 mgd.

Community-level sewer systems (laterals) are the responsibility of individual communities that may take care of the systems themselves or enter into a contract with the LAC Department of Public Works. There are 11 satellite sewage treatment facilities treating sewage from some of the communities. The treated wastes are used for such things as irrigation of highway landscaping and golf courses.

Most of the effluent flows to a sewer network that has about 1,000 miles (1,600 km) of trunk sewers and 48 pumping stations. Wastes are treated in a joint wastewater treatment plant and five water reclamation plants. This is an example of vertical unbundling. In the same area, horizontal unbundling also takes place. Two separate agencies operate trunk sewer systems. The City of Los Angeles takes care of wastes from communities within the city boundaries; the SDLAC looks after the area outside the city and a number of smaller communities surrounding the city.

Source: Office of Information Services, Sanitation Districts of Los Angeles, "Joint Outfall Systems, Master Facilities Plan," Volume 1, Issue 1, March 1994.

such as the Orangi project in Pakistan, the Kumasi project in Ghana, and the PROSANEAR project in Brazil—user willingness to pay has generally been sufficient to cover the costs through direct payments and complementary payments through block and neighborhood groups. These experiences point to one major conclusion regarding user payment: user willingness to pay should be tested before considering cross-subsidies from other user groups or external provision of funds.

Is it necessary that all direct user payments be in cash? The answer is a qualified no. The qualification is necessary because in-kind payments need to meet two additional conditions to be as good as cash. First, the provision of in-kind services must be voluntary to count as a valid indicator of willingness to pay. In practice it is sometimes difficult to determine whether or not this condition is met. Second, the provision of in-kind services must tangibly reduce the real financial cost of providing the service. The value to be assigned to in-kind contributions is the cost-reduction achieved. There are numerous examples of the willingness of users to provide in-kind services during construction of facilities and their subsequent operation. The willingness tends to be greater during the construction phase and becomes more difficult to sustain in the operations phase.

Is household borrowing to finance user payments acceptable? Yes, and in fact the most effective systems for ensuring appropriate user payments for sanitation improvements have been those that insist on front-end payments for construction and access to the service. Availability of

BOX 15 VERTICAL TECHNOLOGY LEVELS

• In-house infrastructure involves household level systems such as latrines, toilets, septic tanks, and house drains. The facilities are located at the point where the waste is generated and the benefit is to the individual householder. There are many separate installations scattered throughout the community. In comparison with other levels of investment, in-house systems have the lowest sunk costs. Householders' value judgments are straightforward, because benefits are direct. Market forces apply and there is great scope for privatization of service provision, with competition bringing cost savings. In some peri-urban settlements, lack of secure property rights may be an important issue inhibiting individuals from making investments.

• Feeder infrastructure relates to the neighborhood sewers or collection systems shared among occupants of a street or block of houses. The users have common interests in ensuring that the systems function properly. Decisionmaking and payment for feeder systems needs to be shared among the beneficiaries. Sometimes this may come about through a local agency responding to collective demands from groups of users. Incentives may be relevant as a means of stimulating demand, particularly if there is a need to spread the costs of trunk sewerage at a later date. Economies of scale begin to emerge, but sewer systems have higher costs than household sanitation. Market forces and private sector involvement help to keep down costs. Peer pressure encourages reluctant neighbors.

• Trunk infrastructure includes mains sewerage and treatment works serving an entire city or region. The large scale of the operation means high costs and appropriate economies of scale, but savings can be offset by restricted competition. Trunk systems are remote from users, who may not readily appreciate the benefits. Accordingly, user charges may not be the best way to recover investments. Decisions generally need to be made at the city government level, and operations and maintenance may be best funded through general city taxation. Privatization or other forms of private sector involvement are possible, with a need for regulatory safeguards.

credit to spread the front-end costs over time contributes to the willingness to pay for improvements or to seek access to existing improved systems. Though it relates principally to rural water supply, the Grameen Bank in Bangladesh is an example of such a system working to everyone's advantage (see Box 16).

One very successful example in the sanitation sector is the credit system in Lesotho's low-cost urban sanitation scheme (see Box 17). That system is based on treating a VIP latrine as a consumer item to be purchased through commercial credit. It is operated by the parastatal Lesotho Bank, which borrowers recognize as an efficient commercial institution. Poor repayment rates on other credit schemes were attributed to borrowers recognizing the government's inefficiency in pursuing defaulters.

Unfortunately, borrowing does not work well in all cases. Credit is not available at a reasonable cost to many of the people who need it most. Where credit is available, repayment experience may be sufficiently poor that the capital base of the lending organization becomes depleted and needs periodic replenishment. The risk premium may be so high that the cost of the funds outweighs the advantage of borrowing.

Collective payments from block and neighborhood groups. Either traditional, non-formal kinship groups or non-governmental civic organizations may be effective in providing

BOX 16 BANGLADESH: GRAMEEN BANK'S CREDIT FOR THE POOR

The Grameen Bank is well known as a provider of credit to more than 2 million poor and landless people in Bangladesh. A large proportion of the clients are women. The bank's great innovation has been to find an alternative to traditional forms of collatoral. The key principle is that if any borrower defaults, the group to which that borrower belongs is no longer considered creditworthy and is no longer eligible for loans.

In recent years, the lending of the Grameen Bank for rural water supplies has risen dramatically. Since early 1992. The bank has provided loans for about 70,000 tubewells. In 1993, it lent about US$16 million. The interest rate charged on loans for tubewells is 20 percent, repayable over two years in weekly installments. The handpumps are procured locally by the borrowers, either from the Public Health Engineering Department or from local private manufacturers.

Source: UNICEF data as cited in: Ismail Serageldin, *Water Supply, Sanitation, and Environmental Sustainability: The Financing Challenge.* Directions in Development. (Washington, DC: The World Bank, 1994).

communal services and organizing collective payments. Some institutional researchers point to difficulties in exercising group decisionmaking and in interpreting group decisions. For example, how representative are the decisions of group consensus, and how strong is the commitment of individual members of the group to the group's decisions?

In the Orangi case, neighborhood groups helped provide finance for neighborhood collection systems. They also became strong enough to encourage additional government financing for trunk sewers to supplement the neighborhood systems. In both Orangi and PROSANEAR, the groups were able to persuade more individual residents to sign on to the less costly neighborhood schemes, and to keep them clean, than the existing sanitation organizations had been able to do. Neighborhood groups were also instrumental in convincing the technical staff of these organizations that cheaper systems could work well, at costs that households were willing to pay.

Collective payments from local and national governments. Directly or indirectly, the government participates in the financing of sanitation services in virtually all countries. Governments supplement user payments for sanitation through direct and indirect financial support to users and through allocations of funds for investments and operations. They mobilize financial resources for this support predominantly through taxes and by controlling credit allocations from financial institutions, internal and external borrowing, and external grant sources.

On average during the last half of the 1980s, governments allocated finances amounting to about half of one percent of GDP to the water and sanitation sector in developing countries, with less than half this amount going to finance sanitation.[7] Whether this aggregate amount is the correct one will not be addressed here. What will be discussed are the rules under which government finances are utilized, how they are allocated, and their impact on achievement of sector objectives and sector performance.

The financial premise of the strategic sanitation approach is to base financial requirements on what is worthwhile to finance, rather than assuming that if something can be financed, it is worthwhile. Government finance has been extensively used in the past as a substitute for user charges and has benefited those who already have access to services, rather than compensating service providers for the external benefits of extending services to users who are not willing or

BOX 17 LESOTHO: CREDIT FOR VIP'S

The low-cost urban sanitation program in Lesotho has achieved a remarkable degree of sustainability by recovering all the costs of VIP latrine construction from users. It does so by promoting the latrines as valuable consumer items and by providing commercial loans through the parastatal Lesotho Bank.

Loans are arranged by the project team, which also helps users to find a qualified builder. Normal interest rates apply and loans are repaid in 20 installments over 24 months, leaving out December and January, when Christmas expenses and school fees often deplete household budgets.

Source: Isabel C. Blackett, *Low-Cost Urban Sanitation in Lesotho*. UNDP-World Bank Water and Sanitation Program, Discussion Paper Series, Number 10, (Washington, DC:The World Bank 1994).

able to pay the full cost. One outcome of this policy has been a continuing reluctance to extend service coverage to the poor. Somewhat paradoxically, this policy has also resulted in relatively little expansion of treatment facilities to protect water sources and insufficient maintenance of existing facilities for those with connections.

In most countries, more financial support has come from central government than from local government. This may be partly justified if central government tax collection is more efficient and if central government can mobilize greater external financial resources. On the other hand, when urban areas with waterborne sewerage systems do not pay the costs of the trunk networks that remove the liquid waste from the immediate urban environment, this benefit is being paid for by others who do not generally benefit from it. Local urban governments generally do not object to this arrangement because, if they are lucky enough or powerful enough to get these facilities paid for by others, they do not have to raise their own direct taxes, such as property taxes. This contributes to the inefficiency in sanitation finance, since such local direct taxes would more efficiently link payment to benefits received.

A further irony of this arrangement is that urban governments (since they do not generally repay the central government for the assets provided) consider any income from users in excess of operations and maintenance expenditures as net revenue, even though sanitation charges do not come close to full cost recovery. Since this net revenue is often a discretionary fund for local government, it can be used to finance shortfalls in other local expenditures rather than being reinvested in the improvement of sanitation services.

Adopting a Strategic Sanitation Approach

Two sets of actions are required in adopting strategic sanitation: formulation of a demand-based policy, and development of an institutional framework to provide the incentive structure to induce the key players in the sector to implement the policy. The sectoral and project-level institutional framework should be in place before attempting to implement the demand-based approach. It should be adaptable and able to respond to new developments and lessons from experience. See Box 18 on the adaptive approach being used in the PROSANEAR project.

Formulating a demand-based policy

National and municipal governments and service utilities work within agreed-upon budgets. They need rolling programs and priority criteria to forecast investment needs and to assign funds. Some elements of the demand-based approach may appear to inhibit accurate planning: if investment is to be demand-driven, how can agencies know in advance where and to what extent investments should occur? The answer is that dynamic financial planning modeling (for

BOX 18 BRAZIL: APPLYING PLANNING INNOVATIONS IN PROSANEAR

The Water and Sanitation Program for Low-Income Urban Populations (PROSANEAR) project in Brazil is investing US$100 million to provide water and sanitation infrastructure to about 800,000 people in low-income areas in eleven cities in different regions.

Participation should be tailored to the population. The PROSANEAR project has taken a variety of approaches to involve beneficiaries in the design of subprojects. In one approach, leaders of community organizations are consulted on basic choices, and the details are then worked out with actual beneficiaries. In another approach, agreement is reached between design engineers and beneficiaries directly, in consultation with community leaders and organizations. In both approaches, conflicts of interest between the water company and community-based organizations are resolved through negotiation, with the project design consultant as facilitator. Preliminary data indicate that these two approaches have dramatically lowered per capita investment costs and increased the sense of project ownership among communities.

Engineers need to adapt. In PROSANEAR, the participatory process has directly affected the kind of engineering advice used. For example, water companies were required to award project design consultancies to a consortium of engineering firms or firms working with nongovernmental organizations that specialize in community participation. The supervision team at the national level encouraged project design consultants and water company engineers to discuss plans with beneficiaries before agreeing on final proposals.

Donors need to adjust their practices. The Brazilian project was approved by the World Bank without blueprints of targeted service levels or delivery systems. Instead, the appraisal reports provided broad principles for project execution and indicative targets for benefits and costs, leaving much of the design to be developed during implementation. The external donor must provide intensive supervision to work out details of the subprojects as chosen by the communities and to monitor and evaluate implementation. Experience so far shows that these learning-intensive, participatory projects can reduce capital costs, although they also entail increased investment of staff time from the donor.

Adapted from: The World Bank, *World Development Report 1994: Infrastructure for Development*, (New York: Oxford University Press, 1994).

local government demand), consumer demand studies (for demand at the household and neighborhood levels), and eligibility criteria linked to the strategic use of incentives not only overcome this apparent problem but in fact lead to more dependable forecasting of resource needs.

Willingness-to-pay consumer surveys provide planners with the type of demand-based data needed to assess likely user choices without prescribing solutions for individual communities. When the sample includes households from all income levels, planners can extrapolate with confidence. From the aggregated data, analysts can predict the take-up rate for different options accurately enough for preliminary budgeting and procurement planning, while still allowing individual communities to make their own decisions later. This helps planners to rule out inappropriate investment options and help avoid waster investments in expensive sewer networks for which cost recovery cannot be achieved.

The take-up rate for household systems, feeder networks, and trunk sewers is also a useful basis for unbundling proposed investments into affordable packages and for developing alternative financing methods for different services.

Though need-based criteria such as health and poverty indicators, water scarcity, and environmental degradation may still guide planners to selections of regions to be served first, the simultaneous occurrence of both user and local government demands in the same geographical area should be the main criterion for determining investment priorities within cities. Demand-based criteria may include commitments to pay a high proportion of costs, to undertake maintenance commitments, and to institute self-help hygiene improvement programs. This criteria helps planners to avoid risky investments and to forecast cost recovery and support needs.

Institutional frameworks

The key functions of agencies in the sanitation sector are policy formulation, regulation, investment, operations and maintenance of sanitation facilities, and the commercial activity of supplying customers with desired sanitation services. Traditionally, these functions have been carried out in many developing countries in a supply-driven way with a high degree of centralized control, little local accountability, and little involvement of consumers. The consequence has been failure to cope with the growing problems of urban sanitation.

Until recently, capacity building and improvements in administrative procedures were considered the most important elements needed to boost institutional performance. Experiences at the World Bank and elsewhere suggest that such efforts may have little or no long-term effects on performance, unless they are accompanied by changes in the internal and external incentives and constraints that staff face. People need to be motivated to use their improved skills and improved administrative procedures.

A demand-driven approach requires new types of institutional arrangements. Roles and responsibilities need to be shared differently among the many stakeholders and with different regulatory and enforcement needs. The goal of the institutional framework in strategic sanitation is to create incentives that are compatible with the goals of investment and operational efficiencies. Incentives are needed for participation of users at all stages, for transparency and accountability, for management at the lowest appropriate level, for use of a step-by-step approach, and for competition and private sector participation. When institutional goals and incentives are well matched, individuals make decisions that produce outcomes that are both personally and institutionally rewarding, generating net benefits for all.

Minimizing transactions costs. In developing an appropriate institutional framework, one of the prime considerations has to be transactions costs, the operating costs of the institutions. Transactions costs are unavoidable; the aim is to keep them as low as possible consistent with operational goals. They include coordination costs, strategic costs, and information search costs.

Coordination costs arise from the time and effort used to negotiate, monitor, and enforce

BOX 19 PHILIPPINES: DESIGNING PROJECTS FOR STRATEGIC SANITATION

Project planners have built strategic sanitation features into the design of the Water Development District Project (WDDP) in the Philippines:

Demand orientation. The WDDP is designed to be demand-driven by consumers and by local and national government. Local government demand has been used to make final decisions about which cities to include in the project. The selection of communities and service areas within cities is based on local demand. The only exception is that connection to the sewer system is mandatory in the central business district.

Demand assessment. Household demand is assessed through use of the contingent valuation method and user consultations in neighborhoods. Local government demand was expressed through voting and resolutions by local government assemblies. The voting followed a number of presentations by project staff to the assemblies and to local government officials. Four of the six cities for which pre-appraisals were conducted decided to participate in the project.

Financing. The capital works in the project are to be financed from a loan from the World Bank. These funds will be channeled through a local financial intermediary, the Land Bank of the Philippines. Operations and maintenance costs will be financed by local water companies. These companies will enter into a concession arrangement for operations and maintenance of the installed systems.

Cost recovery and financial sustainability. The project is designed for full cost recovery of both the capital and operations and maintenance costs. Capital costs will be recovered partly from projected city revenues from local taxes and partly from an annual allocation of funds (IRA) from the central government to local governments. Operations and maintenance costs are to be recovered through a sewer tariff that is to be integrated with the water tariff.

Rules. The project is guided by a national policy and strategy that states that investments in sanitation should be demand driven. Sewer systems are horizontally unbundled whenever feasible to reduce the number of pumping stations needed and to reduce pumping costs. Decentralized treatment systems are to be used to prevent environmental pollution.

Referees. A national level agency, the National Economic Development Agency serves as the referree to ensure compliance with demand by local governments. The Land Bank of the Philippines is the referee for debt repayment of capital costs. Within cities, the Local Water Utilities Administration, through its Central Program Support Office for Sewerage and Sanitation is responsible for helping cities follow the demand-based aproach in selecting neighborhoods and service areas for inclusion in city projects. The local water companies are empowered to enforce payment of sewer charges.

Rewards and sanctions. The Land Bank of the Philippines has the power to intercept the flow of IRAs to local governments that default in their debt servicing. Payments of the sewer tariff will not be separated from the water bill. This is intended to empower local water companies to cut off the supply of water to customers who default in paying the integrated water and sewer bills.

Source: The World Bank, "Staff Appraisal Report. Republic of the Philippines: Water Districts Development Project," Report No. 16526-PH, The World Bank, East Asia and Pacific Region, Urban Development Unit, Washington, DC, July 29, 1997.

contractual agreements among various partners. Coordination costs also include time and other resources spent in gathering information about local conditions, aggregating willingness-to-pay data, holding community meetings, publicizing the project, and seeking user feedback.

Strategic costs arise from the opportunistic behavior of individuals when refereeing is expensive and verification costs high. Free-rider and shirking problems are included in this category, as are problems that arise when stakeholder interests differ. For example in the Ghana Community Water and Sanitation Project financed by the World Bank, participating communities are to be given new equipment by central authorities on the condition that it will not be replaced if it has not been maintained. Since higher-level authorities are unlikely to have full information about local maintenance efforts, local leaders have little incentive to maintain their equipment. Strategic cost problems tend to lead to under-investment and faster rates of deterioration of sanitation infrastructure and so contribute to unsustainable facilities. They are more likely to occur with centralized institutional arrangements; decentralized arrangements with accountability to local authorities and consumers can help to reduce strategic costs.

Information search costs arise from the need to collect, aggregate, and analyze dispersed information on user preferences and technical aspects of the project, and to make this information available to relevant stakeholders. Monitoring and evaluation costs are also included in this category.

In seeking to keep transactions costs down, it is important to realize that trade-offs exist among the different forms of transactions costs. The more information that parties to a transaction have about one another, the lower the strategic and coordination costs. For example, in communities with good social networking, shirking and free-rider problems tend to be less common. Coordination costs are also likely to be low because members get to know and trust one another. Conversely, savings in information search costs may lead to higher coordination and strategic costs. Inadequate coordination also creates incentives for strategic behavior and can lead to increased strategic costs.

Sector-and project-level frameworks. The sector-level institutional and legislative framework provides the ground rules for all sanitation investments. It should define the roles of local governments and higher tier governments, beneficiaries, non-formal institutions, government utilities, private sector enterprises, NGOs, and external support agencies, taking care to include women's groups and women beneficiaries. The framework should address the implications of a demand-based approach for resource allocation, technology choice, and choice of financing arrangements.

This sector-level framework needs to be consistent with financing and cost recovery policies, which includes sources of finance for capital works—users, private sources, government, and external support agencies. It should also involve sources of finance for operations and maintenance of physical infrastructure. The framework needs to set out policies on fiscal equivalence, poverty alleviation, and local decisionmaking. Policies on the use of cash and in-kind contributions should be defined. In accordance with the policies on accountability and fiscal equivalence, the institutional framework should give users the authority to question investment choices and to examine financial statements of the provision and production entities.

Low-cost provisions are needed for monitoring compliance with sector rules and for rewarding compliance and penalizing those who violate the rules. The final step in the design for the institutional framework is a check to find out if the resulting incentive structure is consistent with the goals of investment and operational efficiency and to make necessary corrections if it is not.

Project-specific institutional frameworks are also needed to enable service providers to adapt the ground rules to local circumstances. The project-specific institutional framework should define

specific project goals and set policy on how boundaries of service areas are to be fixed. It should also define a mechanism for resolving disputes. At the project level, planners and designers need criteria for determining benefits, service areas, and technologies. The range of possible benefits includes coverage, health, economic productivity, and safeguarding environmental amenities. The project framework should specify in advance policies on technology choice, service zone selection, and cost recovery. Provision should be made for the application of graduated sanctions against free-riders and other breaches of the rules.

Strategies for institutional design

The challenge in developing an institutional framework for the sanitation sector is to achieve investment and operational efficiency with low transaction costs. The World Bank's 1994 World Development Report identified three strategies for addressing this challenge:

- applying commercial principles;
- broadening competition; and
- involving non-formal institutions.[8]

Applying commercial principles. The basis of this strategy is that sanitation is an industry producing services to meet the demands of users and should therefore be operated with a business orientation.

Performance objectives should be limited, well-focused, and defined to include quantitative targets such as coverage, capacity expansion, profitability, and productivity, and qualitative targets such as improvements in the management of information and internal control systems. A high degree of managerial autonomy with hard budget constraints should be maintained and an incentive system should ensure clear accountability to customers and the providers of capital. Sound financial and accounting systems should provide managers with clear objectives. Commercial principles call for good customer relations, demand-driven investment choices and tariff structures, and tariffs designed to cover at least the costs of operations and maintenance. They also call for effective cost accounting and attention to staffing problems, particularly overstaffing.

One way of introducing commercial practices in public sanitation utilities is through performance agreements. A key element is a built-in incentive system that relates to the duration of the agreement. Experience in Korea and Mexico shows that short duration agreements—a year, for example—to be more effective because they allow for more frequent assessments. Under performance agreements, manager and worker performance is evaluated and ranked using such criteria as service quality, productivity, and administrative and financial efficiency.

Other key elements of such agreements are increased managerial autonomy and rewards for the manager and workers when agreed-upon targets are achieved. Rewards may include publication of performance-based ranking of managers and enterprises; monetary rewards and prizes for the best managers and the best enterprises; or annual bonuses and career prospects for managers linked to the ranking of their companies. Some agreements in India and Mexico have included bonuses of up to 35 percent of total wages.

Another mechanism for creating commercial operations is through corporatization or giving the enterprise the same independent legal status as a private firm. Corporatization insulates utilities from government constraints and pressures while allowing the government to continue to set basic goals. This is best done through explicit contracts.

Broadening competition. Competition is a powerful instrument for promoting investment and operational efficiency, providing users with options in service and suppliers, and improving the accountability of service suppliers to users. Competition may be enhanced by creating equal access to production activities by a number of public and private enterprises as well as private voluntary bodies. This should be supported by equal access to an independent arbitration or

dispute resolution service. A number of instruments can also serve as competition surrogates. An example is transparency brought about through open decisionmaking processes, or by giving special interest and user groups the opportunity to voice their preferences and hold provision and production units accountable for the quality of their services. Decentralization and local decisionmaking are effective instruments for improving transparency and accountability. More explicit ways of introducing competition in the sanitation sector include service contracts, management contracts, lease contracts, and concessions.

Service contracts transfer to private enterprises the responsibility for delivering specific services for a period of a few years. They may also be used to obtain specific skills lacking in a local authority or a public utility, such as engineering skills needed to develop a new sanitation project for public or private funding. Contracts should be awarded through competitive tendering. They may also be awarded by auctioning off the service to the company that offers to deliver the desired service at the lowest price to consumers. In this case, the auctions may be repeated at short intervals to ensure that consumers obtain the best possible terms. The local authority or public provider sets performance criteria, evaluates bidders, supervises contractors, and pays fees that may be lump sum, unit costs, or based on some other contractual basis.

Service contracts offer a versatile means of carrying out many tasks. They have been used for meter reading and fee collection in the water supply and sewerage sectors in Chile since the 1970s. The Santiago public water company even encourages employees to leave their jobs to become independent and compete for service contracts. Service contracts may also be used for operations and maintenance of parts of a sanitation system, such as a neighborhood feeder sewer systems or a decentralized sewage treatment plant. When they are used for maintenance, consideration should be given to creating service contracts of sufficient duration and scope to justify acquisition and capitalization of special equipment by the contractor.

Management contracts transfer the responsibility for a broad range of operations and maintenance to private contractors. Management contracts may be used for operation of an entire sanitation system or for major parts of it. Multiple suppliers may compete for contracts that may be renewed every one to three years. This can be a useful interim arrangement pending preparation of more comprehensive contracts for leasing or concessions while reform of the regulatory framework for the sector is underway.

In some cases, contractors receive a set fee for services rendered. If contractors cannot control key functions like staffing, procurement, and working capital, they should not be held fully accountable for overall results. Alternatively, when compensation is linked to performance, contractors take commercial risks and should be given autonomy in day-to-day management decisions. Management contracts work better when compensation involves incentive payments for such factors as increased connections and effluent quality.

In a *lease contract,* the government or a local authority develops and installs the physical facilities required to produce services and a private contractor pays for the exclusive right to operate them and generate a flow of services over an extended period of time. This right is sometimes called a franchise or a license. The contractor is generally awarded the lease for a period of six to ten years, and bears most of the commercial risks, but not the financial risk associated with large investments in physical plants. A successful small-scale example can be found in Kumasi, Ghana. Public toilet facilities in Kumasi belong to the Kumasi Metropolitan Assembly (KMA) but are leased to private operators who pay the KMA an agreed-upon monthly fee.

Concessions incorporate all the elements of leases, plus the contractor also assumes responsibility for capital investment. The contract is between the private contractor and a public authority; the public authority delegates its

authority to the successful contractor; and the contractor provides the service at its own risk and is paid by users. The assets revert to the public authority at the end of the concession period, which may be as long as 30 years. Three possible solutions may be considered at the end of the concession: extension of the contract, rebidding, or takeover by the public authority.

Concessions involve four parties: the concessionaire, the public authority, users, and a regulator to balance the interests of the other three parties. The system works well when consumers are willing to pay required tariffs, where there is commitment to protect the interest of the concessionaire, and where there is sufficient regulatory capacity. A national institutional capacity is required to design the appropriate incentive structure, prepare and implement bidding and re-bidding processes, and to monitor the concessionaire's performance.

Experience suggests that contractors should be allowed to construct and operate systems the way they want. Strong performance incentives are important. Incentives for concessionaires to maintain and expand physical infrastructure can include asking them to sign a performance bond and hiring an independent party to check compliance. This can have repercussions on the pricing of services—the higher the bond, the higher the pricing—but the problem may be reduced by including a clause that allows the private operator to recoup some of the bond money in return for good performance. Another option is to allow for compensation to be paid to the operator if the assets are found to be in good condition. If the possibility of rebidding is made clear at the outset, it may create an incentive for good maintenance of the assets.

Concessions are flexible but they may require lengthy negotiations. It is important to discourage early negotiations and identify strong operators. It is good practice for interested governments to start concessions with pilot operations so that they can learn from experience and establish successful precedents. This helps in building up trust and makes future negotiations easier.

Involving non-formal institutions. The application of commercial principles and the broadening of competition are important tools for improving the performance of formal institutions in the development and supply of sanitation services. But formal institutions often do not serve residents of peri-urban areas, and non-formal institutions step in even when the services they provide are more expensive or of poorer quality. Non-formal institutions make significant contributions by filling gaps in service in urban areas and in supplying services to rural areas.

Experience has shown that where such non-formal institutions exist, their involvement in the development and implementation of sanitation projects helps to enhance the chances of success. Non-formal institutions have several roles. As neighborhood or residents' representatives, they help to aggregate consumer demand and serve as intermediaries between consumers and service providers. In this capacity, they help to reduce the transactions costs incurred in negotiation and coordination because their involvement brings down information search costs and improves responsiveness to user preferences. In particular, non-formal organizations can help to minimize free-rider problems. By forming large pools of buyers with stronger bargaining powers, they can frequently negotiate better service prices for their members.

To be credible, non-formal institutions should have sufficient clout to be able to ensure that the communities they represent fulfill their commitments, particularly for in-kind contributions. They should also be seen as the true representatives of their consumers. Non-formal institutions may need support from NGOs or other intermediaries to organize themselves for effective action and to develop the skills they need for their assigned roles, as was the case in the Orangi Pilot Project.

Separation of institutional functions

An important aspect of the institutional framework for strategic sanitation is how the market for sanitation services should be structured. The

goal should be to improve competitiveness, which is a powerful incentive for improved performance. On the provision side, this calls for separation of services into multiple provision areas. One way to do this is through vertical and horizontal unbundling. Another is to separate provision functions from production functions and to assign provision functions to local governments in line with the policy on local decisionmaking and management at the lowest appropriate level. Water and sanitation utilities have often carried out provision as well as production functions, but assigning provision functions to one entity and opening up production to competition allows the efficiency gains to be captured.

So that agencies can respond better to user needs, multiple provision areas should be used for different types of sanitation infrastructure or for systems with different geographical impacts, wherever this is feasible. For example, households may serve as the provision areas for on-site sanitation; residents of a block or of a neighborhood may serve as the provision area of a feeder sewer system; residents of a city may be used as the unit for trunk sewer systems; and still larger jurisdictions for regional sewerage systems. Such an arrangement has the same structure as the financing model described earlier, and it widens the choices available to users. It also defines boundaries for demand estimation and revenue generation for cost recovery. What are the implications for the various tiers of government?

Role of local governments. In line with the principles of local decisionmaking and management at the lowest appropriate level, responsibility for provision functions should be assigned to local authorities. When appropriate, lower tiers of local government or user-based non-formal institutions may be assigned this responsibility. This arrangement enhances responsiveness to user preferences, improves accountability, and lowers transactions costs, especially those associated with strategic costs and shirking. It is sometimes argued that local governments may not have the capacity to perform these functions, ignoring the fact that capacity can readily be increased if necessary by hiring consultants or through capacity building programs.

As a rule, local governments will be assigned responsibilities for provision of services whose impacts are confined to their jurisdictions. When a spillover of benefits or impacts occurs, the service boundaries need to be expanded accordingly. The costs of designing, building, operating, and maintaining facilities for such services should be borne by the residents of the provision areas through appropriate financing instruments. These may include user charges, local taxes, or other levies as appropriate.

A number of independent production entities may be invited to compete for each production function in a provision area. This may include production units from other parts of the local government, other local government units, higher-tier government units, and private sector units. Adoption of this new approach should raise questions about the role of public water and sanitation utilities.

Role of national government. A key role for national government is formulation of policies that will capture the benefits of strategic sanitation principles. This may include policies on the division of sanitation functions into provision and production, and the structuring of sanitation markets. Central governments need to introduce appropriate legislation to assign authority to local governments to serve as provision units for sanitation services. This should be accompanied by measures providing local governments with sufficient fiscal and budgetary discretion to raise enough revenue to perform the service provision roles assigned to them.

Legislation may also be needed to authorize local authorities to borrow from private financial markets. Central governments will generally also be involved in allocation of central resources for sanitation services among local governments. This means formulating eligibility criteria for

communities desiring government project financing. Central governments are also the ones to set out regulations governing private sector participation in the sector, and to decide what kinds of risks government will assume in dealing with donors, for example, foreign exchange transfer risk. Other central functions may include conflict resolution through the regular court system or through other mediation mechanisms.

Role of external support agencies. The external support agencies (ESAs) active in the sanitation sector include bilateral agencies and multilateral agencies like the United Nations Children's Fund (UNICEF), United Nations Development Program (UNDP), World Health Organization (WHO), regional development banks, and the World Bank. ESAs have traditionally provided two major types of inputs into the sanitation sector in developing countries: financing and technical assistance. Financial support from the development banks has been in the form of loans, sometimes soft loans for the poorest countries, and funding from bilateral agencies has been mostly in the form of grants. It is hoped that future policies of ESAs can be structured to encourage incentives, including policies on cost recovery, conducive to improved investment and operational efficiency and to sustainable investments in sanitation.

Conclusion

The urban environmental sanitation crisis in developing countries is becoming increasingly more critical each year as rapid urban population growth continues to outpace investments in new or improved sanitation. The sanitary crisis is taking a large health, economic, and environmental toll on all city residents.

Access to convenient and safe water is often one of the top priorities for the urban poor, and demand for improved sanitation often follows soon afterwards, including ways to dispose of wastewater. Willingness to pay for basic water and sanitation services is often high in peri-urban neighborhoods, provided that services are appropriate, effective, and affordable. However, in many developing countries, poorly run water utilities have invested in sewerage schemes that have not been able to operate and maintain services.

The positive and negative experiences of a wide range of organizations and institutions worldwide have been assessed and analyzed in developing a strategic sanitation approach that is demand-based and incentive-driven. This approach, promoted by the UNDP-World Bank Water and Sanitation Program, is meant to be flexible and adaptive so that it can incorporate lessons from new experiences and innovations in the sanitation sector.

A demand-based approach requires implementing agencies to find out what potential users want and what resources they have to finance and manage installed systems, and to design systems, financing mechanisms, and support structures that are best suited to their needs. Adoption of strategic sanitation principles has already been seen to deliver results.

The examples of the use of strategic sanitation principles included in this document demonstrate that such an approach can generate better projects. These successes have helped to build capacity within implementing agencies as well as enhancing the ability of communities to make sustainable sanitation improvements.

Notes

[1] Statistics and data in this section are from: World Health Organization, Water Supply and Sanitation Collaborative Council, and United Nations Children's Fund, *Water Supply and Sanitation Sector Monitoring Report 1996: Sector Status as of 31 December 1994* (Geneva: World Health Organization, 1996).

[2] Bangladesh Bureau of Statistics, *Bangladesh Demographic Statistics and 1991 Statistical Yearbook of Bangladesh*, as cited in World Resources Institute, United Nations Environment Programme, United Nations Development Programme, and the World Bank, *World Resources 1996-97: The Urban Environment* (New York: Oxford Press, 1996).

[3] Guillermo Yepes, *Infrastructure Maintenance in LAC: The Costs of Neglect and Options for Improvement,* Volume 3, Water Supply and Sanitation Sector, Latin America and the Caribbean Technical Department, Regional Studies Program, Report No.17 (Washington DC: The World Bank, June 1992).

[4] The World Bank, *China Urban Environmental Service Management,* World Bank Report No. 13073-CHA (Washington, DC: The World Bank, December 31,1994).

[5] The World Bank, *World Development Report 1992: Development and the Environment* (New York: Oxford Univeristy Press, 1992).

[6] The World Bank, *World Development Report 1992: Development and the Environment* (New York: Oxford Univeristy Press, 1992).

[7] The World Bank, *World Development Report 1992: Development and the Environment* (New York: Oxford Univeristy Press, 1992).

[8] The World Bank, *World Development Report 1994: Infrastructure for Development* (New York: Oxford Univeristy Press, 1994).

Key recommendations and an operational plan for national and sub-national governments, bilateral and multilateral development assistance agencies, the UN system, service providers, civil society, and international networks and partnerships to achieve the water and sanitation targets and to optimize water resources management for the Millennium Development Goals.

MillenniumProject
Commissioned by the UN Secretary General and supported by the UN Development Group

SWEDISH WATER HOUSE

Key Recommendations: UN Millennium Project Task Force on Water and Sanitation Final Report

Health, Dignity, and Development: What Will It Take?

Achieving the Millennium Development Goals

Download the Final and Abridged Reports:
www.unmillenniumproject.org
www.siwi.org

Photo: WHO/P. Virot

Water is Life

Four out of every ten people in the world don't have access to even a simple pit latrine; and nearly two in ten have no source of safe drinking water. This silent humanitarian crisis kills some 3,900 children every day and robs the poorest —particularly women and girls—of their health, time, and dignity. Water supply and sanitation services as well as water as a resource are critical to sustainable development —from environmental protection and food security to increased tourism and investment, from the empowerment of women and the education of girls to reductions in productivity losses due to morbidity and malnutrition. The UN Millennium Project Task Force on Water and Sanitation sought to answer two questions: what will it take to reach the MDGs for water supply and sanitation?; and how can the use of water as a resource be optimized to achieve the MDGs?

Five guiding principles

At the conclusion of its three-year project, the Task Force was unanimous in its belief that the water and sanitation target, "to cut in half, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation," will not be reached unless:

1. There is a **deliberate commitment** by donors to increase and refocus their development assistance and to target sufficient aid to the poorest low-income countries.
2. There is a **deliberate commitment** by governments of middle-income countries that do not depend on aid to reallocate their resources such that they target funding to the unserved poor.
3. There are **deliberate activities** to create support and ownership for water supply and sanitation initiatives among both women and men in poor communities.
4. There is a **deliberate recognition** that basic sanitation in particular requires an approach that centers on community mobilization and actions that support and encourage that mobilization.

Furthermore, the Task Force is convinced that the MDGs as a whole will not be met unless:

5. There is **deliberate planning** and investment in sound water resources management and infrastructure.

Photo: Mats Lannerstad

Ten Critical Actions

The Task Force identified ten critical actions for achieving the water and sanitation target and fostering the sound management of water resources for all the MDGs. They are:

Action 1
Governments and other stakeholders must move the sanitation crisis to the top of the agenda.

Action 2
Countries must ensure that policies and institutions for water supply and sanitation service delivery, as well as for water resources management and development, respond equally to the different roles, needs, and priorities of women and men.

Action 3
Governments and donor agencies must simultaneously pursue investment reforms for improved water supply, sanitation, and water management.

Action 4
Efforts to reach the water and sanitation target must focus on sustainable service delivery, rather than construction of facilities alone.

Action 5
Governments and donor agencies must empower local authorities and communities with the authority, resources, and professional capacity required to manage water supply and sanitation service delivery.

Action 6
Governments and utilities must ensure that users who can pay do pay in order to fund the operation, maintenance, and expansion of services—but they must also ensure that the needs of poor households are met.

Action 7
Within the context of national poverty reduction strategies based on the Millennium Development Goals, countries must elaborate coherent water resources development and management plans that will support the achievement of the Goals.

Action 8
Governments and their civil society and private sector partners must support a wide range of water and sanitation technologies and service levels that are technically, socially, environmentally, and financially appropriate.

Action 9
Institutional, financial, and technological innovation must be promoted in strategic areas.

Action 10
The United Nations system organizations and their Member States must ensure that the UN system and its international partners provide strong and effective support for the achievement of the water supply and sanitation target and for water resources management and development.

An Operational Plan

Modest dreams

"At least my daughter's education will ensure that she will get a groom who comes from a home with a toilet."
—Manjulaben, age 38, a daily wage laborer from Nagalpur village (Kachchh district, Gujarat state)

"I do wish that I get married in a family which has the facility of toilet and separate water tap. It is a dream for me."
—Barkha, age 12, Sanjay Amar Colony, Delhi, India
From UN-HABITAT's "Unheard Voices of Women" project

The five guiding principles and ten actions represent, in broad strokes, the vital conditions needed both to achieve the Millennium Development Goals for water supply and sanitation, and to ensure that sound water resources development and management underpins the broader MDG effort. These principles and actions are further elaborated within an operational plan that specifies the steps that each actor—national and sub-national governments, donors, civic and community organizations, and research institutions—must undertake in support of the goals. Although the operational plan focuses only on actions by actors in the water sector, investments in other sectors are crucial to the achievement of the water and sanitation targets.

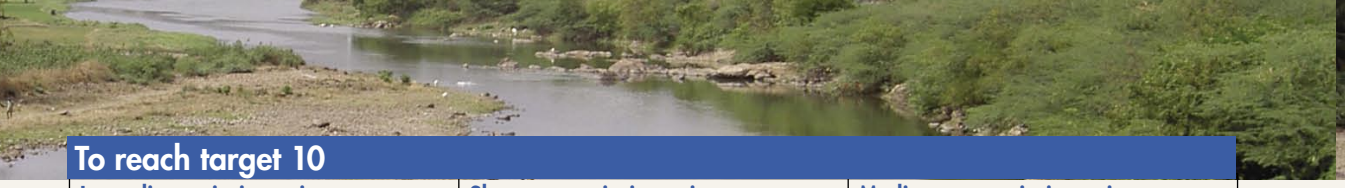
The operational plans are summarized in tables 1 to 8. In each table, entries have been categorized into immediate priorities, short-term priorities, and medium-term priorities.

- National and Sub-National Governments: National governments have principal responsibility for initiating the planning procedures and policy reforms, as well as for committing the financial and human resources, necessary to achieve the MDGs. In addition, efforts by other stakeholder groups are often contingent upon strong initial action by national governments. The proposed operational plan should therefore be spearheaded by the actions that have to be taken by national governments, as summarized in table 1 (a and b). Since some actions, such as setting of standards for water and sanitation technologies, are carried out at the national level in some countries and at the sub-national level in others, these actions have been grouped together in this table, on the assumption that they would be assigned to the responsible parties within a given country. Actions that are typically exclusive to national governments, such as the carrying out of national planning processes, have been noted with an asterisk.
- Bilateral and multilateral development assistance agencies, regional development banks, donor agencies and countries: If the target is to be reached, fundamental changes by the bilateral and multilateral development agencies, regional development banks, donor agencies and countries will be required, as summarized in table 2.
- The United Nations System: Key actions that have to be taken by the United Nations system organizations and their Member States are outlined in table 3.
- Other National and International Actors: Actions to be undertaken by other key actors—service providers, civic and community organizations, international networks and partnerships, and research organizations—are summarized in tables 4 to 7.

Other important actions that should be undertaken by all actors on a continual basis—both during the MDG process and beyond—have been summarized in table 8.

The Task Force recommends that all organizations engaged in the effort to achieve the MDGs—from national and sub-national governments to donors to NGOs—should themselves prepare an operational plan in order to focus their support on the achievement of the MDGs.

Photo: WHO/P. Virot



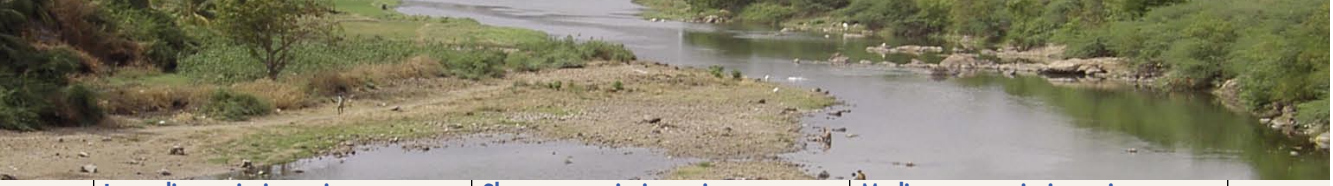
To reach target 10

Immediate priority actions	Short-term priority actions	Medium-term priority actions
• Ensure that water supply and sanitation are included in national planning processes, especially Poverty Reduction Strategy Papers. • Undertake assessments of water and sanitation infrastructure endowments and deficits. • Create a national-level "institutional home" for sanitation. • Obtain current, accurate information about the characteristics of unserved households, so that appropriate policies to expand access to these households are pursued. • Review and modify subsidy policies as necessary to ensure that improved water and sanitation services are affordable to the poor, and subsidies are provided only to low-income households. • Prioritize activities and programs that raise the profile of and demand for improved sanitation.	• Monitor changes over time to gauge the effectiveness of interventions and the impact of policy reforms and investments at national and subnational levels. • Ensure that appropriate, flexible standards for water, sanitation, and wastewater treatment technologies are in place. • Initiate policy reforms that improve the financial and technical sustainability of water and sanitation service provision, such as tariff reforms, "ring fencing," and adequate support for ongoing operations and maintenance. • Initiate policy reforms to attract financing to, and facilitate efficient use of human and financial resources in water and sanitation service delivery. • Initiate policy reforms that improve the accountability of service providers, such as the establishment and funding of credible regulatory institutions, reform of civil-service legislation, and limiting political interference in decisionmaking.	• Monitor changes over time to gauge the effectiveness of interventions and the impact of policy reforms and investments at national and subnational levels. • Remove barriers to service provision in unregularized areas. • Shift principal control over water and sanitation planning and service delivery to local administrations, including budgetary authority. • Support decentralization by retaining strong oversight and support functions, particularly with respect to ensuring access to services by poor households. • Provide funding to support community mobilization and organization for actions towards the water and sanitation targets.

To improve water resources management for all the Goals

Immediate priority actions	Short-term priority actions	Medium-term priority actions
• Support Goals-based planning and policy development by an integrated approach to land, water, and ecosystems. • Use the action target set by WSSD in Johannesburg for countries to develop IWRM and water efficiency strategies by 2005 as an opportunity to infuse Goals planning processes with consideration of water resources. • Develop a coherent approach toward deciding on the investments in water resources infrastructure and management needed to meet the Millennium Development Goals.	• Monitor changes over time to gauge the effectiveness of interventions and the impact of policy reforms and investments at national and subnational levels. • Define and promote strategies that will contribute to multiple Goals and avoid strategies that create conflicts among them.	• Monitor changes over time to gauge the effectiveness of interventions and the impact of policy reforms and investments at national and subnational levels. • Disseminate small-scale water technologies to provide livelihoods to small and landless farmers, while addressing the hunger and environment Goals. • Reduce the vulnerability of communities to water-related natural disasters by land reform, infrastructure construction for water storage and flood protection, and improved land-use planning, including slum upgrading. • Invest in community-based natural resource management, including urban agriculture, for hunger, poverty, and environment Goals.

Table 1. Priority actions for national and sub-national governments



Immediate priority actions	Short-term priority actions	Medium-term priority actions
• Increase current aid in the water and sanitation sector to levels commensurate with the costs of attaining the water and sanitation target in the poorest countries. • Redirect aid to the poorest countries and, within countries, toward programs that provide basic services for poor households. • Prioritize investments in basic sanitation and hygiene. • Reform aid procedures, so that aid supports policy reforms and infrastructure investment simultaneously, thereby enhancing institutional and policy frameworks while expanding services. • Increase funding to Joint Monitoring Programme and refrain from setting up parallel structures.	• Substantially accelerate the process for making aid available, and simplify the procedures for allocating aid. • Prioritize investments in programs that help "crowd in" community and private resources to benefit the poor, as well as initiatives that have the potential to yield results at scale. • Use the upcoming second Water Decade, 2005-15 ("Water for Life"), to mobilize international awareness and political commitment to sound water resources management and expansion of water and sanitation services to meet the Millennium Development Goals.	• Support initiatives that seek to encourage more open and frank discussion of sanitation needs and practices. • Promote and finance research and development that fosters innovations in appropriate technologies, social marketing, and institutional arrangements that improve access to water and sanitation services by the poor. • Promote initiatives that address multiple Millennium Development Goals. • Support, where useful, the creation of new, regional-level multilateral donor mechanisms such as the African Water Facility.

Table 2. Priority actions for bilateral and multilateral development assistance agencies

Photo: UNICEF/HQ98-0928/ Giacomo Pirozzi

Immediate priority actions	Short-term priority actions	Medium-term priority actions
• Strengthen UN country team efforts to provide technical and capacity-building support to governments. • Effectively coordinate actions at the country level, including harmonization of procedures and joint programs, both within the UN system and with development banks and bilateral donor agencies. • Support the Joint Monitoring Programme as the key global mechanism for monitoring sustainable access to water and sanitation and provide it with the necessary resources to carry out its work.	• Expand monitoring efforts to include information on the actions and investments undertaken by the international community toward meeting the Goals, as well as on the impacts of those activities. • Use the upcoming second Water Decade, 2005–15 ("Water for Life"), to mobilize international awareness and political commitment to sound water resources management and expansion of water and sanitation services to meet the Millennium Development Goals. • Ensure the independence and adequate funding of the Advisory Board on Water and Sanitation as a means of achieving high-level strategic focus among the international community. • Focus the Secretary-General's Advisory Board on Water and Sanitation on providing high-level policy commentary on progress toward the water and sanitation target. • Ask the Secretary-General's Advisory Board on Water and Sanitation to comment independently and boldly on developing country, donor country, and UN system practices, and produce a periodic, brief, focused, high-profile report with pointed recommendations.	• Develop clear mechanism to provide leadership and strategic guidance to the international community. • Mandate UN-Water to periodically report through World Water Development Report on progress in water resources development and management for the Goals, including progress on the development of IWRM strategies by 2005. • Strengthen UN-Water and WWDR and provide with greater funding to fulfill these roles successfully. • Reform monitoring systems such that they measure access to sustainable services, rather than the presence of particular infrastructure. • Support the use of scientific sampling and household surveys for water and sanitation monitoring. • Ensure that data collected in global monitoring is widely disseminated in "user friendly" formats. • Support initiatives that seek to encourage more open and frank discussion of sanitation needs and practices.

Table 3. Priority actions for the United Nations system

Immediate priority actions	Short-term priority actions	Medium-term priority actions
• Support and lobby for policy reforms in water and sanitation subsidies, so that benefits are targeted to poor households. • Support and lobby for policy reforms in water and sanitation tariffs, so that service provision becomes financially sustainable.	• Seek out opportunities for partnerships with civic organizations that can improve access to water and sanitation services by poor households. • Revise budgets and institutional incentive structures, so that sustainable operations and maintenance of installed infrastructure receives sufficient priority and resources.	• Pursue innovative strategies, including lower cost appropriate technologies, to expand services to unregularized settlements.

Table 4. Priority actions for service providers

Immediate priority actions	Short-term priority actions	Medium-term priority actions
• Prioritize activities and programs that raise the profile of and demand for improved sanitation. • Use accurate information—the end product of reliable monitoring efforts—as a powerful advocacy tool for change.	• Develop strategies for encouraging more open and frank discussion of sanitation needs and practices. • Seek out opportunities for partnerships with service providers that improve access to water and sanitation services by poor households. • Share information and experiences with service providers, as well as with subnational and national governments, seeking to better understand the characteristics of and obstacles faced by unserved households.	• Help to identify strategies for ensuring access to services by poor households while also maintaining financial sustainability for service providers. • Help to hold service providers and governments accountable for expanding and improving water and sanitation services to the poor through audits, public information campaigns, etc.

Table 5. Priority actions for civic and community organizations

Immediate priority actions	Short-term priority actions	Medium-term priority actions
• Raise public awareness of the deficits in coverage and quality of water supply and sanitation services through public statements, articles, events, celebrity endorsements, and other innovative strategies. • Test, refine, and publicize effective strategies for water and sanitation service delivery to the poor that have the potential to yield results at scale. • Collectively strengthen and rationalize efforts and align them towards the achievement of the Goals while at the same time taking steps to ensure accountability to the communities of the developing world. • Use accurate information—the end product of reliable monitoring efforts—as a powerful advocacy tool for change.	• Use the upcoming second Water Decade, 2005–15 ("Water for Life"), to mobilize international awareness and political commitment to sound water resources management and expansion of water and sanitation services to meet the Millennium Development Goals. • Publicly support policy reforms that better target subsidies to poor households, promote sustainability of service delivery, and heighten accountability of service providers to households. • Support initiatives that seek to encourage more open and frank discussion of sanitation needs and practices.	• Help to hold service providers and governments accountable for expanding and improving water and sanitation services to the poor through audits, public information campaigns, etc. • Package and disseminate information collected in national and international monitoring efforts such that it is accessible to community organizations, the media, and the general public. • Explore ways to use the new UN ECOSOC affirmation of the Right to Water to influence national policy on water and sanitation.

Table 6. Priority actions for international networks and partnerships

Immediate priority actions	Short-term priority actions	Medium-term priority actions
• Better document and communicate the economic benefits of improved water and sanitation services. • Conduct research and disseminate findings on effective strategies for providing sustainable water supply and sanitation services in persistently challenging settings (unregularized urban communities, small towns, poor rural villages).	• Support the development of appropriate technical standards for water supply, sewerage, and sewage treatment. • Increase research and development on technologies and institutional innovations aimed at meeting several Goals simultaneously and reducing tradeoffs among the uses of water resources to meet the various Goals. • Develop new sanitation technologies to reuse wastewater for periurban agriculture. • Develop a conceptual framework for defining and measuring the contribution of water resources development and management to the Millennium Development Goals.	• Carry out research and development of appropriate, affordable sanitation technologies.

Table 7. Priority actions for research organizations

- Prepare an operational plan that outlines what they will do during the period 2005–15 to help achieve target 10 and the development and management of water resources for the Millennium Development Goals.
- Maintain a focus on sustainability to ensure that gains made in expanding access to water and sanitation services and improving water resources management during the Millennium Development process will be maintained in the long term.
- Incorporate gender considerations into policy recommendations and program design; address gender biases within their own institutions.
- Take measures to reduce corruption at all levels, whether in donor organizations, international agencies or companies, or public, private, or civic institutions in developing countries.

Table 8. Priority actions for all actors throughout the Millennium Development process and beyond

"Collecting water takes me five hours a day."
—Joyce Tunda, Tanzania
From the BBC's Global Village Voices

"How long are we going to live this way? It is affecting our pride and dignity."
—Charlene, age 42, Caribbean urban slum
From UN-HABITAT's "Unheard Voices of Women" project

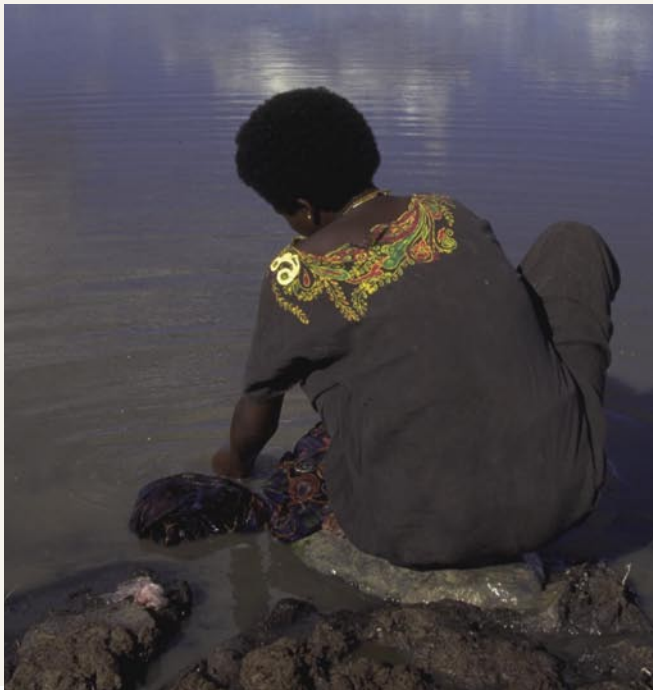


Photo: UNICEF/HQ00-0507/ Radhika Chalasani

MillenniumProject

Key Recommendations from Health, Dignity, and Development

The UN Millennium Project is an independent advisory body commissioned by the UN Secretary-General to propose the best strategies for meeting the Millennium Development Goals (MDGs). The MDGs are the world's targets for dramatically reducing extreme poverty in its many dimensions by 2015—income poverty, hunger, disease, exclusion, lack of infrastructure and shelter—while promoting gender equality, education, health, and environmental sustainability. Ten Millennium Project task forces, including one on Water and Sanitation, were charged with identifying what it would take to achieve the Goals.

In this brochure version of the report's key recommendations, the Task Force outlines the bold yet practical actions needed to increase access to water and sanitation. The report underscores the need to focus on the global sanitation crisis, which contributes to the death of 3,900 children each day, to increase access to domestic water supply, and to invest in integrated development and management of water resources. All are necessary for countries to reduce poverty and hunger, improve health, advance gender equality, and ensure environmental sustainability.

Implementing the recommendations of the report and this brochure will allow all countries to halve the proportion of people without access to safe water and sanitation by 2015. This brochure was prepared by the UN Millennium Project Task Force on Water and Sanitation and published by the Swedish Water House, an initiative of the Government of Sweden which supports international policy development and cooperation on water. The full report is available at www.unmillenniumproject.org.

SIWI

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3R Initiative and the Experience of Japan in Sanitation and Wastewater Management

Hiroaki TAKIGUCHI
Waste and Recycling Department
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Contents

1. 3R Initiative
2. Japan's Experience in Solid Waste Management
3. Japan's Experience in Wastewater Management
4. Conclusion

1. 3R Initiative

Background of the 3R initiative

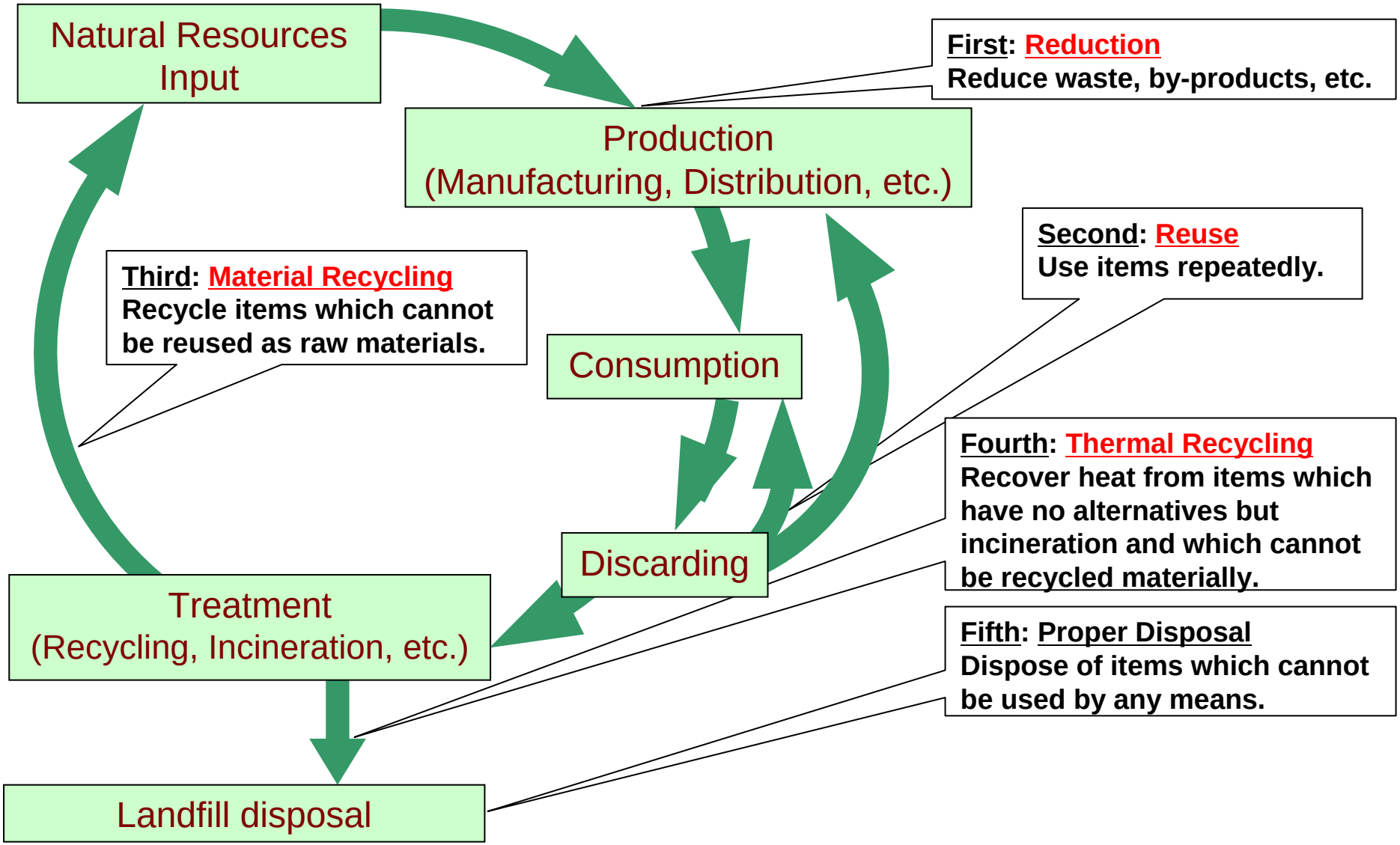
The 3R Initiative was endorsed at the G8 Summit held in 2004 at Sea Island, USA.

Reduce, Reuse, and Recycle Initiative

We will launch the Reduce, Reuse, and Recycle (“3R”) Initiative at a Ministerial Conference in spring 2005 hosted by the Government of Japan

(Source) G8 action Plan on Science and Technology for Sustainable Development adopted at the G8 Sea Island Summit

Concept of 3 Rs



Ministerial Conference on the 3R Initiative

Date: April 28-30, 2005

Venue: Tokyo, Japan

Participants:

G8 countries

Asian countries

China, Indonesia, Malaysia, Philippines, Republic of Korea, Singapore, Thailand, Vietnam

Other countries; relevant organizations

Brazil, Mexico, South Africa; OECD, UNEP, Basel Convention Secretariat, the League of Arab States

Issues Discussed

1. Strengthening of domestic policies to implement the 3Rs
2. Reduction of trade barriers against the international flow of goods and materials
3. Cooperation between developed and developing countries
4. Cooperation among various stakeholders
5. Promotion of science and technology suitable for the 3Rs

Outcome of the Ministerial Conference

Adoption of Chair's Summary

- Agree on further strengthening of a worldwide promotion of 3Rs under international cooperation
- Report to the G8 Government Summit at Gleneagles in the UK
- Hold a senior official level follow-up meeting

Japan's Action Plan for Developing Global Zero Waste Society

Realization of Zero Waste in Japan

- Review of the Fundamental Plan for Establishing a SMC Society
- Review of 3R-relvant policy

Support to Developing Countries for Developing Zero Waste Society

- Assistance to capacity building of developing countries

Collaborative Efforts toward Global Zero Waste Society

- Organizing an official-level meeting for 3R Initiative follow-up
- Development of 3R-relevant policy towards zero waste
- Knowledge and Technology Development in Asia towards zero emissions
- Enhancement of actions toward zero waste through information sharing and networking

2. Japan's Experience in Solid Waste Management

Keys to Success

① Law and Regulation

② Technology

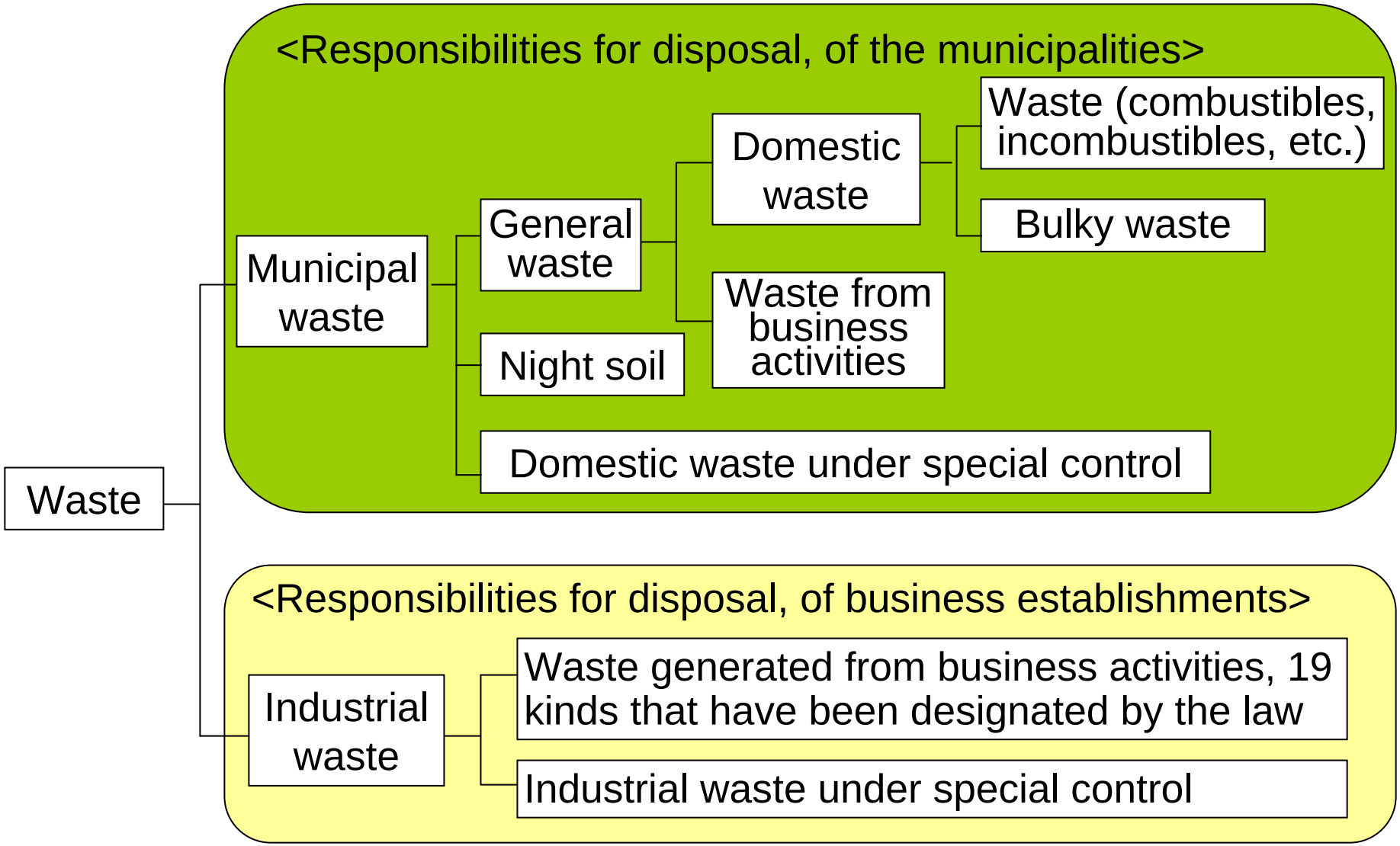
③ Economic Incentives

④ Partnership

Law and Regulation

1954	Public Cleansing Law	Improvements in public health
1971	Waste Management Law	Environmental protection
1991	Law for Promotion of Utilization of Recyclable Resources	Recycle
2000	Fundamental Law on the Establishment of a Sound Material-Cycle Society	Establishment of a sound material-cycle society

Waste Classification



Major Regulations on Waste Management

Governors of Municipalities

Governors of Prefectures

Municipalities

- develop a "municipal solid waste (MSW) management plan"
- collect, transport and dispose MSW according to the plan

Discharging Entities

- treat industrial solid waste (ISW) by themselves or commission to qualified contractors
- observe storage, treatment, commission standards

B C D

MSW Treaters

ISW Treaters

A B C D

- obtain the permission
- observe treatment standards
- must not recommission (in principle for ISW treaters)
- must not rent the name

MSW Facility Installers

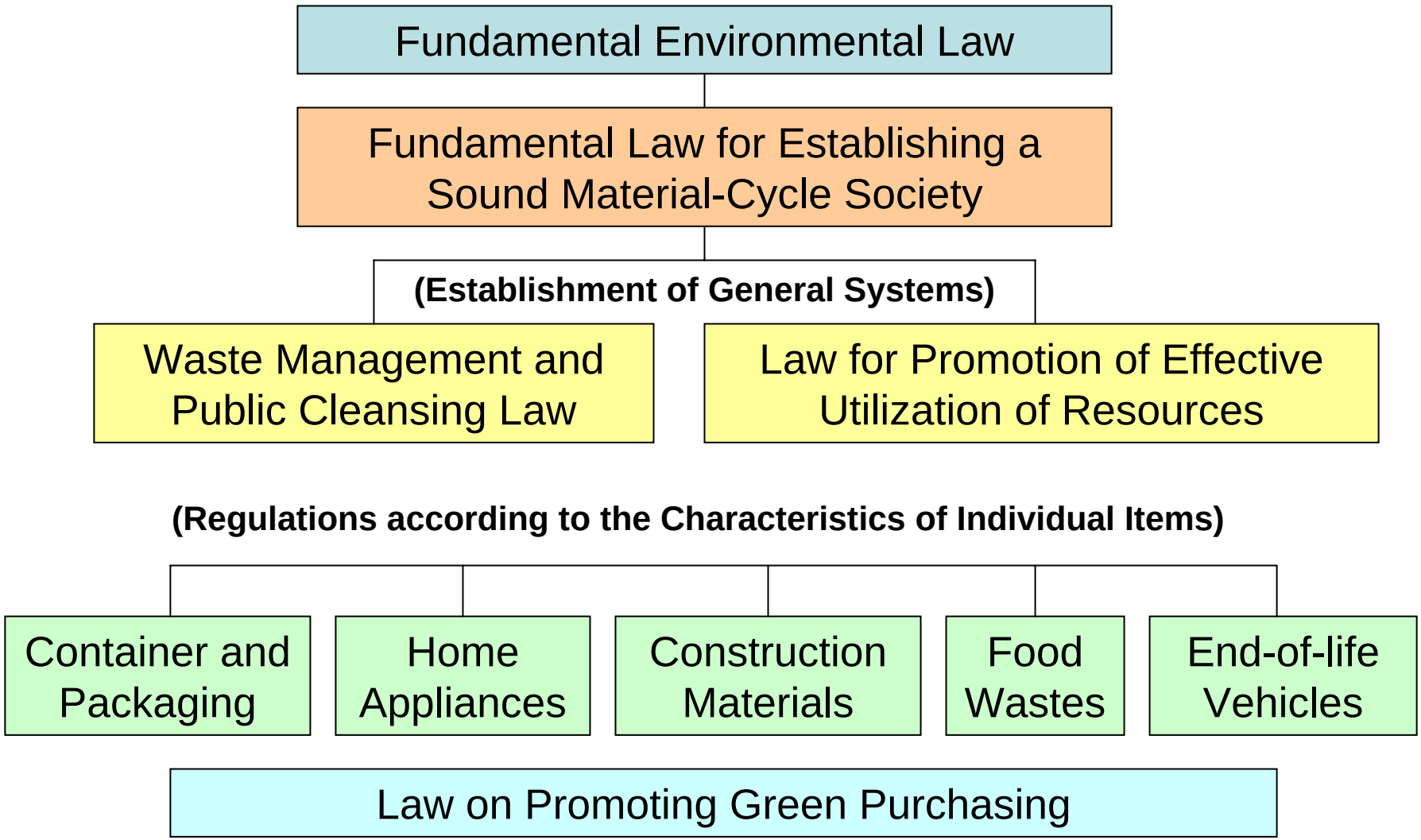
ISW Facility Installers

A B C

- obtain the permission for establishment or handover of the facility

A: permission, B: collection of reports, C: order for improvement, D: order for actions

Legislative Framework to Establish a Sound Material-Cycle Society



Technology

Technology enables us to manage waste in a sanitary manner.

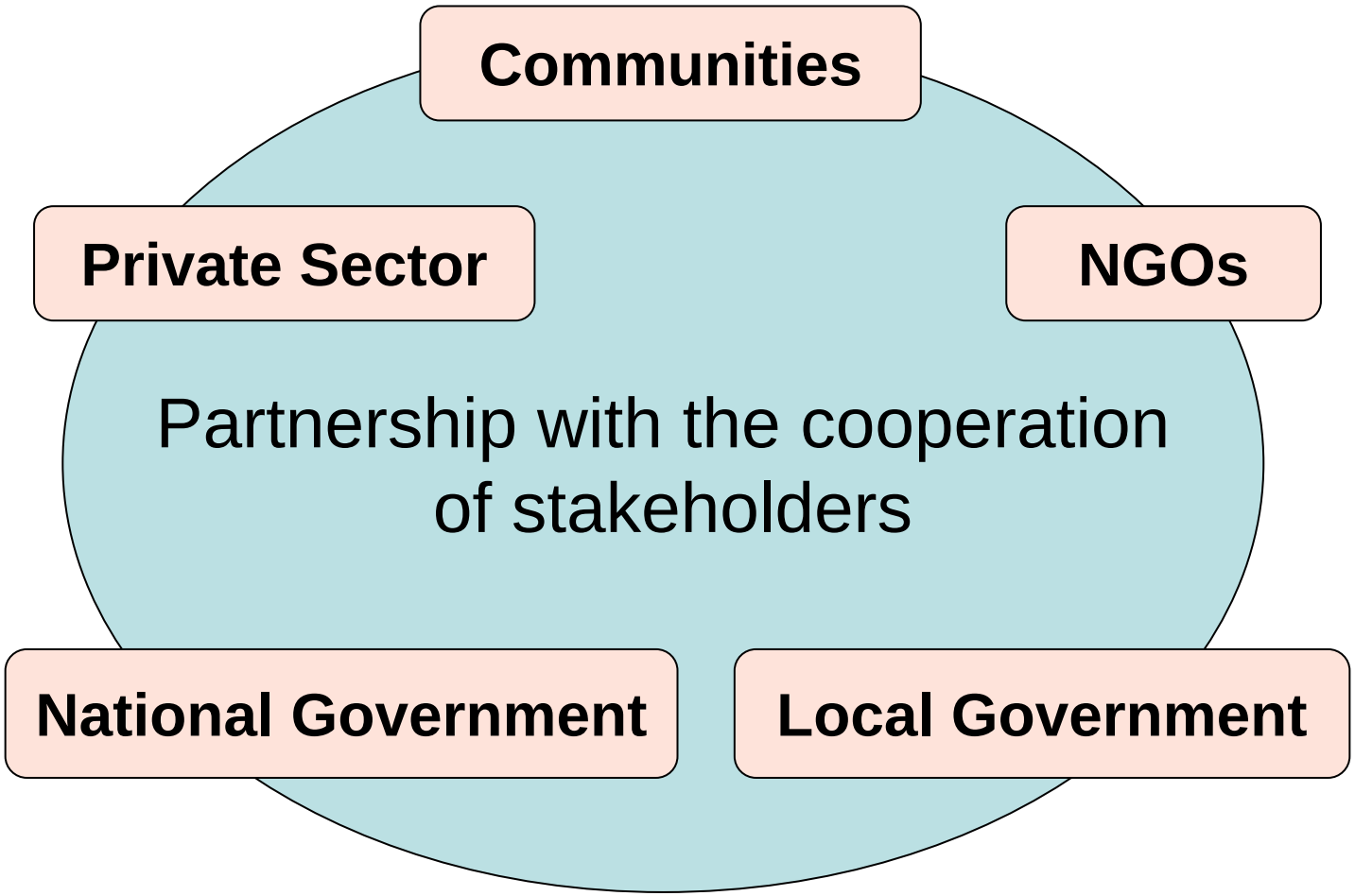
- Waste collection
  - Manual → Packer Trucks
- Incineration
  - Batch-loading → Continuous-loading
- Sanitary landfills
  - Introduction of semi-aerobic landfill and liner sheets
- Reuse and recycle technologies

Economic Incentives

Economic incentives work as a driving force for sound waste management.

- Preferential taxation
- Low interest loans
- Subsidies
- Debt guarantee

Partnership



3. Japan's Experience in Wastewater Management

History of Japan's Wastewater Management

Mid-1950	Methyl-mercury induced Minamata disease
1958	The Water Quality Control Law The Industrial Effluent Control Law
1967	The Basic Law Environmental Pollution Control
1971	The Water Pollution Control Law
1993	The Basic Environment Law

Japan's Wastewater Management

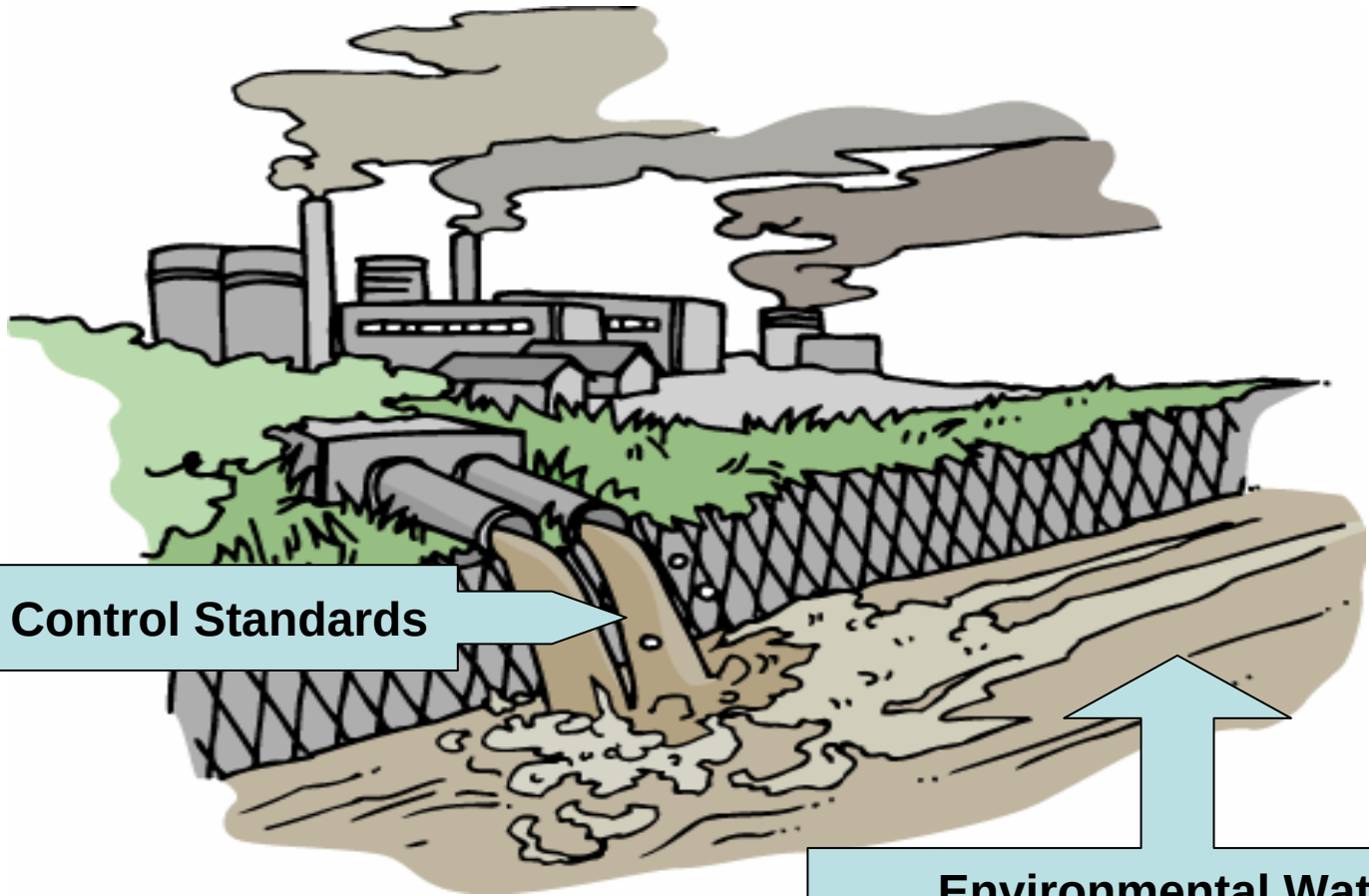
Objective:

- Improvements in public health
- Environmental protection (achievement of environmental water quality standards)

Approaches

- Control of factory effluents
- Maintenance and construction of sewage systems and septic tanks

Water Quality Control



4. Conclusion

Conclusion

- Japan suffered from environmental pollution and solid waste problems.
- After overcoming those problems, Japan is moving towards the establishment of a Sound Material-Cycle Society through 3R Initiatives.
- Keys to success are:
  - Law and Regulation
  - Technology
  - Economic Incentives
  - Partnership

Sustainable Wastewater Reuse through Private Sector Participation - The Adelaide Experience

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1. Introduction

Grape growers in Adelaide's world renowned wine growing valley of McLaren Vale have cooperatively developed a demand driven wastewater reuse scheme that was entirely built and financed by the private sector. It has been successfully operating for the last 6 years, and still growing. The farmers have overcome technical, financial, institutional, regulatory, social and environmental constraints to launch this show case wastewater reuse scheme that is sustainable and financially viable. This case study will give an insight into how and under what conditions, ADB's Developing Member Countries could develop similar schemes through private sector participation.

2. The Problem – Water Scarcity

Located in the Willunga Basin of the state of South Australia, the Willunga Basin Reuse Scheme, as it is known, was initiated by grape growers in the region who were concerned with their dwindling water supplies and excessive groundwater extraction which was unsustainable. Further, the government had placed restrictions on groundwater extraction and imposed a water extraction licensing regime. The agricultural area was beginning to see declining crop yields and land values due to the drying up of the region. Water, or the lack of it, could potentially cause a decline in economic activity and destroy the livelihoods of the growers. Coupled with its location in the Australian state that is generally recognized as 'the driest state in the driest continent', farmers were well aware of the value of water and were prepared to pay for it.

Water had obviously become a scarce and valuable resource for the vineyards located in Basin. The situation had the essential elements for a financially viable water 'production' project that could be attractive to the private sector. A committed group of growers, driven by an individual champion, got together and decided to do something about it. The Willunga Water Reuse Scheme was conceptualized, but there were numerous obstacles and constraints that needed to be overcome.

3. The Strategy

This bold venture involved tapping into the wastewater discharged into the ocean by a wastewater treatment plant (WWTP) located 15 kilometers away at the seaside town of Christies Beach. The Christies Beach WWTP services a population of 150,000 people and generates an average of 27 million liters of wastewater every day. If fully reused, it could irrigate 50 square kilometers of vineyards and yield $150-180 million of grape production at the then prevailing prices. The effluent at Christies Beach undergoes secondary treatment

and is disinfected with chlorine. The water complies with Class B rating[1] and is suitable for agricultural irrigation if worker contact is minimized. Contact with certain crops is permitted but the water can only be used for restricted spray irrigation.[2]

If a viable and sustainable project could be developed to pipe the wastewater from the Christies Beach WWTP to the McLaren Vale vineyards through a private sector scheme, it would yield significant synergistic benefits by

(a) reducing high nutrient effluent discharge into the sea;
(b) diverting nutrient rich water for agricultural irrigation; and
(c) developing a commercially viable new private water distribution business that yields significant environmental and economic benefits.

4. Situation Analysis – Issues and Constraints

The challenges were numerous and daunting but the financial, economic and environmental benefits of such a scheme motivated a group of growers to pioneer its development. Fortunately they had the tacit support of the South Australian Water Corporation which was the corporatised state entity responsible for water supply and wastewater treatment and which had received a directive to reduce effluent discharge into the sea.

There were several complex and often interrelated issues that needed to be resolved before a scheme such as this can come into fruition. Most of the issues relate to the pre-construction phase of the project, as several agreements had to be put in place and all affected parties and institutions needed to be satisfied with the arrangement. The issues can be classified into the following areas: (1) Engineering and Technical; (2) Financial and Commercial; (3) Regulatory and Policy; (4) Institutional and (5) Social.

4.1 Engineering and Technical

a) Water on Demand: Growers preferred their water allocations to be available on demand, on a 24 hours/day-7days/week basis. The pumps and pipes were sized accordingly to allow for this.
b) Demand management: The monitoring was sufficiently sophisticated to allow it to automatically cut off the supply to growers who take more water than their entitlement, particularly during peak (summer) demand periods.
c) Drip Irrigation: As the state's Environment Protection Authority (EPA) guidelines did not permit the Class "B" water to be used for unrestricted spray irrigation, and as drip irrigation systems are very efficient and commonly used for grape growing, they were adopted by the growers to reduce their risk.
d) Security of supply of water: The source water supply from the WWTP was considered to be reasonably secure, given that it originates from a population base of 150,000.
e) Staged Construction: A two-stage construction strategy was adopted to minimize technical and investment risk. In Stage 1 water was delivered to the shareholders of the scheme. One year later, in Stage 2, the water supply was progressively extended to third party growers.

[1] Key specifications are: Biochemical Oxygen demand (BOD) < 20 mg/ML, suspended solids < 30 mg/L and E Coli < 100 organisms/100ML

[2] Environment Protection Authority 1996, p. 20

4.2 Financial and Commercial

a) Shareholdings and Costs: The initial investment cost of USD 5.5 million for constructing a 24 kilometer trunk main from the Christies Beach WWTP and the spur mains were borne by the shareholders of the scheme, all of whom were growers. The growers were responsible for financing their share of the investment cost and for their on-farm drip irrigation system. In order to ensure technical integrity and consistency, a specialist irrigation consultant, Hydro-Plan, that designed and project managed the main pipeline, was commissioned to also design the drip irrigation systems.

b) Feasibility Study: Initial feasibility studies were conducted to determine the financial (and technical) viability of the scheme. It was potentially attractive to both the land owners and the Willunga Basin Water Company (WBWC) that was set up to build and operate the Scheme. No government subsidy/funding support was provided for the scheme. However, WBWC was also not charged for the effluent water by the South Australian Water Corporation (SA Water) 'producing' the effluent, as it had no alternative use or value for it. It was a win-win situation with SA Water reducing high nitrogen content effluent discharge into the sea to comply with the EPA guidelines and the growers getting water that they desperately needed.

c) Tariff Structure: Tariff for the reused water was based on a financially sustainable rate that maintained the long term viability of WBWC. It is about half the ground water cost, while at the same time having lower salinity and restrictions. The tariff structure comprised fixed (USD 4,500/ML of entitlement) and variable tariff (50 US cents/KL) components, or equivalent to about 65% of the potable water charge. The fixed tariff is based on allocated water entitlement and the variable tariff based on usage. (The owners of the scheme pay a lower tariff to compensate them for the initial investment cost). However, akin to a take-or-pay arrangement, there is also an unused water tariff to incentivise customers to physically take or on-sell their water entitlements.

d) Contractual Agreements: Various agreements were signed to appropriately allocate risks and to ensure that commercially sustainable contractual structures were in place. These included:
- Shareholder agreements;
- Water Sales Agreement;
- Pipeline construction contracts; and
- Water Reuse License with SA Water.

4.3 Legal and Policy

An enabling regulatory and policy framework has contributed to South Australia spawning several water recycling schemes and becoming the leading water reuse state in Australia. [3]

The government policy *"to phase out all sewerage discharges to the marine environment where it is economically and environmentally sustainable"*.[4] has significantly influenced the development of water reuse programs in South Australia, where the vast majority of its population live in coastal cities. The inclusion of reclaimed water in the South Australian Government's State Water Plan 2000 further demonstrates the State's commitment to recycled wastewater projects.

[3] The Virginia Scheme, the largest wastewater for irrigation reuse project in Australia, is also located in South Australia.

[4] Statement of the Environment, 1995, under the government's "A Cleaner South Australia" Policy.

There were several regulatory controls that needed to be complied with, which improved the acceptability of the Scheme to the government, growers, neighboring residents and the consumers:

a) Comprehensive Reclaimed Water Guidelines issued by the Department of Human Services and Environment Protection Authority;
b) Compliance with Water Resources Act;
c) Annual Irrigation Management Plans ;
d) Approval of the Public and Environmental Health Service; and
e) Approval of Environment Protection Authority (EPA)

4.4 Institutional

Given the favorable regulatory and policy regime in South Australia, government departments were quite proactive and forthcoming in granting approvals for water reuse schemes. Getting the approvals were nevertheless onerous and time consuming due to the government's thorough review and evaluation process. Approvals were required from various government organizations and departments including the EPA, SA Water, Health Commission, Primary Industries Department, Department of the Environment and Natural Resources, the local Council, Electricity Trust of South Australia etc.

The Major Projects Group, the government body responsible for developing major infrastructure projects, assisted greatly in coordinating and accelerating the necessary government approvals. This helped to maintain the momentum and private sector interest during the project development stage and to minimize government related project development costs.

4.5 Social

Initially some growers were apprehensive that the water quality may not be suitable for grape growing and may ruin their land. Information dissemination through discussions and seminars to improve acceptability of water helped to alleviate some of their concerns. Steps to monitor and control the water quality and soil conditions also improved their comfort level. This has helped to gain the confidence of growers and increase the number prepared to sign up for the Scheme.

Appropriate safety measures such as on-farm warning signs have also been placed in the vineyards. Users are also issued with manuals on Standard Operating Procedures.

5. The Project - Solution

The initial project involved the construction of a 24 km, 500mm diameter PVC pipeline and associated spur mains that are capable of delivering the full load of 10,000 ML/year from the Christies Beach WWTP to the Willunga Basin. As demand increased, the distribution pipe length has been increased to over 70 km. Fittings are of stainless steel and ductile iron coated with nylon with a service life of more than 100 years. The monitoring and control system comprised of state of the art telemetry and instrumentation.

6. Results

The Willunga Basin Water Reuse Scheme yields significant benefits to the growers in the region and the state's economy and environment. The key results achieved from the scheme were:

a) A technically, financially, commercially and environmentally sustainable wastewater reuse scheme;
b) A scheme that is entirely built, financed and operated by the private sector i.e. a viable reuse project with private sector participation;
c) Contribution to economic growth through increased grape production and job creation;
d) Delivery of Class B rated reclaimed wastewater suitable for horticultural use.
e) Reduction in fertilizer requirements due to the nutrient content; and
f) Reduced effluent discharge and damage to the marine environment.

7. The Future

Due to the seasonality of demand the pipeline currently delivers only 40% or 4,000 ML/year[5] of the effluent from Christies Beach with the remainder being discharged to sea from the plant. Given that 60% of the wastewater from Christies Beach WWTP is still untapped, there is significant upside potential to further improve the economic and environmental benefits from the Scheme. There is also potential for further improvement in the effluent water quality as the EPA progressively imposes more stringent standards for effluent discharge into the environment.

The current financial viability of the Scheme is an added bonus. The Willunga Basin Water Company has begun paying dividends to the shareholders, reflecting a financially robust company that has the capacity to finance expansion schemes.

The biggest scope for expansion of the Scheme is to provide for off-peak winter storage for peak summer reuse through aquifer storage and recovery (ASR) projects or building of surface storage dams. Further increases in water supply has been and will continue to be achieved through flows from smaller water treatment plants and small septic tank effluent discharge schemes (STEDS) located in the surrounding areas. As there is sufficient pent up demand, and subject to the necessary government approvals and financial viability, the geographical reach of the Scheme can be significantly increased over the next few years.

8. Lessons Learned

With a pioneering project such as the Willunga Reuse Scheme, there are some activities that, on hind sight, could have been improved while there were other activities that were well effectively executed. From these we are able to learn some lessons:

a) A highly motivated or incentivised core group or individual is needed to champion and drive pioneering projects such as reuse schemes;
b) A demand driven scheme, such as the project discussed in this paper, has a much greater likelihood of success;
c) An appropriate institutional, regulatory and policy framework is a prerequisite for the sustainability and financial viability of the scheme and to attract private sector participation e.g. appropriate groundwater charge, licensing and restrictions; and
d) The technical and commercial aspects of the scheme must be customer oriented e.g. provision of water on demand, no major on-farm investments such as pumps and storage facilities, water supply cut-off facilities and penalties to monitor and control excessive water usage by unscrupulous growers, a water tariff that is affordable and financially viable for the growers etc.

[5] Gransbury, John, 2004, The Willunga Basin Pipeline, p 7

9. Proposed Best Practices

There were several areas where best practices were adopted that others could emulate:

(a) Independent and competent design and tendering processes that ensure technical integrity of the scheme;
(b) Regular water quality monitoring and control to ensure environmental sustainability;
(c) A tariff structure that is affordable while ensuring the financial sustainability of the project;
(d) Technically possible to monitor and control each customer's off-take of water, including excessive demand cut-off mechanisms, through appropriate instrumentation and telemetry;
(e) Commercial arrangements and agreements that allocate risk appropriately between the government, WWTP, the management company and the growers;
(f) Appropriate safety measures and practices to avoid any occupational health and safety hazards;
(g) Best irrigation practice through soil surveys, review of on-farm irrigation systems and headworks, regular soil and crop management reports and seminars. Regular independent monitoring and audits need to be carried out; and
(h) Irrigation Management Plan that is scrutinized and monitored by various government agencies to ensure the sustainable management of the reclaimed water irrigation scheme.

10. Conclusion

This wastewater reuse scheme is a model example of a private sector, demand driven reuse scheme that is environmentally, financially, technically and commercially sustainable. An enlightened public sector, an enabling regulatory and policy regime and a commercially driven private sector can deliver a sustainable wastewater reuse project with no government subsidies.

A. Acknowledgements

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1. Norman Doole, Chairman, Willunga Basin Water Company
2. Glen Templeman, Operations Manager, Willunga Basin Water Company
3. John Gransbury, Principal Consultant, Hydro-Plan Irrigation Consultants
4. Dr. Nixon, John, Senior Research Scientist, United Water International

B. References

1. Gransbury, John, 2004, The Willunga Basin Pipeline,
2. Carter, Marianne, 2001, An Investigation into Agricultural Use of Reclaimed Water in the Willunga Basin, South Australia
3. McKean, Jack, 2002, Managing Adelaide's Water. The Role of the South Australian Water Corporation

ASIAN DEVELOPMENT BANK

PCR: TIM 81890

PROJECT COMPLETION REPORT

ON THE

WATER SUPPLY AND SANITATION REHABILITATION PROJECTS

PHASE I

(Grant 8185-TIM [TF])

AND

PHASE II

(Grant 8189-TIM [TF])

IN

TIMOR-LESTE

October 2004

CURRENCY EQUIVALENTS

Currency Unit – US dollar ($)

ABBREVIATIONS

ADB	–	Asian Development Bank
CWSS	–	Community Water Supply and Sanitation
ETTA	–	East Timor Transitional Administration
IEC	–	Information, Education and Communication
IWRM	–	Integrated Water Resources Management
NGO	–	nongovernment organization
O&M	–	operation and maintenance
PCR	–	Project Completion Report
PID	–	program implementation document
PMU	–	project management unit
PSC	–	project steering committee
RRP	–	Report and Recommendation of the President
SOTL	–	Special Office in Timor-Leste
SMIF	–	Sector Management Investment Framework
TFET	–	Trust Fund for East Timor
UN	–	United Nations
UNTAET	–	United Nations Transitional Administration in East Timor
WS&S	–	water supply and sanitation
WSS	–	Water and Sanitation Service
WSSRP-I	–	Water Supply and Sanitation Rehabilitation Project, Phase I
WSSRP-II	–	Water Supply and Sanitation Rehabilitation Project, Phase II

NOTES

(i) The fiscal year of the Government ends on 30 June.
(ii) In this report, "$" refers to US dollars.
(iii) The term Government refers to the Democratic Republic of Timor-Leste.

CONTENTS

BASIC DATA

A.	**Grant Identification**	
1.	Country	Timor-Leste
2.	Grant Number	Grant 8185-TIM(TF) : Water Supply and Sanitation Rehabilitation Project, Phase I Grant 8189-TIM(TF) : Water Supply and Sanitation Rehabilitation Project, Phase II
3.	Project Title	
4.	Borrower	Democratic Republic of Timor-Leste
5.	Executing Agency	Water and Sanitation Service (WSS)
6.	Amount of Grant	Grant 8185-TIM (TF) - $4.5 million Grant 8189-TIM (TF) - $4.5 million
7.	Project Completion Report Number	PCR: TIM 859

B.	**Grant Data**	
1.	Appraisal	
	– Date Started	
	Grant 8185-TIM(TF) – Phase I	4 June 2000
	Grant 8189-TIM(TF) – Phase II	5 March 2001
	– Date Completed	
	Grant 8185-TIM(TF) – Phase I	8 June 2000
	Grant 8189-TIM(TF) – Phase II	14 March 2001
2.	Grant Negotiations	
	– Date Started	
	Grant 8185-TIM(TF) – Phase I	20 July 2000
	Grant 8189-TIM(TF) – Phase II	3 July 2001
	– Date Completed	
	Grant 8185-TIM(TF) – Phase I	21 July 2000
	Grant 8189-TIM(TF) – Phase II	3 July 2001
3.	Date of Board Approval	
	Grant 8185-TIM(TF) – Phase I	31 July 2000
	Grant 8189-TIM(TF) – Phase II	13 July 2001
4.	Date of Grant Agreement	
	Grant 8185-TIM(TF) – Phase I	24 August 2000
	Grant 8189-TIM(TF) – Phase II	27 August 2001
5.	Date of Grant Effectiveness	
	Grant 8185-TIM(TF) – Phase I	
	– In Grant Agreement	no specific date mentioned in the Grant Agreement for effectivity date
	– Actual	24 August 2000
	– Number of Extensions	0
	Grant 8189-TIM(TF) – Phase II	
	- In Actual Agreement	no specific date mentioned in the Grant Agreement for effectivity date
	- Actual	27 August 2001

- Number of Extensions	0
6. Closing Date	
Grant 8185-TIM(TF) – Phase I	
– In Grant Agreement	31 December 2001
– Actual	30 June 2003
– Number of Extensions	1
Grant 8189-TIM(TF) – Phase II	
– In Grant Agreement	30 April 2003
– Actual	19 March 2004
– Number of Extensions	3
7. Terms of Grant	
– Interest Rate	NA
– Maturity (number of years)	
– Grace Period (number of years)	
8. Terms of Relending (if any)	
– Interest Rate	NA
– Maturity (number of years)	
– Grace Period (number of years)	

TIM = Timor-Leste, TF = Trust Fund
Source: Asian Development Bank

9. Disbursements

a. Dates

Grant 8185-TIM(TF)	**Initial Disbursement** 25 September 2000	**Final Disbursement** 30 June 2003	**Time Interval** 33.5 months
Grant 8189-TIM(TF)	22 January 2002	26 March 2004	14 months
Grant 8185-TIM(TF)	**Effective Date** 24 August 2000	**Original Closing Date** 31 December 2001	**Time Interval** 15 months
Grant 8189-TIM(TF)	27 August 2001	30 April 2003	19 months

TIM = Timor-Leste, TF = Trust Fund
Source: Asian Development Bank

b. Amounts ($)

Category	Original Allocation	Last Revised Allocation	Net Amount Available	Amount Disbursed	Undisbursed Balance
Grant 8185-TIM (TF) – Phase I					
01 – Water Supply & Sanitation Sector Mgt	633,000	706,346	706,346	706,346	0
02 – Capacity Building & Institutional Development	556,000	1,013,243	1,013,243	1,013,243	0
03 – Water Supply & Sanitation Implementation	2,657,000	2,780,411	2,780,411	2,780,411	0
04 – Unallocated	654,000	0	0	0	0
Total	**4,500,000**	**4,500,000**	**4,500,000**	**4,500,000**	**0**
Grant 8189-TIM(TF) – Phase II					
01- Water Supply & Sanitation Impl Program	2,776,000	3,201,228	3,201,228	3,201,228	0
02 –Capacity Building & Inst'l Dev't Program	585,000	621,136	621,136	621,136	0
03-Project Management Unit	486,000	677,636	677,636	677,636	0
04 – Unallocated	654,000	0	0	0	0
Total	**4,500,000**	**4,500,000**	**4,500,000**	**4,500,000**	**0**

TIM = Timor-Leste, TF = Trust Fund
Source: Asian Development Bank

10.	Local Costs (Financed)	
	– Amount ($)	NA
	– Percent of Local Costs	NA
	– Percent of Total Cost	NA

C. Project Data

1. Project Cost ($)

Cost	Appraisal Estimate	Actual
Foreign Exchange Cost		
Grant 8185-TIM(TF) – Phase I	4,500,000	4,500,000
Grant 8189-TIM(TF) – Phase II	4,500,000	4,500,000
Local Currency Cost	none in RRP	0
Total	**9,000,000**	**9,000,000**

RRP = Report and Recommendation to the President, TIM = Timor-Leste, TF = Trust Fund
Source: Asian Development Bank

2. Financing Plan[a] ($)

Cost	Appraisal Estimate	Actual
Implementation Costs		
Borrower-Financed		
ADB-Financed		
Other External Financing		
Grant 8185-TIM(TF)	4,500,000	4,500,000
Grant 8189-TIM(TF)	4,500,000	4,500,000
Total	9,000,000	9,000,000
IDC Costs	NA	NA
Borrower-Financed		
ADB-Financed		
Other External Financing		
Total	**9,000,000**	**9,000,000**

ADB = Asian Development Bank, IDC = interest during construction, NA = not applicable to grant project.
Source: Asian Development Bank
[a] This is a Trust Fund for East Timor (TFET) funded project.

3. Cost Breakdown by Project Components ($)

Component	Appraisal Estimate	Actual
I. Base Cost		
Grant 8185-TIM(TF) – Phase I		
A. WS&S Sector Management and Investment Program	633,000	706,346
B. Capacity Building & Institutional Development Program	556,000	1,013,243
C. Water Supply & Sanitation Implementation Program	2,657,000	2,780,411
Grant 8189-TIM(TF) – Phase II		
A. Water Supply & Sanitation Implementation	2,775,000	3,201,228
B. Capacity Building & Institutional Development	585,000	621,136
C. Project Management Unit	486,000	677,636
II. Contingencies		
1. Physical Contingencies		
Grant 8185-TIM(TF) – Phase I	562,000	0
Grant 8189-TIM(TF) – Phase II	562,000	0
2. Price Contingencies		
Grant 8185-TIM(TF) – Phase I	92,000	0
Grant 8189-TIM(TF) – Phase II	92,000	0
Total		
Grant 8185-TIM(TF) – Phase I	**4,500,000**	**4,500,000**
Grant 8189-TIM(TF) – Phase II	**4,500,000**	**4,500,000**

TIM = Timor-Leste, TF = Trust Fund
Source: Asian Development Bank

4. Project Schedule

Item	Appraisal Estimate[a] (not applicable)	Actual
Date of Contract with Consultants		
Grant 8185-TIM(TF)		Sep 2000, Oct 2000, Jan–Nov 2001
Grant 8189-TIM(TF)		Oct 2001, Feb 2002, Jun 2002, Oct–Nov 2002
Completion of Engineering Designs		
Civil Works Contract		
Grant 8185-TIM(TF)		Mar–Jun 2001, Nov 2001
Grant 8189-TIM(TF)		Sep 2002, Nov–Dec 2002, Jan 2003, Mar 2003, Jun 2003
Date of Award		
Completion of Work		
Grant 8185-TIM(TF)		Nov 2001
Grant 8189-TIM(TF)		Jun 2003
Equipment and Supplies		
Grant 8185-TIM(TF)		Mar 2001
Grant 8189-TIM(TF)		NA
Dates		
First Procurement		
Grant 8185-TIM(TF)		Jan 2001
Grant 8189-TIM(TF)		May 2002
Last Procurement		
Grant 8185-TIM(TF)		Nov 2001
Grant 8189-TIM(TF)		Jun 2003
Completion of Equipment Installation		
Grant 8185-TIM(TF)		Nov 2001
Grant 8189-TIM(TF)		Jun 2003
Start of Operations[b]		
Completion of Tests and Commissioning[b]		
Beginning of Startup[b]		
Other Milestones[b]		

TIM = Timor-Leste, TF = Trust Fund
Source: Asian Development Bank
[a] No appraisal dates indicated in the report and recommendation to the President.
[b] Due to the emergency nature of these projects, other milestone dates cannot be determined.

5. Project Performance Report Ratings

Implementation Period	Ratings
	Development Objectives/ Implementation Progress
Grant 8185-TIM(TF) – 31 July 2000–30 June 2003	S/S
Grant 8189-TIM(TF) – 13 July 2001–19 March 2004	S/S

TIM = Timor-Leste, TF = Trust Fund

D. Data on Asian Development Bank Missions[3]

Name of Mission	Date	No. of Persons	No. of Person-days	Specialization of Members[a]
Grant 8185-TIM(TF) – Phase I				
Fact Finding and Appraisal	4–8 Jun 2000	3	15	h,e,e
Inception	4–7 Sep 2000	2	8	h, i
Review	27–30 Nov 2000	2	8	h, i
Review	5–14 Mar 2001	2	20	h, i
Review	12–13 Mar 2001	1	2	h
Review	21–27 Oct 2001 24–27 Oct 2001	1 1	7 4	h, i
Special Loan Review	15–20 Feb 2002	1	6	i
Review	23–28 Sep 2002	1	6	i
Review	28 Feb 2003– 7 Mar 2003 3–7 Mar 2003	1 1	8 5	h, i
Project Completion Review[b]	24 May 2004– 3 Jun 2004	2	22	e, i
Grant 8189-TIM(TF) – Phase II				
Fact Finding and Appraisal	5–14 Mar 2001	4	40	h,i,j,g
Inception	24–26 Oct 2001	2	6	h, i
Review	23–28 Sep 2002	6	1	i
Review	28 Feb 2003 3–7 Mar 2003	1 1	8 5	h, i
Review	18–21 Jun 2003	1	4	h
Project Completion Review[b]	24 May 2004– 3 Jun 2004	2	22	e, i

TIM = Timor-Leste, TF = Trust Fund
Source: Asian Development Bank

[a] e-procurement or consultant specialist, g-program officer, h-project officer, i-assistant project analyst

[b] The Project Completion Report was prepared by Amarnath Hinduja, Cesar Yñiguez, Noris Galang and Zacarias da Costa.

[c] Weekly meetings held in Special Office in Timor-Leste (SOTL) for immediate resolutions of arising problems.


TIMOR-LESTE
124°30'E
126°30'E
8°30'S
9°30'S
0 5 10 15 20 25
Kilometers
National Capital
District Capital
Town
Hera Port
Main Road
River
District Boundary
International Boundary
Boundaries are not necessarily authoritative.
Atauro Island
Maumeta-Atauro
Strait of Wetar
Joco Island
Cape Cutcha
Tutuala
Lauten
Laivai
Baucau
Manatuto
Port Hera
Metinaro
DILI
Liquisa
Maubara
Laklo
Laleia
Vemasse
Laga
Luro
Lospalos
Iralalaro
Lore
Iliomar
Quelicai
Baquia
Venilale
Ossu
Viqueque
Barique
Beacu
Natar-Bora
Laclubar
Turiscai
Maubisse
Hato-Builico
Fatu-Berliu
Alas
Same
Ainaro
Hato-Udo
Betano
Zumalai
Fatalulic
Fohorem
Suai
Cape Suai
Bobonaro
Balibo
Atsabe
Ermera
Fatubessi
Lacluta
Atabae
Hatolina
Railako
Aileu
Maliana
Pane Macassar
Nitibe
Oe-Silo
Passabe
LIQUICA
DILI
MANATUTO
BAUCAU
LAUTEM
AILEU
ERMERA
BOBONARO
MANUFAHI
VIQUEQUE
AINARO
COVA-LIMA
OECUSSI
Timor Sea
Savu Sea
South China Sea
PACIFIC OCEAN
INDIAN OCEAN
Java Sea
KALIMANTAN
SULAWESI
SUMATRA
JAVA
BALI
FLORES
SUMBAWA
SUMBA
TIMOR
TIMOR-LESTE
HALMAHERA
BURU
CERAM
KEPULAUANARU
BANGKA
BELITUNG
110°00'E
130°00'E
10°00'N
10°00'S
0°
04-40085 HR

I. PROJECT DESCRIPTION

1. On 30 August 1999, the people of Timor-Leste voted overwhelmingly for independence. The following month, most of the country's infrastructure and private homes were destroyed by post-election violence. The widespread destruction included damage to town and village water supply and sanitation (WS&S) facilities throughout the country. Most WS&S records and documentation also were destroyed. Many of the former water supply managers left Timor-Leste, and the water supply or sanitation institutions ceased to exist.

2. The United Nations Transitional Administration in East Timor (UNTAET) assumed the interim administration of the country, in consultation with the National Consultative Council of East Timor. The Trust Fund for East Timor (TFET), administered jointly by the World Bank and the Asian Development Bank (ADB), was established to rebuild the country. With funding from TFET, ADB was responsible for rehabilitating the infrastructure, which included assisting in the restoration of damaged and inadequate WS&S infrastructure throughout Timor-Leste. ADB also aimed to re-establish the human and institutional capacity to manage, operate, and maintain these facilities. The ADB Board approved the procurement of materials and engagement of consultants from member countries of ADB, the World Bank, the UN, and other donors to TFET.

A. Grant 8185-TIM (TF): Water Supply and Sanitation Rehabilitation Projects, Phase I

3. The strategic goal of the Water Supply and Sanitation Rehabilitation Projects, Phase I (WSSRP-I) was to re-establish a system that would provide the people of Timor-Leste with adequate, affordable, and sustainable WS&S services using appropriate technology and effective management systems. The Project aimed to:

(i) develop a WS&S sector management and investment program, including (a) the establishment of a project management unit (PMU) under UNTAET's Water and Sanitation Service (WSS); and (b) the preparation of a detailed, budgeted program implementation document (PID) to coordinate improvements to Timor-Leste's WS&S sector;

(ii) establish a capacity building and institutional development program that would (a) identify and implement priority activities to support ongoing or planned physical construction, and (b) complement capacity and institutional development activities of other funding agencies; and

(iii) commence implementation of the WS&S program.

4. As appraised, WSSRP-I consisted of a (i) WS&S Sector Management and Investment Program, (ii) Capacity Building and Institutional Development Program, and (iii) Water Supply and Sanitation Implementation Program.

B. Grant 8189-TIM (TF): Water Supply and Sanitation Rehabilitation Projects, Phase II

5. The Water Supply and Sanitation Rehabilitation Projects, Phase II (WSSRP-II) continued the work that began under WSSRP-I with the same strategic goal. As appraised, WSSRP-II had three components:

(i) WS&S Implementation Program, which had five parts: (a) a quick-response facility to provide services and resources rapidly for urgent WS&S repair and rehabilitation needs across Timor-Leste; (b) priority rehabilitation and improvements for the Dili water supply system; (c) priority WS&S rehabilitation and improvements, focusing on district capitals; (d) rehabilitation and improvement of community-managed WS&S systems; and (e) urban sanitation improvements,

particularly for Dili, through investments in solid waste collection, septic tank desludging and septage treatment, and drainage rehabilitation.

(ii) Capacity Building and Institutional Development Program, which included technical assistance to WSS for policy development, human resources development, and institutional support; as well as the upgrading of essential computer and communication systems for the WSS Central Dili office, including the PMU.

(iii) Extension of the operation of the PMU established under WSSRP-I.

II. EVALUATION OF DESIGN AND IMPLEMENTATION

A. Relevance of Design and Formulation

6. The two projects, as designed, were extremely relevant to Timor-Leste's development objectives and ADB's country strategy and program. The implementation components of both projects responded to the urgency of restoring WS&S services to urban and rural areas. The capacity building and institutional development components of the projects also were relevant and necessary to sustain the services once the facilities were repaired and rehabilitated.

7. Fifteen months for each project was considered sufficient to repair and rehabilitate the targeted water systems. However, the cumulative 30 months for the projects was considered insufficient for developing the skills of the PMU counterpart and utility staff. WSS was still building its organization at the national and district levels, and most of its staff and managers had no sector experience. Capacity building generally is a long-term process, especially when the level of expertise is low, as it was in Timor-Leste. Due to the limited timeframe for TFET funding and the urgent need to complete the infrastructure, the projects could not assume total responsibility for such a long-term capacity building program. However, the projects started the human resources and institutional development for the sector.

8. The projects were designed with enough flexibility to permit appropriate responses to emerging post-conflict priorities in the sector, and to seize opportunities that emerge during project implementation. The formulation of a legal and regulatory framework for the WS&S sector and draft legislation for water resources, water supply, and sanitation were added during implementation.

B. Project Outputs

1. Grant 8185-TIM (TF): Water Supply and Sanitation Rehabilitation Project, Phase I

9. The project outputs for WSSRP-I under their respective components were:

a. Component A: Water Supply & Sanitation Sector Management and Investment Program

10. The outputs under component A are as follows:

(i) The PMU was established under WSS, comprising a domestic project manager and two full-time international staff; and

(ii) The PID and a sector management investment framework (SMIF) were prepared, which the PMU used in the implementation of the Project, and in coordinating and managing the sector.

b. Component B: Capacity Building and Institutional Development

11. The outputs under component B are as follows:

(i) Operations buildings of 12 WSS district offices were reconstructed and equipped with essential operation and maintenance (O&M) tools and vehicles;
(ii) A legal and regulatory framework for the WS&S sector and separate draft legislation for water resources, water services, and sanitation management were prepared; the Water Services Law was promulgated in February 2004;
(iii) A water supply tariff study analyzing consumers' willingness to pay and ability to pay was prepared to guide cost recovery for urban water suppliers;
(iv) WS&S standards and guidelines for WSS staff were established;
(v) An urban water treatment study for WSS district operations was conducted and;
(vi) A solid waste management plan for Dili was prepared.

c. Component C: Water Supply and Sanitation Implementation Program

12. The outputs under component C are as follows:

(i) **Quick-Response Facility.** Outputs under this component are as follows: (a) three boreholes in Dili and two in Suai were constructed; (b) the water transmission main over Cuha River in Viqueque was repaired; and (c) four generator sets were procured and handed over to WSS for use as standby power by its districts.

(ii) **Dili Water Supply Repair and Rehabilitation.** Outputs under this component are as follows: (a) a water distribution system was constructed in Bidau Santana; (b) the water systems in Hera were rehabilitated; (c) a water transmission main was laid to Becora; (d) a borehole was drilled in Bekosi; and (e) 4,000 meters of water were procured in preparation for the reintroduction of water user charges.

(iii) **Districts' Water Supply Repair and Rehabilitation.** Domestic and international nongovernment organizations (NGOs) undertook repair works in smaller urban and rural communities. Training in environmental health, gender awareness, community participation, and planning complemented these repair works. Outputs under this component are as follows: (a) repair and rehabilitation of district towns water supply systems in Liquica, Manatuto, Suai, and Viqueque were completed; and (b) NGOs rehabilitated community water supplies jointly with the communities in Ermera, Liquica, Lospalos, Manatuto, Same, Suai, Tapo, and Zumalai, benefiting 31,000 people.

13. A detailed description of project outputs for WSSRP-I is in Appendix 1(a).

2. Grant 8189-TIM (TF): Water Supply and Sanitation Rehabilitation Project, Phase II

14. The Project outputs for WSSRP-II under their respective components were:

a. Component A: Water Supply and Sanitation Implementation Program

15. The outputs under component A are as follows:

(i) **Quick-Response Facility.** Outputs undertaken for this component are as follows: (a) a borehole pump was replaced in Bidau Santana in Dili; (b) electrical equipment at a number of pumping stations in Dili was upgraded; (c) small construction contracts were implemented to improve the water supply infrastructure in Dili's Zone 10; (d) skilled personnel were hired to undertake minor design tasks to support the WSS Implementation Program; and (e) small-scale drain cleaning and manhole rehabilitation in Dili were undertaken as a capacity building exercise.

(ii) **Dili Water Supply Rehabilitation and Improvement Program**. Outputs undertaken for this component are as follows: (a) a domestic consulting firm and domestic engineering staff designed and documented improvements in distribution mains in the Beto area, and the warehouse at the Dili Distribution Depot, as part of capacity building; (b) the revision of the Dili water supply network plan was deferred following an agreement to undertake that component under a project supported by the Government of Japan; (c) Comoro G borehole was constructed to replace the Comoro A borehole, which has started to pump fine particles; and (d) additional development work was done on the Comoro F borehole, which was constructed under WSSRP-I.

(iii) **District Towns Water Supply Repair and Rehabilitation Program**. The capital works completed under this component of the Project included; (a) rehabilitation of part of the transmission main for Viqueque; (b) construction of a new intake, transmission main, reservoir, and distribution main in Lauhata in Liquica; (c) construction of a new transmission main, and installation of a new submersible borehole pump in Suai; (d) construction of a new borehole, and installation of a new transmission main, reservoir, distribution mains, and public tanks in Oecussi; (e) construction of intake works at principal surface water sources for Gleno and Maliana; and (f) rehabilitation of the transmission main, and construction of new reservoir for Maliana.

(iv) **Community Water Supply and Sanitation Rehabilitation and Improvement**. Sixteen domestic and international NGOs were contracted to implement water supply and sanitation projects in small communities and rural areas, with community participation in construction and management. The outputs from this component of the Project included: (a) about 74,000 people were provided with water in 30 subdistricts in eight districts of Timor-Leste; (b) 662 people were provided with household toilets in three districts; and (c) rainwater harvesting facilities were constructed, which benefited 1,746 people on Atauro Island.

(v) **Urban Sanitation Improvement**. Consultants assisted the WSS in preparing strategic plans, designs, and implementation contracts for drainage and wastewater improvements. The outputs under this component are as follows: (a) priority works to improve the operation of the central Dili drainage system, between the Maloa and Lahane streams, were completed. These works included clearing and repairing road inlet pits and replacing covers, and clearing open channels and pipe drains of sediment and solid waste accumulated over the years; (b) a storage

building at the Tibar waste disposal site was upgraded to house the service's bulldozer.

b. Component B: Capacity Building and Institutional Development Program

16. The outputs under this component are as follows:

(i) Twelve WSS staff went overseas for training to gain exposure to improved technology and management methods for water and sanitation services;
(ii) In January 2004, the Council of Ministers approved the Water Services decree, which the President signed into law in February 2004. The Sanitation Management legislation is still awaiting approval. The previous Water Resources Planning and Management assistance was deleted, and replaced by similar assistance from the ADB Water, Environment, and Natural Resources Technical Assistance package;
(iii) The Community Water Supply and Sanitation (CWSS) Guidelines were improved in cooperation with the Australian Agency for International Development CWSS Project;
(iv) The Project assisted WSS in developing the billing system;
(v) An infrastructure asset management system was prepared for WSS;
(vi) The Dili drainage and wastewater management strategy was prepared, establishing a clear institutional framework for the management of wastewater, drainage, and solid waste in urban areas. It also provided an implementation program for the medium term.

c. Component C: Project Management Unit

17. The Project strengthened planning and implementation capability of WSS through the transfer of skills to additional full-time domestic PMU staff as they worked on project activities with the project consultants. ADB and PMU staff participated in the Joint Donor Coordination Missions in March 2002 and June 2003. The missions reviewed policies, priorities, and institutional arrangements in the WS&S sector. They also identified the constraints to the achievement of the goals of external assistance to the sector. A draft Five-Year Water and Sanitation Development Plan was completed in April 2002, providing more details on WS&S sector plans than was in the SMIF prepared under WSSRP-I.

18. A detailed discussion of project outputs for WSSRP-II is in Appendix 1(b).

C. Project Costs

19. The $4.50 million budget for WSSRP-1 was fully disbursed by the end of the Project. Two reallocations were necessary during implementation, because (i) the cost of capacity building almost doubled when the scope of WSS district office and workshop rehabilitation was increased from the original seven districts to 12 districts; and (ii) additional works on a transmission main in Viqueque and a water treatment plant in Dili required more funds under WS&S implementation. Expenditures for WS&S management also increased due to the necessary extension of PMU staff contracts and two international consultants' contracts.

20. Project costs could have been estimated more accurately at appraisal. However, considering the emergency situation and the primary objective to restore infrastructure and services urgently, the adjustments in the scope of work could only be made when the PID was prepared and more information became available. Further, an immediate response to the emergency was needed. The overall project cost was unchanged as the adjustments were made

through reallocations. The changes helped the Project achieve the capacity building objective, making them relevant.

Table 1: Water Supply and Sanitation Rehabilitation Project – Phase I Cost Breakdown by Project Components
($)

Component	Appraisal Estimate	Actual
A. Base Cost		
1. Water Supply and Sanitation Sector Management and Investment Program	633,000	706,346
2. Capacity Building & Institutional Development Program	556,000	1,013,243
3. Water Supply & Sanitation Implementation Program	2,657,000	2,780,411
B. Contingencies		
Physical Contingencies	562,000	0
Price Contingencies	92,000	0
Total	**4,500,000**	**4,500,000**

Source: Asian Development Bank

21. The $4.50 million budget for WSSRP-II also was fully disbursed. The WS&S implementation component was increased from $2.78 million to $3.20 million with the addition of rehabilitation works in the water supply systems of Liquica, Maliana, Oecussi, Suai, and Viqueque. This followed the Government's policy decision in late 2002 to focus on rural development, shifting most of the contingencies to district town water supply and community water supply and sanitation. A significant portion of the added cost went to Oecussi, a district that had missed out on funding in the past due to its geographic isolation from the rest of Timor-Leste.

22. The cost of capacity building also increased from $0.59 million to $0.62 million due to the addition of water supply and drainage planning activities for Dili. The PMU component increased from $0.49 million to $0.68 million due to the extension of the Project from the original 15 months to 22 months. These changes were achieved through the reallocation of contingencies. In view of Government's policy change, the use of contingencies was justified since the reallocation helped the Project achieve its objective of providing greater access to water and sanitation services to the people of Timor-Leste.

Table 2: Water Supply and Sanitation Rehabilitation Project – Phase II Cost Breakdown by Project Components
($)

Component	Appraisal Estimate	Actual
A. Base Cost		
1. Water Supply and Sanitation Implementation Program	2,775,000	3,201,228
2. Capacity Building and Institutional Development Program	585,000	621,136
3. Project Management Unit	486,000	677,636
B. Contingencies		

Physical Contingencies	562,000	0
Price Contingencies	92,000	0
Total	**4,500,000**	**4,500,000**

Source : Asian Development Bank

D. Disbursements

23. The $4.50 million grant available for each of the projects was fully disbursed at their respective closing dates. The use of the imprest account for the projects greatly facilitated the payment of the many small contracts. The imprest advance was $1.40 million for WSSRP-I, and $1.00 million for WSSRP-II. Overall, the disbursement procedures adopted for the projects were satisfactory and helped improve the efficiency of project implementation.

E. Project Schedule

24. Under the Grant Agreement, WSSRP-I was to be implemented from 24 August 2000 to 30 June 2001. Completion was significantly delayed, and the original closing date of 31 December 2001 was extended to 30 June 2003. Most of the WS&S implementation for the district towns and the quick-repair facility were completed by 30 November 2001 well within the original closing date. However, the Dili Water Supply Repair and Rehabilitation activities were not completed until 31 March 2003, as this component was linked to the Government of Japan's ongoing implementation work in Dili district. A comparison of the proposed and actual implementation schedule for WSSRP-I is shown in Table A2.1 in Appendix 2.

25. The appointment of domestic counterpart staff to the PMU was delayed by 6 months. The international consultants assigned to the PMU managed the Project. Domestic contractors encountered delays on civil works projects in the districts due to the lack of qualified or experienced domestic engineers and field supervisors. With so many emergency WS&S projects being implemented by external funding agencies, they were competing for the services of a limited number of domestic contractors.

26. The NGOs also encountered delays with community WS&S projects. They had to spend time organizing the community and developing the users to participate in project implementation, and subsequently O&M. While the time for these activities might have been underestimated, the involvement of domestic NGOs in their implementation was essential due to the dearth of available domestic contractors. The NGOs' involvement also was critical to the long-term sustainability of the projects.

27. Under the Grant Agreement, WSSRP-II was to begin immediately after the completion of WSSRP-I and run from 27 August 2001 to 30 October 2002. Except for the provision of information technology and communication equipment, all activities were completed by December 2003. The Project was closed on 19 March 2004. The need to complete WSSRP-I activities satisfactorily and fully utilize WSSRP-I funds delayed the start of WSSRP-II activities.

28. The successive changes in the governing authority from UNTAET to the East Timor Transitional Administration (ETTA) to the Government also delayed and affected project implementation. Every change in the ministries concerned with the projects required another orientation of the ministers and their advisers. They needed more time to review and decide on issues, delaying the approval of project matters. Eventually, such issues were resolved through the joint efforts of the WSS and PMU, with strong support by ADB's Special Office in Timor-Leste (SOTL) and frequent ADB review missions. A comparison of proposed and actual implementation schedule for WSSRP-II is shown in Table A2.2 in Appendix 2.

29. These projects demonstrated that capacity building at the national, district, and community levels, which was essential to project implementation and sustainability, required more time than had been estimated. However, the post-conflict conditions in Timor-Leste were unusual, which made a realistic assessment of the capacity building needs at the time of project appraisal very difficult. With progressive changes in the conditions, a more in-depth analysis of the prevailing needs must be included in the preparation of future projects involving capacity building. Overall, the projects were successful in establishing systems and developing capacity to provide a basic level of service that existed before the conflict. Significant future assistance will be necessary to overcome the institutional and human resources constraints of the WSS and the other stakeholders in the sector.

F. Implementation Arrangements

30. Except for the establishment of a project steering committee (PSC), the implementation arrangements envisaged at appraisal for the projects were followed and were effective in attaining the project objectives. The Infrastructure Advisory Committee initially was proposed to take the role of the PSC. However, this proposal was abandoned due to difficulties in convening monthly meetings of senior officials of other sectors. However, implementation, procurement, community, and other project issues were resolved effectively in the regular weekly meetings between the PMU and SOTL, and during the review missions for the two projects.

31. The technical approach for both projects called for works to incorporate labor-intensive and employment-generating methodologies, and least-cost technical solutions. Works for the district and community water supplies were awarded to domestic contractors, and international and domestic NGOs. WSSRP-I contracts generated an estimated 12,100 person-days of direct domestic employment, and 12,500 person-days of indirect domestic employment. WSSRP-II contracts generated an estimated 18,500 person-days of direct domestic employment, and 30,000 person-days of indirect domestic employment. The approach was effective in developing the capability of domestic contractors and NGOs to undertake WS&S projects.

32. Since most of the works under the WS&S implementation components involved repair and maintenance, these district and community water supply projects were within existing rights-of-way. No resettlement was required for any of the components in WSSRP-I and WSSRP-II.

G. Conditions and Covenants

33. The Recipient and the PMU complied with the majority of the conditions stipulated in the Grant Agreements. These included the timely preparation of reports (Inception, Risk Management, and Performance Monitoring Indicators), as well as regular progress reports to ADB and for the TFET. However, the establishment of the PSC for WSSRP-I and WSSRP-II was not complied with (para.30). Tables A4.1 and A4.2 in Appendixes 3a and 3b show the compliance status concerning all major conditions and covenants for WSSRP-I and WSSRP-II, respectively.

H. Consultant Recruitment and Procurement

34. The recruitment of consultants was carried out in accordance with ADB guidelines. As agreed, consultants were recruited from ADB member countries, as well as all donors (or external sources) and members of international organizations that contributed to the TFET. Relevant procedures were followed when domestic and international NGOs and domestic contractors were hired to implement community WS&S projects and do civil works for district water supply systems.

35. NGO contracts were awarded based on demonstrated WS&S experience and prior work in the localities assigned to them. Donors accepted the UNTAET/ETTA policy to assign NGOs to

specific districts to minimize potential overlap in the communities. A simplified approach was used for the NGO contracts, wherein NGOs submitted proposals based on the terms of reference prepared by the PMU and WSS-issued guidelines.

36. Contracts for civil works for district water supplies were awarded to prequalified contractors based in Timor-Leste. Prequalification and local competitive bidding documents were in the English and Indonesian languages to minimize the possibility that the bidders would misunderstand the contents of the documents.

37. No significant problems were encountered in the recruitment of consultants and the procurement of equipment, supplies, and materials. As a whole, the recruitment and procurement processes used for the projects were satisfactory and effective.

I. Performance of Consultants, Contractors, and Suppliers

38. The consultants who handled capacity building performed well in delivering their outputs, notwithstanding the constraints in transferring skills to counterpart domestic staff. In addition to being deployed late, the domestic staff had little experience or qualifications.

39. The performance of consultants assigned to design the systems and supervise the construction by domestic contractors was questionable in some of the districts. The water tank built in Liquica (Lauhata) should not have been accepted, because it sprung a leak and could not be used. One borehole in Liquica and two in Suai also could not be used due to insufficient power supply. The design should have included electrical equipment appropriate for the location. Water production in some boreholes visited by the Project Completion Review (PCR) Mission was not adequate to meet the community demand. Better assessment of domestic contractors' capabilities could have prevented the delay in the projects as well. Overall, the performance of these consultants was rated partly satisfactory.

40. In general, most of the NGOs contracted to implement district and community water supply and sanitation projects performed satisfactorily, and completed their works within the contracted periods. Fourteen NGOs were contracted to implement projects in seven districts under WSSRP-I, which provided new or rehabilitated water supply to 31,000 people. Contracts were awarded to 10 domestic NGOs and six international NGOs under WSSRP-II, which benefited 21,200 beneficiaries. Despite some difficulties, the support and assistance from these NGOs greatly aided the improvement of access to water supply and sanitation services.

41. Three civil works contractors completed their contracts within time and cost expectations, and produced acceptable quality work. However, two civil works contracts were delayed due to the transfer of key staff to other projects of the contractors in Timor-Leste. The more qualified domestic contractors preferred to work on larger projects. The performance of domestic contractors was rated partly satisfactory.

J. Performance of the Recipient and the Executing Agency

42. While the transitional government was in place, international staff managed WSS. The national staff only took key positions in the later stages of WSSRP-I implementation. This absence of early national involvement in the Project created some problems with WSS ownership of WSSRP-I activities. In some instances, WSS did not immediately accept ongoing operational and maintenance responsibilities of completed project infrastructure.

43. WSSRP-II was implemented in a very different, but still evolving, political and institutional environment. Recruitment and procurement approvals took longer than expected as new ministers and their staff had to familiarize themselves with procedures that their predecessors already had agreed upon. Despite these constraints, the partnership between WSS (through the

PMU) and ADB, with the close monitoring and support of SOTL, overcame these implementation difficulties. Given the weaknesses in WSS, the performance of the Government and WSS was rated partly satisfactory.

K. Performance of the Asian Development Bank

44. ADB exercised considerable flexibility in the implementation of WSSRP-I and WSSRP-II. It had to adjust to evolving institutional changes over the duration of the two projects from the UNTAET to ETTA to the present Government established with the declaration of independence in May 2002. ADB supported PMU requests that would enhance management and administration of the projects.

45. ADB fielded eight review missions for WSSRP-I and four for WSSRP-II to monitor project progress and ensure timely resolution of implementation issues. Special attention was given during implementation of WSSRP-I, and at the early stages of WSSRP-II. SOTL took a proactive role in the implementation of the projects, helping WSS overcome some of its difficulties by holding weekly meetings with project counterparts. Given the human resource and organizational constraints of the WSS, ADB made extra efforts to guide and assist the implementation of the two projects. Overall, the performance of ADB was rated highly satisfactory.

III. EVALUATION OF PERFORMANCE

A. Relevance

46. The designs of the projects were highly relevant to the Government's national development strategy and ADB's country strategy and program. The projects provided immediate assistance by repairing and rehabilitating urban water supply systems in Dili and selected districts, and community water supply and sanitation systems. They also provided capacity building activities for the institutional strengthening of WSS over the longer term. The flexibility of the design allowed the formulation of a legal and regulatory framework for the sector and draft legislation on water supply services and sanitation management, which led to the approval of the Water Services Law. These changes enhanced the relevance of the projects, particularly by strengthening the sector management capability of WSS. Overall, the projects were rated highly relevant.

B. Efficacy in Achievement of Purpose

47. The projects achieved their common objectives to (i) rehabilitate and restore damaged and inadequate WS&S infrastructure throughout Timor-Leste, and (ii) re-establish the human and institutional capacity needed to manage, operate, and maintain the WS&S structures. The improved WS&S services implemented under WSSRP-I benefited 31,400 people directly. WSSRP-II similarly benefited 80,500 people. The short duration and limited funds of the projects constrained their impact on the provision of sanitation services, and only 226 household toilets were installed in three districts.

48. The capacity building and institutional development components of the projects helped lay the groundwork for improved planning and implementation of WS&S projects by WSS, the agency responsible for the development of the sector. The Five-Year Water Supply and Sanitation Development Plan will provide a longer term guide for increased WS&S coverage. Water supply coverage is estimated at 64% in urban areas and 34% in rural areas, while sanitation coverage is 34% in urban areas and 8% in rural areas. The billing system developed under the projects, and the tariff system that was part of the approved Water Services Law, will enhance cost recovery. That should lead to sustainable urban water supplies in Dili and the district towns. Given the limitation of their coverage, the projects were rated efficacious.

C. Efficiency in Achievement of Outputs and Purpose

49. Together, WSSRP-I and WSSRP-II provided about 112,000 people with direct access to WS&S services, and generated 74,100 person-days of direct and indirect domestic employment. The projects also enhanced the capacity of WSS staff directly involved in implementation of the capacity building activities. The experience gained by domestic contractors and NGOs in implementing subprojects enhanced their capacity to implement future WS&S projects in Timor-Leste.

50. The other capacity building and institutional development activities, such as the development of draft legislation for the sector, asset management systems, billing systems, tariff structures, and sector development plans, have not produced direct benefits. However, these have the potential to enhance the development of the WS&S sector once they are put in place and used. While WSS encountered some difficulties in implementation, ADB was a highly efficient and effective partner that intervened to help resolve issues.

51. **Financial Evaluation.** During the crisis in 1999, most of the installations in Timor-Leste were destroyed. The primary objective of this post-conflict emergency assistance was to restore the infrastructure that existed before the crisis, providing the community with basic access to water and sanitation. Given the emergency situation, financial viability was not given a high priority in the early stage of the projects. However, financial viability would be critical to the long-term sustainability of the project outputs. Further, since the destruction was almost total, no pre-project indicators were available, making any comparison with past financial evaluations impractical. Thus, the assessment of financial viability depended solely on the development of these projects. However, the projects instituted measures to ensure sustainability of the infrastructure that was developed. A cost recovery mechanism, including a tariff structure and a billing system, was developed under the projects. While implementation of the cost recovery system was not started during the life of the projects, all necessary legislation was approved. Plans to start billing the water users are underway under a separate assistance.

52. **Economic Evaluation**. The projects were designed essentially to address the emergency WS&S needs of Timor-Leste. Since an economic analysis was not done at appraisal, the PCR Mission could not undertake an economic analysis of the projects. Access to clean water is a basic need for people. The projects provided economic benefits to as many as 112,000 people, who gained direct access to WS&S services. In addition, the projects created 74,100 person-days of direct and indirect domestic employment. Considering the destruction of all water infrastructure, the net economic benefits would be positive. In urban areas, the projects introduced a system that would permit the created water agency to introduce water user charges to help spur economic growth in the district towns. In rural areas, the projects freed labor for more productive economic uses and reduced health-related costs. Even though these benefits have not been measured, we are confident that the projects provide a net positive economic benefit to the society. Further details are contained in Appendix 4.

53. Overall, the Project was rated efficient.

D. Preliminary Assessment of Sustainability

54. The sustainability of the WS&S facilities provided under the two projects will depend on the capacity of the Government and WSS, especially at the district level, to maintain them. During field visits, the PCR Mission observed some O&M problems in the district water supplies. These included reduced pumping outputs, vandalized or missing public taps, and slow responses by the WSS head office in Dili district to requests for assistance or supplies from the districts.

55. To enhance the sustainability of WS&S services in small communities and rural areas, the NGO contracts for implementing community WS&S projects required the benefiting

communities to commit social capital towards construction and ongoing O&M activities before physical activities commenced. Each WSS district office has only one community water supply and sanitation officer. Initial O&M and minor repairs have been accomplished with the assistance of the NGOs. However, long-term maintenance is beyond the capacities of the communities. Continued support will be required for the long-term sustainability of the projects.

56. Financial sustainability of these urban water supplies would be possible with the collection of water user charges or tariffs that cover the costs of basic O&M, repairs, and expansion to increase the coverage and revenue base for the utilities. While user charges were not being collected at PCR, consumers in the district towns have expressed willingness to pay such charges. With legislation to permit collection approved and a billing system designed, collection of user charges needs to begin urgently. Thus, the sustainability was rated as less likely.

E. Environmental, Sociocultural, and Other Impacts

57. As anticipated at appraisal, the projects' environmental impacts were minimal. Minor construction caused transient environmental disturbances, which were insignificant. Typical environmental disturbances during water supply construction included minor excavations to replace damaged pipes and fittings, temporary road closures to allow pipe replacement, small clearings along pipelines being replaced, and small clearings for drill rig and truck access to borehole sites.

58. The repair of offices, workshops, store, storage tanks, and borehole housing were carried out on sites of existing damaged structures. No significant environmental effects were observed, other than those associated with normal small building construction, such as cartage of building materials and construction noise. No relocation or resettlement was required as the projects used existing rights-of-way or public lands.

59. The environmental and social benefits of the projects were significant. The improved access to WS&S upgraded the quality of life for people in urban and rural areas. Without the projects, the people's attempts to improve their status and health would continue to be impeded by the need to divert time, energy, and financial resources to acquire water for their daily needs. Overall, the projects provided significant positive impacts.

IV. OVERALL ASSESSMENT AND RECOMMENDATIONS

A. Overall Assessment

60. The projects were implemented as proposed, with some flexibility. Water and sanitation facilities were repaired and rehabilitated in the district towns, small communities, and the rural areas. Despite time limitations and counterpart staff constraints, capacity building was undertaken. The PMU resolved implementation issues with support from the international consultants and SOTL. The projects (i) substantially improved access to WS&S services for about 112,000 people of Timor-Leste, (ii) improved management systems, and (iii) enhanced community empowerment. Considering the extraordinarily difficult situation in Timor-Leste before and during the projects, including the evolving political and institutional changes, WSSRP-I and WSSRP-II were rated successful.

B. Lessons Learned

61. The review of the projects identified several lessons learned that should be applied to future WS&S sector projects. These lessons apply to the projects' success and sustainability:

(i) Officials at the national, district, and community levels should become involved early in projects, and should be encouraged to give people a sense of ownership and responsibility for the success and sustainability of projects;

(ii) A strong sector organization and competent staff are needed to implement and sustain WS&S sector development plans and projects. For effective human resource capacity building, the organization must be well structured and function properly;

(iii) A strong partnership between WSS (through the PMU) and ADB, coupled with close monitoring of the projects, was effective in solving problems;

(iv) NGOs can be effective partners of the Government and the communities in implementing community-managed WS&S projects by providing technical and institutional assistance;

(v) Funds are needed for continuing O&M of WS&S facilities at district and community levels;

(vi) Sanitation is a necessary component along with health and hygiene education for maximizing health benefits from water supply projects. However, sanitation is not given enough attention, as the low coverage and small number of projects implemented demonstrated;

(vii) A big gap remains between the WS&S coverage and the National Development Plan goals, which will require large investments that are beyond the Government's resources;

(viii) Flexibility is required when designing sector programs in a post-conflict country such as Timor-Leste. Implementing projects takes longer when the institutional capacities are uncertain.

C. Recommendations

1. Project-Related

62. Several activities need follow-up:

(i) The Government needs to approve the organic law for the Ministry of Transport, Communication, and Public Works, which would establish the mandate and organization of WSS;

(ii) WSS national and district offices should develop and strengthen their institutional and human resources capacities;

(iii) Water user charges for urban water supplies in the district towns should be introduced, along with the installation of water meters and the enforcement of the billing system;

(iv) WSS should mandate the capable NGOs to provide O&M services to community water and sanitation systems at cost to the water user groups;

(v) Sanitation and hygiene education should be integrated with water supply programs, especially in rural communities;

(vi) WS&S policies need to be developed, and long-term sector development plans prepared, for Timor-Leste to attain its national development goals;

(vii) Appropriate power connections to the borehole pumps in Lauhata and two community water supply facilities in Suai need to be installed.

63. Assistance in human resource and institutional development is required to improve project performance and sustainability. Technical assistance in the preparation of a long-term sector development plan also is needed.

2. General

64. **Project Performance Audit Report Preparation**. To meaningfully assess the operational performance and development impacts, a project performance audit report mission should be fielded in 2005 when all the facilities should be operating.

PROJECT OUTPUTS

Table A1.1: Detailed Project Outputs for Grant 8185-TIM(TF) : Water Supply and Sanitation Rehabilitation – Phase I

Components	Planned Outputs	Actual Outputs
Component A: Water Supply and Sanitation Sector Management and Implementation Program		
(a) Establishment of a Project Management Unit (PMU) in United Nations Transitional Administration in East Timor (UNTAET's) Water and Sanitation Service (WSS)	• Effective PMU; close coordination with WSS, donors, NGOs, and communities by September 2000	• PMU established; regular contacts maintained with the East Timor NGO Forum, domestic and international NGOs, and donors involved in the sector
(b) Planning for the Sector: Preparation of program implementation document (PID)	• Detailed Water Supply and Sanitation (WS&S) implementation plan For FY2003 completed by December 2000 • Indicative plan for subsequent 2 years and beyond completed by December 2000	• PID completed and approved by UNTAET • Sector Management Investment Framework (SMIF) completed and approved by UNTAET
Component B: Capacity Building and Institutional Development Program		
(a) Short-Term Support: Priority activities in support of ongoing rehabilitation projects as identified by WSS and the PID	• Repairs and fit-out to priority WS&S buildings (workshops, stores, generator buildings) in the main towns of each of 12 districts (excluding Dili) • Replacement of priority tools, equipment, and materials in the main towns of each of 12 districts (excluding Dili) • Replacement of priority information technology and communications equipment in the main towns of each of 12 districts (excluding Dili) • Capacity building technical assistance packages	• WSS offices and/or stores constructed or renovated in all 12 district towns • PMU and WSS district offices provided with vehicles, priority tools, equipment, and materials • Radio equipment procured and installed in 12 WSS district offices • The following technical assistance were provided: - Water supply design, documentation, and contract supervision - IEC program developed and implemented - Policy, legislation, and guidelines prepared

Components	Planned Outputs	Actual Outputs
		- Water supply tariff study completed - National WS&S technical standards and guidelines completed - Solid waste management plan for Dili completed - Water quality improvement plan completed
Component C: WS&S Implementation Program		
(a) WSS Quick-Response Facility: Provision of resources sufficient to respond rapidly to urgent town and villageWS&S repair and rehabilitation needs of Timor-Leste	Emergency repairs and rehabilitation to Dili and districts' water supply systems (approximately 30) through: • Rehabilitation or new bores in Dili (Bekosi) and Suai • River crossing pipe realignment in Viqueque • Solid waste removal from damaged buildings and drains in Dili • Generator sets and fuel tanks for standby power for WSS bores • Miscellaneous design and construction services	• Three bores completed in Dili and two in Suai; one Suai bore abandoned • Completed • Completed by Sanitation Section of WSS • Four generator sets with associated equipment supplied to WSS • Subcontract for drafting services awarded, and work completed
(b) Dili Water Supply Repair and Rehabilitation Program: Provision of resources to repair and rehabilitate Dili water distribution network to complement upstream rehabilitation by the Government of Japan	Repairs and rehabilitation to Dili water supply system (approximately 30) through provision of: • Design and construction of Bidau Santana system • Design and construction of transmission main to Becora, including Bekosi bore • Pipe replacement in Motael area and zone isolation • Hera system rehabilitation • Information, Education and Communication (IEC) programs to support WSS field activities • Technical assistance for market solid waste disposal • Meter and valve procurement for consumer connections	• Works in Bidau Santana completed • Works for Bekosi bore and Becora main completed • Replacement deferred because Japan project design for the Dili Water Supply Project delayed. • Works completed • Domestic NGO Bia Hula implemented IEC programs successfully • Solid waste management plan for Dili prepared with tender documents • 4,000 water meters procured • Completed

Components	Planned Outputs	Actual Outputs
	• Design and documentation of Year 2 works • Minor civil design, documentation, supervision, and civil construction works	• Completed
(c) District Water Supply Repair & Rehabilitation Program: Small towns and villages in selected priority districts using community participation and planning processes	• Repair and rehabilitation of priority small town water supplies and sanitation • Repair and rehabilitation of priority village water supplies and sanitation • Priorities and activities based on need, willingness to pay, and funds availability • Six NGOs working in each district on approximately 20 sites, starting in January 2001 • Design and documentation of transmission, storage, and distribution for new bores in Suai and Liquica • Asset mapping and feasibility study for Oecussi • Design and documentation works for Year 2 rehabilitation works • Borehole rehabilitation in Suai • Minor design, documentation, supervision, and civil works	• Water supply rehabilitation works completed in eight districts through NGO contracts • Water supply rehabilitation works completed in eight districts through NGO contracts • NGOs formed water user groups • Twelve contracts awarded to six NGOs for rehabilitation works • Completed • Completed • Completed • Completed • Completed

Table A1.2: Detailed Project Outputs for Grant 8189-TIM(TF) : Water Supply and Sanitation Rehabilitation Project – Phase II

Components	Planned Outputs	Actual Outputs
Component A: WS&S Implementation Program		
(a) Water Supply and Sanitation (WS&S) Quick-Response Facility: Provision of resources sufficient to respond rapidly to urgent town and village WS&S repair and rehabilitation needs of Timor-Leste	• Quick-response design services	• Minor design tasks completed; drafting services contracted
	• Quick-response construction contracts	• (a) Electrical supply upgrading in Dili pumping stations; (b) fencing and associated land acquisition works completed in Dili; (c) small-scale drain cleaning and manhole rehabilitation in Dili; (d) improvement of water supply infrastructure in Dili's Zone 10
	• Quick-response equipment procurement	• (a) Pump procured for Bidau Santana borehole; (b) materials procured for upgrading of WTP for Dili and Oecussi.
	• Miscellaneous capacity building	• Nine university students given on-the-job training to assist PMU-WSS staff.
(b) Dili Water Supply Rehabilitation and Improvement Program: Provision of resources to repair and rehabilitate Dili water distribution network to complement upstream rehabilitation by the Government of Japan.	Repairs and rehabilitation to Dili water supply system through provision of:	Detailed implementation program prepared and agreed upon with Water and Sanitation Service (WSS):
	• Small contracts for miscellaneous work	• (a) additional development work for Comorro F bore; (b) Comorro G well completed
	• Design and documentation for miscellaneous small-scale work	• (a) Design for distribution mains improvement in Beto (Zone 1); (b) design and documentation for warehouse at Dili Distribution Depot
	• Equipment procurement for distribution system repair and improvement	• Equipment for Comorro F and G boreholes procured
	• Construction of priority distribution system augmentation	• None
	• Installation of meters for large consumers	• Contract for installation of 224 water meters for non-domestic services procured.
	• NGO contracts for IEC programs,	• IEC programs completed and used.

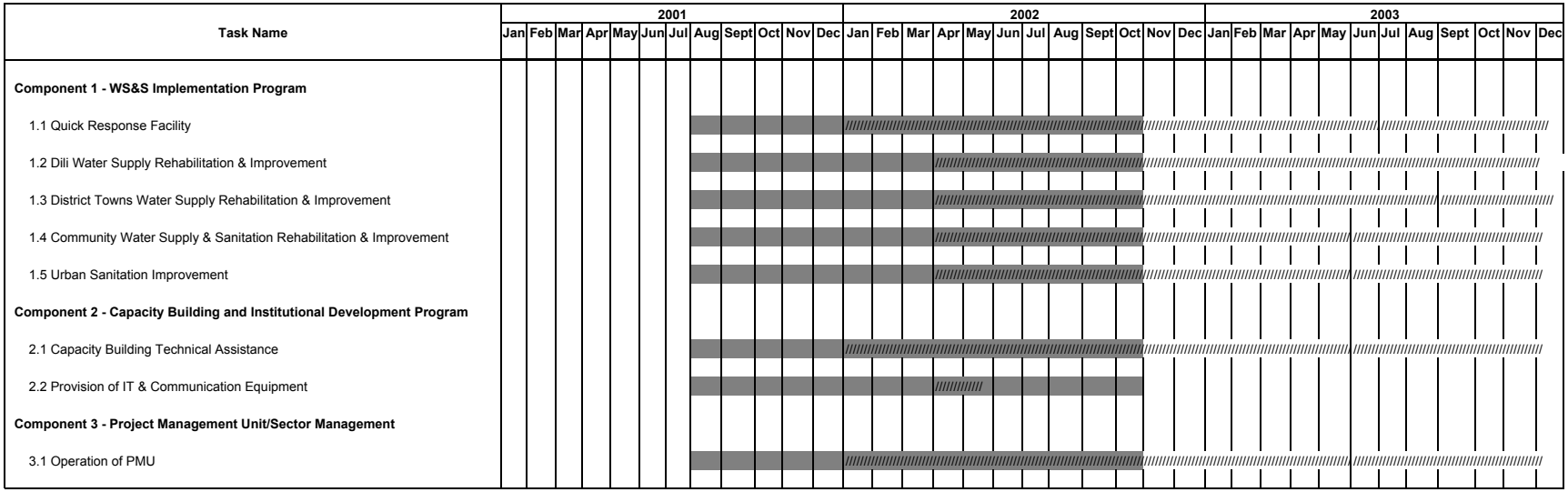
Components	Planned Outputs	Actual Outputs
	community mapping, and problem solving • Installation of gauging stations on surface water sources, rehabilitation of meteorological stations All activities to start October 2001.	• Deleted. The component will be part of Integrated Water Resources Management (IWRM) TA.
(c) District Town (Public) Water Supply Repair and Rehabilitation: Focusing on district capitals and priority works consistent with agreed master plans	Repairs and rehabilitation to district towns (public) water supply system through the provision of : • Small contracts for miscellaneous work • Design and documentation for miscellaneous small-scale work • Equipment procurement for distribution system repair and improvement • NGO contracts for priority rehabilitation and repair and associated IEC programs • Installation of gauging stations on surface water sources All activities to start September 2001.	Water supply systems works completed in Gleno, Liquica, Manliana, Oecussi, Suai, and Viqueque: • Rehabilitation of part of Viqueque transmission main completed • Construction of new intake, transmission main, reservoir, and distribution main in Lauhata (Liquica) completed • Construction of new transmission main and installation of new pump in Suai completed • Construction of new bore, reservoir, distribution mains, and new transmission main in Oecussi completed • Intake improvement works at principal surface water sources for Gleno and Maliana completed • Installation of new reservoir for Gleno completed • Rehabilitation of the transmission main and construction of new reservoir for Maliana completed • Installation of gauging stations deleted, will be part of ADB TA on IWRM
(d) Community Water Supply and Sanitation Rehabilitation and Improvement: Focusing on peri-urban, district, subdistrict, and rural WS&S systems through NGO and/or support from other bilateral programs.	Rehabilitation and improvement of community water supply and sanitation using community participatory approaches and integrated with hygiene promotions programs commencing September 2001, through: • Design and/or technical services for priority systems • Equipment procurement for	• Fifteen contracts awarded to 10 domestic and six international NGOs. An estimated 21,200 people will benefit. • All contracts included use of community participatory processes • More detailed TORs and procurement arrangements

Components	Planned Outputs	Actual Outputs
	Priority systems • NGO contracts for priority rehabilitation and improvement through community participatory process • Support and funding for extensions to approved projects and or programs through other bilateral and or multilateral programs.	were used following lessons learned from WSSRP-I.
(e) Urban Sanitation Improvement: Focusing on Dili drainage, solid waste, and human waste management (including incentives for private sector involvement)	Implementation of priority improvements to urban sanitation through: • Solid waste collection and disposal, including implementation of minor civil works, equipment hire, and collection works through private sector contracts • Implementation of priority drainage improvements by force account (day labor and equipment hire), including removal of accumulated solid waste and sediment, and structural repairs to drains and associated structures • Private sector contracts for septage collection, and disposal from major waste generators All activities to start by September 2001.	Strategic plans, designs, and implementation contracts for drainage and wastewater improvements completed • Solid waste collection deleted. Rehabilitation of Tibar waste disposal site done instead. Upgrading of storage building at Tibar waste disposal completed • Priority works to improve operation of Dili drainage system between Maloa and Lahane streams completed • Septage collection and disposal not done
Component B: Capacity Building and Institutional Development Program		
(a) Capacity Building and Technical Assistance: Comprising training, capacity building for system development and implementation, water resources, aid coordination, and environmental monitoring	• Training programs for WSS staff	• Activity added at Inception Report to include: - development of hydraulic network software - Four East Timorese given on-the-job Auto CAD training - Seven senior WSS officers received training in Bangkok, Sydney, and Perth on water supply technology, pricing and asset management, and water resources sustainability

Components	Planned Outputs	Actual Outputs
	• Management and financial information systems • Water resources study • Tariff and billing system implementation • Asset management system implementation • Major projects, donor and NGO coordination • Environmental monitoring and evaluation • All activities to be accomplished by May 2002	• Twelve WSs domestic staff received various training in English, bookkeeping, accounting package, and participation in the 3rd IWA Congress in Melbourne • Deleted. Assistance to be provided through Ministry of Finance • Deleted. To be part of ADB IWRM TA • Tariff study completed. Billing system developed and installed; still to be used • Completed • Five-Year Water and Sanitation Development Plan prepared • Deleted. Implemented under ADB TA 3501
(b) Information Technology (IT) and Communications Equipment: Comprising computer equipment, including local area network and communications system for WSS and PMU office	• Local area network for WSS, including PMU • Reliable Internet and e-mail access by March 2002 Facilities to be realized by March 2002	• WSS-PMU implemented and improve Local Area Network, backup facility, Internet access and advanced photocopying capability within PMU; capacity to provide services to WSS in the future made available • Internet and e-mail access provided
Component C: Project Management Unit (PMU)		
Establishment of PMU within WSS	• Effective PMU; close coordination with WSS, donors, NGOs, and communities by August 2001	• PMU established; close coordination maintained

PROJECT IMPLEMENTATION SCHEDULE

Table A2.2 : Water Supply and Sanitation Rehabilitation Project- Phase II



Source : Asian Development Bank

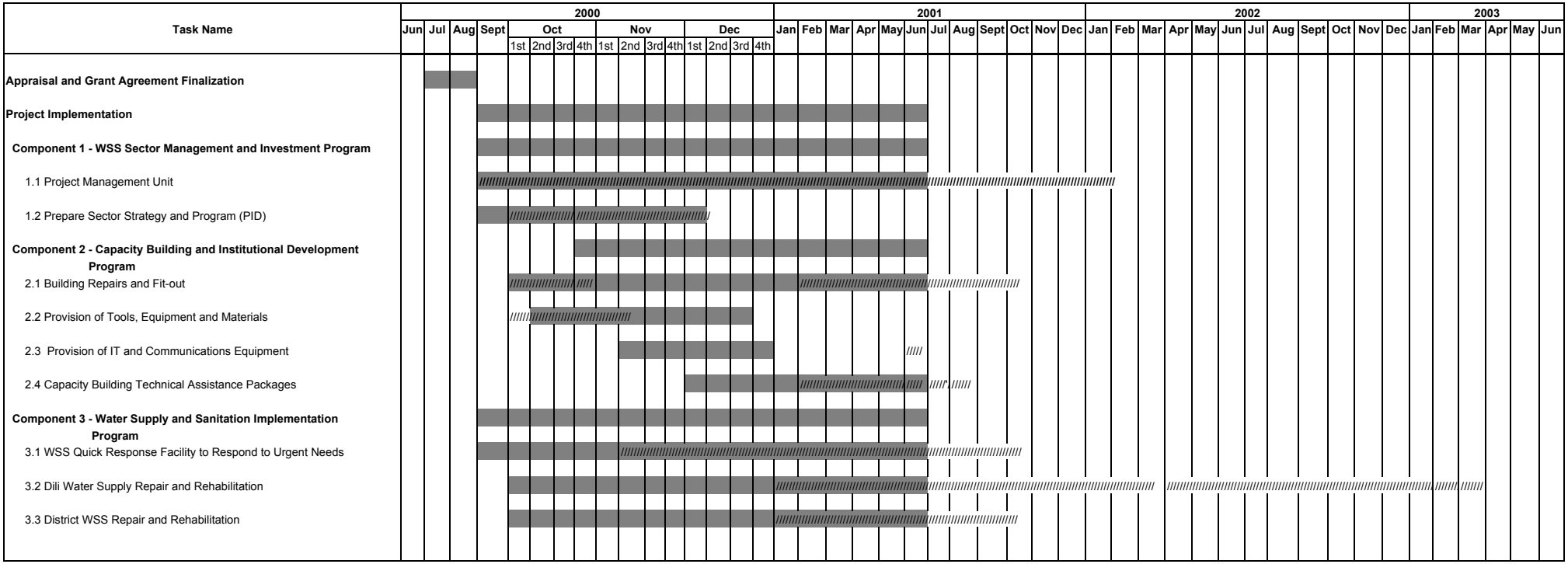
WS&S = Water Supply and Sanitation, TF = Trust Fund

- planned

//////////// - actual

PROJECT IMPLEMENTATION SCHEDULE

Table A2.1 : Water Supply and Sanitation Rehabilitation Project - Phase I



Source : Asian Development Bank

WS&S = Water Supply and Sanitation, TF = Trust Fund

- planned
- actual

STATUS OF COMPLIANCE WITH GRANT COVENANTS

Table A3.1 : Grant 8185-TIM(TF) Water Supply and Sanitation Rehabilitation Project – Phase I

Condition/Covenant	Status
Article III – Execution of the Project	
Section 3.01 (a) The Recipient declares its commitment to the overall strategic goal of the Project as set forth in Schedule 2 to this agreement, and to this end shall carry out the Project through the project management unit (PMU) with due diligence and efficiency and in conformity with appropriate administrative, engineering, environmental, financial, and social practices; and shall provide, promptly as needed, the funds, facilities, services, and other resources required for the Project.	Complied with.
Section 3.01 (b) Without limitation upon the provisions of paragraph (a) of this Section, and except as the Recipient and the Asian Development Bank (ADB) shall otherwise agree, the Recipient shall cause the Project to be carried out in accordance with the implementation arrangements set forth in Schedule 4 of this agreement.	Complied with.
Section 3.02 Except as ADB shall otherwise agree, procurement of the goods, works, and consultants' services required for the Project and to be financed out of the proceeds of the grant shall be governed by the provisions of Schedule 3 to this agreement.	Complied with.
Article IV – Financial Conditions	
Section 4.01 (a) The Recipient shall maintain, or cause to be maintained, records and accounts adequate to reflect in accordance with sound accounting practices the operations, resources, and expenditures in respect of the Project of the departments or agencies of the Recipient responsible for carrying out the Project or any part thereof.	Complied with.
Section 4.01 (b) The Recipient shall : (i) have the records and accounts referred to in paragraph (a) of this Section including those for the special account for each fiscal year audited, in accordance with appropriate auditing principles consistently applied, by independent auditors acceptable to ADB; (ii) furnish to ADB as soon as available, but in any case not later than 6 months after the end of each such year, the report of such audit by said auditors, of such scope and in such detail as ADB shall have reasonably requested; and (iii) furnish to ADB such other information concerning said records and accounts and the audit thereof as ADB shall from time to time reasonably request.	Complied with.

Condition/Covenant	Status
Section 4.01 (c) For all expenditures with respect to which withdrawals from the grant account were made on the basis of statements of expenditure, the Recipient shall: (i) maintain or cause to be maintained, in accordance with paragraph (a) of this Section, records and accounts reflecting such expenditures; (ii) retain until at least 1 year after ADB has received the audit report for the fiscal year in which the last withdrawal from the grant account was made, all records (contracts, orders, invoices, bills, receipts, and other documents) evidencing such expenditures; (iii) enable ADB's representatives to examine such records as ADB shall from time to time reasonably request; and (iv) ensure that such records and accounts are included in the annual audit referred to in paragraph (b) of this Section, and that the report of such audit contains a separate opinion by said auditors as to whether the statements of expenditure submitted during such fiscal year, together with the procedures and internal controls involved in the preparation, can be relied upon to support the related withdrawals.	Complied with.

Condition/Covenant	Status
Schedule 3 – Procurement and Consultants' Services	
A. General 1. Except as ADB may otherwise agree, the procedures and qualifications referred to in the following provisions of Section I of this Schedule shall apply in the procurement of goods and works to be financed out of the proceeds of the grant. 2. The Recipient may use the proceeds of the grant only for procurement of goods and works supplied from, and produced in: (i) member countries of ADB, (ii) Timor-Leste, (iii) countries that have entered into a contribution agreement with the trustee with respect to the Trust Fund for East Timor (TFET), and (iv) countries that are members of any organization that has entered into a contribution agreement with the trustee with respect to the TFET. 3. Subject to the qualification stated in the preceding paragraph, procurement of goods and works shall be subject to the provisions of the *Guidelines for Procurement Under Asian Development Bank Loans*, dated February 1999 (hereinafter called the Guidelines for Procurement) as amended from time to time, and the following provisions of Section I of this Schedule.	Complied with.
B. Modes of Procurement **International Competitive Bidding** 4. Each civil works contract estimated to cost the equivalent of more than $1,000,000, and each supply contract for equipment or materials estimated to cost the equivalent of more than $500,000, shall be awarded on the basis of international competitive bidding as described in Chapter II of the Guidelines for Procurement. Bidders for civil works contracts shall be prequalified before bidding. **International Shopping** 5. With respect to each civil works contract estimated to cost the equivalent of $1,000,000 or less, and each supply contract for equipment or materials estimated to cost the equivalent of $500,000 or less (other that minor items), such contracts shall be awarded on the basis of international shopping as described in Chapter III of the Guidelines for Procurement. **Direct Purchase** 6. Goods, materials and equipment estimated to cost less than the equivalent of $100,000 per contract may generally be procured on the basis of direct purchase/negotiation or single tender in accordance with the provisions of paragraph 3.05 of the Guidelines for Procurement. **Local Competitive Bidding** Notwithstanding the provisions of paragraph 5 above and paragraph 8 below, small works contracts (defined as any civil	Complied with.

works contract estimated to cost the equivalent of less than $100,000) may at the discretion of ADB be procured under lump-sum, fixed-price contracts awarded on the basis of local competitive bidding among prequalified contractors. Any such procurement shall be in accordance with procurement procedures acceptable to ADB, with prequalification, selection, and engagement of contractors being subject to the approval of ADB. Without limiting the generality of the foregoing, whenever local competitive bidding is approved, quotations shall be obtained from three qualified contractors in response to a written invitation. The invitation shall include a detailed description of the works, including basic specifications, the required completion date, a basic form of agreement acceptable to ADB, and relevant drawings where applicable. The award shall be made to the contractor who offers the lowest price quotation for the required work, and who has the experience and resources to complete the contract successfully. **Community Participation** 8. Works required for the Project are expected to incorporate labor-intensive, employment-generating methodologies wherever possible. Least-cost methodologies shall be adopted under the Project to ensure maximum use of domestic labor, materials, and contractors. In this connection, community participation shall be permitted, with such participation being procured in accordance with procedures acceptable to ADB.	
C. Review by the Asian Development Bank of Procurement Decisions. **Procurement Planning** 9. Before issuing any invitations to prequalify for bidding or to bid for contracts, the PMU shall furnish ADB with a proposed procurement plan for the Project for its review and approval. Procurement of all goods and works shall be undertaken in accordance with such procurement plan as shall have been approved by ADB. **Invitation to Bid/Contract Award** 10. (a) With respect to each contract awarded on the basis of international competitive bidding, procurement actions shall be subject to review by ADB in accordance with the procedures set forth in Chapter IV of the Guidelines for Procurement. Each draft prequalification invitation, and each draft invitation to bid, to be submitted to ADB for approval under such procedures, shall reach ADB as far as possible in advance of when it is to be issued and shall contain such information as ADB shall reasonably request to enable ADB to arrange for the separate publication of such invitation. (b) With respect to all other contracts, each draft invitation to bid and related bid document shall be submitted to ADB for approval before they are issued.	Complied with.

(c) Each award of contract shall be subject to prior ADB approval.	
Section II. Employment Of Consultants 11. (a) The services of consultants shall be used in carrying out the Project, particularly with regard to (i) the staffing of the PMU, and (ii) the preparation by end-2000 of the program implementation document under Component A(b) of the Project. (b) The terms of reference of the consultants shall be as prepared by ADB, and agreed with the Recipient. 12. The consultants shall be nationals of (i) any of the member countries of ADB, (ii) Timor-Leste, (iii) countries that have entered into a contribution agreement with the trustee with respect to the TFET, and (iv) countries that are members of any organization that has entered into a contribution agreement with the trustee with respect to the TFET. 13. Subject to the qualification stated in the foregoing paragraph, the selection, engagement, and services of the consultants shall be subject to the provisions of the *Guidelines on the Use of Consultants by Asian Development Bank and its Borrowers,* dated October 19998, as amended from time to time, and the following provisions of Section II of this Schedule. 14. All consultants shall be selected and engaged by the Recipient in accordance with the following procedures : (i) A list of the candidates together with their qualifications and a draft contract shall be furnished to ADB for approval before the selection of consultants; (ii) Promptly after the contract is signed, ADB shall be furnished with the evaluation of the candidates and a brief justification for the selection, with a copy of the signed contract; and (iii) If any substantial amendment of the contract is proposed after its execution, the proposed changes shall be submitted to ADB for prior approval.	Complied with.
Schedule 4 – Project Implementation	
1. The PMU shall program, administer, and coordinate all project activities. The PMU shall be headed by a Timorese project manager, and shall comprise a Timorese project accountant and a Timorese community development specialist. The project manager shall be supported by at least two internationally recruited consultants: a chief technical adviser, and a community development specialist. The chief technical adviser shall support the project manager in administering the Project and its contracts in accordance with ADB guidelines. The PMU through the project manager and the chief technical adviser shall report to the head of WSS.	Complied with.
2. The Recipient shall establish a steering committee for the Project to involve broader stakeholder representation in project	This requirement was deleted since it could not be established in

implementation. The steering committee shall meet monthly to discuss and resolve emerging project implementation, procurement, and community issues, and to review and comment on the project reports for submission to ADB.	the dynamic political and institutional environment.
3. In carrying out any part of the Project, the Recipient, through the PMU, shall ensure that : (a) appropriate engineering and environmental standards and practices that would minimize any acquisition of land and avoid involuntary resettlement of affected persons have been complied with; (b) ADB's resettlement guidelines have been complied with, and if applicable, appropriate compensation arrangements have been completed and are satisfactory to the affected persons; and (c) for the purposes of subparagraphs (a) and (b) above, affected persons means any person who, on account of the execution of any parts of the Project, has or would have his or her; (i) standard of living adversely affected; (ii) right, title, or interest in any house, land (including premises, agricultural land, and grazing land), or any other fixed or movable assets acquired or possessed, temporarily or permanently; or (iii) business, occupation, work, or place of residence or habitat adversely affected.	Complied with.
4. In the rehabilitation, repair, operation and maintenance of water supply and sanitation (WS&S) infrastructure, the Recipient shall comply with applicable environmental laws and regulations. Environmental monitoring shall be under the guidance of the PMU. In addition to regular inspections of works to ensure that all possible mitigation measures have been taken, the PMU shall (i) measure the effectiveness of environmental improvements; (ii) identify problems that may arise during the works; and, if necessary, (iii) provide ecological audit information for future works of this nature.	Complied with.
5. Without limiting the generality of Section 8.06 of the General Conditions, the Recipient shall cause the PMU to prepare and furnish to ADB quarterly reports on the implementation of the Project, in a format acceptable to ADB. The quarterly reports shall cover all aspects of the Project, including financial, procurement of services and equipment, expenditure budgets, and all civil works included in the Project. The Recipient shall also furnish ADB with quarterly reports on the use of its recurrent funds for activities in the water supply and sanitation sector, listing expenditure by items, and detailing implementation of donor support, and progress in implementing policy initiatives, transport policy and regulations, and organizational changes. 6. In addition to a schedule of regular reviews to monitor project progress, a technical review of the Project shall be carried out approximately 6 months after mobilization. The focus of the review shall be to determine the need for any deviations from the project design or implementation. The review shall also assess adequacy of funds, cost overruns, need for reallocations, and other factors, if	Complied with.

any, including assumptions and risks, which might constrain the satisfactory implementation of the Project and achievement of development objectives.	

STATUS OF COMPLIANCE WITH GRANT COVENANTS

Table A3.2 : Grant 8189-TIM(TF) : Water Supply and Sanitation Rehabilitation Project – Phase II

Condition/Covenant	Status
Article III – Execution of the Project	
Section 3.01 (a) The Recipient declares its commitment to the overall strategic goal of the Project as set forth in Schedule 2 to this agreement, and to this end shall carry out the Project through the Project Management Unit (PMU) with due diligence and efficiency and in conformity with appropriate administrative, engineering, environmental, financial, and social practices; and shall provide, promptly as needed, the funds, facilities, services, and other resources required for the Project.	Complied with.
Section 3.01 (b) Without limitation upon the provisions of paragraph (a) of this Section and except as the Recipient and the Asian Development Bank (ADB) shall otherwise agree, the Recipient shall cause the Project to be carried out in accordance with the implementation arrangements set forth in Schedule 4 of this agreement.	Complied with.
Section 3.02 Except as ADB shall otherwise agree, procurement of the goods, works, and consultants' services required for the Project and to be financed out of the proceeds of the grant shall be governed by the provisions of Schedule 3 to this agreement.	Complied with.
Article IV – Financial Conditions	
Section 4.01 (a) The Recipient shall maintain, or cause to be maintained, records and accounts adequate to reflect, in accordance with sound accounting practices, the operations, resources, and expenditures in respect of the Project of the departments or agencies of the Recipient responsible for carrying out the Project or any part thereof.	Complied with.
Section 4.01 (b) The Recipient shall : (i) have the records and accounts referred to in paragraph (a) of this Section, including those for the special account for each fiscal year audited, in accordance with appropriate auditing principles consistently applied, by independent auditors acceptable to ADB; (ii) furnish to ADB as soon as available, but in any case not later than 6 months after the end of each such year, the report of such audit by said auditors, of such scope and in such detail as ADB shall have reasonably requested; and (iii) furnish to ADB such other information concerning said records and accounts and the audit thereof as ADB shall from time to time reasonably request.	Complied with.

Section 4.01 (c) For all expenditures with respect to which withdrawals from the grant account were made on the basis of statements of expenditure, the Recipient shall: (i) maintain or cause to be maintained, in accordance with paragraph (a) of this Section, records and accounts reflecting such expenditures; (ii) retain until at least 1 year after ADB has received the audit report for the fiscal year in which the last withdrawal from the grant account was made, all records (contracts, orders, invoices, bills, receipts, and other documents) evidencing such expenditures; (iii) enable ADB's representatives to examine such records as ADB shall from time to time reasonably request; and (iv) ensure that such records and accounts are included in the annual audit referred to in paragraph (b) of this Section, and that the report of such audit contains a separate opinion by said auditors as to whether the statements of expenditure submitted during such fiscal year, together with the procedures and internal controls involved in the preparation, can be relied upon to support the related withdrawals.	Complied with.

Schedule 3 – Procurement and Consultants' Services	
A. General 1. Except as ADB may otherwise agree, the procedures and qualifications referred to in the following provisions of Section I of this Schedule shall apply in the procurement of goods and works to be financed out of the proceeds of the grant. 2. The Recipient may use the proceeds of the grant only for procurement of goods and works supplied from, and produced in: (i) member countries of ADB, (ii) Timor-Leste, (iii) countries that have entered into a contribution agreement with the trustee with respect to the Trust Fund for East Timor (TFET), and (iv) countries that are members of any organization that has entered into a contribution agreement with the trustee with respect to the TFET. 3. Subject to the qualification stated in the preceding paragraph, procurement of goods and works shall be subject to the provisions of the *Guidelines for Procurement under Asian Development Bank Loans*, dated February 1999 (hereinafter called the Guidelines for Procurement) as amended from time to time, and the following provisions of Section I of this Schedule.	Complied with.
B. Modes of Procurement **International Competitive Bidding** 4. Each civil works contract estimated to cost the equivalent of more than $1,000,000, and each supply contract for equipment or materials estimated to cost the equivalent of more than $500,000, shall be awarded on the basis of international competitive bidding as described in Chapter II of the Guidelines for Procurement. Bidders for civil works contracts shall be prequalified before bidding. **International Shopping** 5. With respect to each civil works contract estimated to cost the equivalent of $1,000,000 or less, and each supply contract for equipment or materials estimated to cost the equivalent of $500,000 or less (other that minor items), such contracts shall be awarded on the basis of international shopping as described in Chapter III of the Guidelines for Procurement. **Direct Purchase** 6. Goods, materials and equipment estimated to cost less than the equivalent of $100,000 per contract may generally be procured on the basis of direct purchase/negotiation or single tender in accordance with the provisions of paragraph 3.05 of the Guidelines for Procurement. **Local Competitive Bidding** 7. Notwithstanding the provisions of paragraph 5 above and paragraph 8 below, small works contracts (defined as any civil works contract estimated to cost the equivalent of less than $100,000) may at the discretion of ADB be procured under lump-sum, fixed-price contracts awarded on the basis of local competitive bidding among prequalified	Complied with.

contractors. Any such procurement shall be in accordance with procurement procedures acceptable to ADB, with prequalification, selection, and engagement of contractors being subject to the approval of ADB. Without limiting the generality of the foregoing, whenever local competitive bidding is approved, quotations shall be obtained from three qualified contractors in response to a written invitation. The invitation shall include a detailed description of the works, including basic specifications, the required completion date, a basic form of agreement acceptable to ADB, and relevant drawings where applicable. The award shall be made to the contractor who offers the lowest price quotation for the required work, and who has the experience and resources to complete the contract successfully. **Community Participation** 8. Works required for the Project are expected to incorporate labor-intensive, employment-generating methodologies wherever possible. Least-cost methodologies shall be adopted under the Project to ensure maximum use of domestic labor, materials, and contractors. In this connection, community participation shall be permitted, with such participation being procured in accordance with procedures acceptable to ADB.	
C. Review by the Asian Development Bank of Procurement Decisions. **Procurement Planning** 9. Before issuing any invitations to prequalify for bidding or to bid for contracts, the PMU shall furnish ADB with a proposed procurement plan for the Project for its review and approval. Procurement of all goods and works shall be undertaken in accordance with such procurement plan as shall have been approved by ADB. **Invitation to Bid/Contract Award** 10. (a) With respect to each contract awarded on the basis of international competitive bidding, procurement actions shall be subject to review by ADB in accordance with the procedures set forth in Chapter IV of the Guidelines for Procurement. Each draft prequalification invitation and each draft invitation to bid, to be submitted to ADB for approval under such procedures, shall reach ADB as far as possible in advance of when it is to be issued and shall contain such information as ADB shall reasonably request to enable ADB to arrange for the separate publication of such invitation. (b) With respect to all other contracts, each draft invitation to bid and related bid document shall be submitted to ADB for approval before they are issued. (c) Each award of contract shall be subject to prior ADB approval.	Complied with.

Section II. Employment of Consultants 11. (a) The services of consultants shall be used in the carrying out of the Project, particularly with regard to the staffing of the PMU. (b) The terms of reference of the consultants shall be as prepared by ADB and agreed with the Recipient. 12. The consultants shall be nationals of (i) any of the member countries of ADB, (ii) Timor-Leste, (iii) countries that have entered into a contribution agreement with the trustee with respect to the TFET, and (iv) countries that are members of any organization that has entered into a contribution agreement with the trustee with respect to the TFET. 13. Subject to the qualification stated in the foregoing paragraph, the selection, engagement, and services of the consultants shall be subject to the provisions of the *Guidelines on the Use of Consultants by Asian Development Bank and its Borrowers*, dated October 1998, as amended from time to time, and the following provisions of Section II of this Schedule. 14. All consultants shall be selected and engaged by the Recipient in accordance with the following procedures : (i) A list of the candidates together with their qualifications and a draft contract shall be furnished to ADB for approval before the selection of consultants; (ii) Promptly after the contract is signed, ADB shall be furnished with the evaluation of the candidates and a brief justification for the selection, with a copy of the signed contract; and (iii) If any substantial amendment of the contract is proposed after its execution, the proposed changes shall be submitted to ADB for prior approval.	Complied with.
Schedule 4 – Project Implementation	
1. The PMU shall program, administer, and coordinate all project activities. The PMU shall be headed by a Timorese project manager, and shall comprise a Timorese project accountant and a Timorese community development specialist. The project manager shall be supported by at least two internationally recruited consultants: a chief technical adviser, and a sector community capacity development specialist/adviser, one of whom shall be designated team leader. The team leader shall support the project manager in administering the Project and its contracts in accordance with ADB guidelines. The PMU, through the project manager and the team leader, shall report to the head of the Water and Sanitation Service (WSS).	Complied with.
2. The Recipient shall establish a steering committee for the Project to involve broader stakeholder representation in Project implementation. The steering committee shall meet regularly as required to discuss and resolve emerging project implementation, procurement, capacity building, sustainability, and community issues; and to review and comment on the project reports for submission to ADB.	This requirement was deleted since it could not be established in the dynamic political and institutional environment.
3. In carrying out any part of the Project, the Recipient, through the PMU, shall ensure that :	Complied with.

(i) appropriate engineering and environmental standards and practices designed to minimize acquisition of land and avoid involuntary resettlement of affected persons have been followed; and (ii) ADB's *Policy on Involuntary Resettlement* and ADB's *Handbook on Resettlement 1998*, as amended from time to time, have been complied with, and if applicable, appropriate compensation arrangements have been completed and are satisfactory to the affected persons.	
4. In the rehabilitation, repair, operation and maintenance of water supply an sanitation infrastructure, the Recipient shall ensure due compliance with all existing laws, regulations, and standards concerning environmental protection and ADB's environmental guidelines. Environmental monitoring shall be under the guidance of the PMU. In addition to regular inspections of works to ensure that all possible mitigation measures have been taken, the PMU shall (i) measure the effectiveness of environmental improvements; (ii) identify problems that may arise during the works; and, if necessary, (iii) provide ecological audit information for future works of this nature.	Complied with.
5. Without limiting the generality of Section 8.06 of the General Conditions, the Recipient shall cause the PMU and WSS to prepare and furnish to ADB the following reports: (a) a brief inception report, to be submitted within 4 weeks of the start of the Project, which shall, *inter alia*, outline the PMU's approach, methodology, and work plan, as well as cost implications for consulting services; the report shall also provide a bar chart of all activities under the Project; (b) a project risk matrix report, to be submitted within 2 months of mobilization, which shall clarify potential project risks, assess the possible damage these risks could cause, propose strategies to remove or ameliorate the risks, and nominate those responsible for managing the various risks; the risk matrix shall be an integral part of project monitoring and ongoing evaluation, with updated results being presented to the project steering committee on a regular basis; (c) a report setting down a system for project performance management and evaluation, to be submitted within 3 months of mobilization. The project performance management and evaluation report shall be conducted by the PMU, in association with WSS, using inputs from managing agents of donor-funded projects, nongovernment organizations (NGOs), community organizations, and other related stakeholders; (d) brief progress reports to be submitted on a quarterly basis, which shall inform the Recipient and ADB of achievements under the Project, such quarterly progress reports to identify any emerging difficulties in project implementation, and to outline proposed solutions. The quarterly reports shall provide, in clear graphical presentations, the status of project progress and performance, and plans for the next 6 months' work, including budgets and quarterly disbursement and payment forecasts; (e) a technical midterm review report to be undertaken by the PMU 8 months after mobilization, which shall focus on the need, if any, for	Complied with.

deviations from the project design or implementation; the midterm review shall also assess adequacy of funds, cost overruns, need for reallocations, and other factors, if any, including assumptions and risks that might constrain the satisfactory implementation of the Project and the achievement of its development objectives; (f) a draft final report, to be submitted no later than 1 month prior to completion of the Project, which shall summarize all project activities and recommendations, and shall outline continuing training programs, and programs for establishment, implementation, and strengthening of the relevant institutions, and recommendations for future support; and (g) a final report, to be submitted by the PMU immediately prior to completion of the Project, after receipt of the comments on the draft final report from ADB.	

FINANCIAL AND ECONOMIC EVALUATION

A. Financial Evaluation

1. Considering the emergency situation in Timor-Leste at project preparation, the primary objective of the projects was the urgent restoration of water supply and sanitation (WS&S) infrastructure and services throughout the country. Extensive destruction to most WS&S records and documents, and the departure of many former utility managers from Timor-Leste during the conflict, made a comparative financial analysis impossible. While restoring the population's access to water was the immediate concern, the projects also were designed to be sustainable and financially viable over the long term.

2. Detailed information gathered during studies undertaken as part of the projects revealed that none of the 62 public water supply systems in the district and subdistrict towns of Timor-Leste was financially viable before August 1999. While the systems generally were subsidized from the central budget, water quality, coverage, and service reliability remained universally poor. Customers in Dili were charged 150 Indonesian rupiah (Rp) per cubic meter for household supplies, compared to Rp240–390 per cubic meter paid by households serviced by larger Indonesian water utilities with commercial and industrial users providing cross-subsidies.

3. At the moment, the Government is able to provide a sufficient operational budget to maintain the urban infrastructure and systems provided by the projects. However, medium- and long-term sustainability will require (i) the collection of water user charges, which the Government has approved; (ii) metering of urban water supplies; and (iii) the installation of the billing system in the Water and Sanitation Service (WSS) district offices. The projects have established the systems for repair and maintenance with technical guidelines and standards, billing and collection, and the initial procurement of water meters to implement these recommendations.

4. Based on anecdotal information gathered during implementation of the project, the water user charges known to have been applied before 1999 would need to be increased significantly. A household in Dili consuming 21 cubic meters per month (m^3/month)—at 150 liters per capita per day for an average household size of 4.7 person—had to pay the equivalent of only Rp3,150 ($0.35) before the crisis. With the new tariff structure that is ready to be implemented, a household consuming the same amount would have to pay about $5.60 per month for water supply. Based on a per capita gross national product of $530, an average household of 4.7 persons would be able to pay $6.00/month for water services (about 3% of monthly household income following norms in developing countries). In rural areas, some household members expressed their willingness to pay $1.00/month for water when asked during the Project Completion Review (PCR) Mission.

5. Given the economic situation in Timor-Leste, the Government initially might have to subsidize the water supply in poor communities. As WSS district offices become more efficient and expand their revenue base, those subsidies could be phased out gradually. The appropriate charges also will have to be levied on users of community-managed WS&S systems in the rural areas to cover at least operation and maintenance costs.

B. Economic Evaluation

6. Due to the emergency situation and urgent priorities at project appraisal, an economic evaluation of the projects was not possible. The restoration of water services to basic levels that existed prior to the conflict was the immediate need, which was addressed successfully by the projects. The urgent repair and rehabilitation of damaged WS&S

infrastructure limited the options to restoration of facilities at the current sites, using equipment and technologies compatible with the damaged facilities.

7. Given the low water supply service coverage in urban and rural areas, and the rationing of supply the PCR Mission observed in some areas served by the systems, a serious supply shortage can be assumed. That shortage will have to be addressed immediately.

8. The projects maximized the use of domestic contractors and nongovernment organizations (NGOs) in the repair and rehabilitation works, creating local jobs. Apart from job creation, Phase I and Phase II of the Water Supply and Sanitation Rehabilitation Project developed the capacity of these contractors and NGOs to undertake future WS&S project construction. This use of domestic contractors and NGOs, as opposed to international contractors, also lowered the cost of providing WS&S services in these areas.

9. The projects provided economic benefits to nearly 112,000 people, who received direct access to WS&S services. The projects also generated 74,100 person-days of direct and indirect local employment. Following the destruction of all water-related infrastructure, the economic benefits can only be viewed as positive. The economic benefits will be evident soonest in urban areas where water user charges, based on the legal framework and the billing system developed under the project, are expected to be introduced soon to help spur economic growth in the district towns. In rural areas, freeing labor for more productive economic uses and reducing health-related costs are expected to make these projects economically positive.

15. Treated Wastewater Use in Tunisia: Lessons Learned and the Road Ahead

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Abstract

With per capita freshwater availability of around 450 m^3, Tunisia is one of the most drought-stressed countries in the Middle East and North Africa (MENA) region. In the MENA region, and indeed worldwide, Tunisia along with Israel, has been recognised as a leader in the area of wastewater reclamation and use. This chapter presents the case of a

middle-income country that has pursued a conscious strategy of treated wastewater reuse in agriculture with a fair measure of success. The current status of wastewater treatment and the use of treated wastewater in agricultural irrigation are reviewed. The impacts of water quality are discussed in this context, and the institutional, legal, and economic aspects analysed. The final section presents the lessons learned from the Tunisian experience and the options and hurdles for expanding the scope of treated wastewater use in agriculture. The key findings are that despite strong government support, treated wastewater use in irrigation has faced several constraints, chief among them being problems of social acceptance, agronomic considerations and sanitation, and restrictive regulations that have tended to limit its full potential for development. Further, the multiplicity of agencies and overlapping institutional responsibilities have also tended to limit the potential for expansion. Through its carefully phased approach to treated wastewater use and the

concomitant development of a regulatory framework that prohibits untreated wastewater use, Tunisia has significantly mitigated the environmental and public health risks associated with untreated wastewater use elsewhere in the world.

Background

Tunisia is a middle-income country located on the southern rim of the Mediterranean Sea with a population of approximately 10 million that is growing at about 1.8% per annum. Annual per capita income is around US$4,250 (World Development Report, 2002). Tunisia has a semi-arid climate and few renewable natural resources. It occupies 165,000 km^2 with the Atlas mountain range in the north accounting for 25% of the area. The Central Steppe and Sahel regions make up another 25% and the Southern Sahara region 50%. The annual rainfall varies from 600 mm in the north (400 mm in Tunis) to 100 mm in the southern region. The population is

relatively urbanised, with 58% living in urban areas on the northern and eastern coast. Administratively, Tunisia is divided into 23 governorates, 136 counties, and 250 communes.

Water Resources and Quality

The annual total volume of exploitable water resources in Tunisia is about 4670 million cubic metres (MCM) of which about 57% (2,700 MCM) is surface water and the remaining 43% (1970 MCM) groundwater. Tunisia is a drought-stressed country with per capita renewable water availability of 486 m^3 – well below the average of 1,200 m^3/capita for the Middle East and North Africa (MENA) region. Of the available surface water resources of 2,100 MCM, only about 1,220 MCM are expected to be captured for actual use. Eighteen existing dams, 21 projected dams, and 235 hillside dams are expected to augment the available supply but rapid sedimentation of

reservoirs will progressively reduce storage capacity and shorten life. Deep groundwater extraction rates are currently at 73% of annual recharge, and shallow groundwater is at 97% in the coastal and central regions. Excessive groundwater extraction in the coastal regions of Cap Bon, Soukra, and Ariana has resulted in saline intrusion in many areas leading to groundwater being rendered unsuitable for further irrigation. Water quality, especially salinity, is a serious constraint. Only 50% of all water resources have salinity levels lower than 1,500 mg/l and can be used without restrictions. While the surface water has a generally low salinity (with the exception of the tributaries entering the Medjerda river from the south), groundwater resources are badly affected with 84% of all groundwater resources having salinity levels of more than 1,500 mg/l and 30% of the shallow aquifers more than 4,000 mg/l. World Health Organization (WHO) *Health Guidelines for the Use of Wastewater in Agriculture and Aquaculture* (1989) specifies considerably

lower limits for potable water. This saline irrigation water reduces crop yields and requires the installation of costly drainage systems to maintain soil fertility. The effect of salinity on the water balances is an important consideration for Tunisia's water resource planning (World Bank, 1994). As in most other countries, agriculture accounts for the bulk of water consumption (89%) with domestic use accounting for 8% and industrial use 3%.

Tunisia has also experienced three serious droughts in the last decade that have affected agricultural growth and domestic consumption. With an increasing population, rapid urbanisation, and rise in living standards developing additional water resources is imperative. The last three Five-Year Plans (Government of Tunisia, 1987, 1992, 2002) have emphasised water harvesting and treated wastewater use. Since the severe drought in 1989, the use of treated wastewater in irrigation has been a part of the Government's overall water resource

management strategy. As seen in Table 15.1, treated wastewater use and desalination are both expected to virtually double in the coming years.

Current Status of Wastewater Treatment

About 70% of the urban population is connected to a sewerage network but among the rural population only 20% are connected. The number of wastewater treatment plants (WWTPs) has gradually risen in the last decade and is expected to reach 83 by 2006 (Table 15.2). Currently, 61 WWTPs are in operation with 9,650 km of wastewater network collecting 178 MCM wastewater, 148 MCM of which are treated and used in agriculture, to water golf courses and for other purposes. Almost 83% is treated in 44 WWTPs by activated sludge, 0.5% is treated in 3 WWTPs by biological filters, 7.6% in 7 plants in natural lagoons, and 8.6% in 7 plants in aerated lagoons (Koundi, 2001). Effluent is treated to the primary and

secondary levels.

Table 15.1. Projected water resources in Tunisia – accessible (A) and available (B) (MCM/annum) for different time horizons (1998).

	1996		2010		2020		2030	
	A	B	A	B	A	B	A	B
Large dams	1,340	871	1,800	1,170	1,750	1,138	1,750	1,138
Hillside dams and lakes	65	59	100	50	70	35	50	45
Tubewells and springs	997	997	1,250	1,150	1,250	1,000	1,250	1,000
Open wells	720	720	720	720	720	620	720	550
Treated wastewater	120	120	200	200	290	290	340	340
Desalinated water	7	7	10	10	24	24	49	49
Total	3,249	2,774	4,080	3,300	4,104	3,107	4,159	3,122

Source: Bahri, 2000.

Table 15.2. Evolution in number of wastewater treatment plants in Tunisia, 1995–2006.

Year	WWTPs (number)	Capacity (MCM/ annum)	Treated (MCM/ annum)
1995	48	135	111
1996	49	137	116
1997	51	145	131
2001	66	175	155
2006	83	185	165

Source: Ministry of Agriculture, 1998.

Treated Wastewater Use in Agriculture

Tunisia has had a cautious and gradual approach to applying treated wastewater in irrigation. Since 1965, wastewater from the Charguia WWTP has been used to irrigate citrus orchards in the Soukra irrigation scheme covering 1,200 ha (now reduced to 600 ha due to urbanisation) north of Tunis in order to safeguard them from saline intrusion caused by the overexploited aquifer. However, it was not until 28 July 1989 with the passage of the Decree 89-1047 setting conditions for

the use of treated wastewater for agricultural purposes, that the use of treated wastewater in irrigation really expanded in a controlled manner (Ministry of Agriculture, 1998). This Decree set the conditions for the use of treated wastewater in agriculture. In addition to the institutional aspects, the Decree also specified the modalities for control of quality including the necessary physicochemical parameters, microbiological parameters and the frequency of monitoring (Ministry of Agriculture, 1998). The main legal framework is also contained in the Code des Eaux (Water Code) dating back to 1975. As Table 15.3 shows, use in irrigation and golf courses is predominant. However, only about 35 MCM of treated wastewater is currently used on about 6,500 ha mainly (55%) in the area surrounding Tunis which represents about 20–30% of the volume produced. It is estimated that by 2020 about 20,000–30,000 ha, or about 7–10% of total irrigated area, will be irrigable using treated wastewater (World Bank, 1997; Ministry of Agriculture, 1998).

Table 15.3. Categories of treated wastewater use in Tunisia.

	Area irrigated		Volume used	
Use	ha	%	MCM	%
Irrigated perimeters	6,272	90	3.72	43
Golf courses	570	8	4.07	46
Others	155	2	0.95	11
Total	6,997	100	8.74	100

Source: Ministry of Agriculture, 1998.

Effluent Water Quality and Impacts of Treated Wastewater Use

In Tunisia the quality of treated wastewater varies spatially with the lowest salinity found in the northwest (min. 1,000; max. 1,500; average 1,300 mg/l) owing to the good quality of surface water resources and the low level of industrial activity in that region. By contrast, the WWTPs in the south exhibit alarmingly high concentrations of salt due to the salinity of the

distribution waters and the presence of important industries that dispose of their wastes in certain stations (min. 2,700; max. 8,900; avg. 4,100 mg/l) (see Table 15.4). This is a major problem for the farmers who express concerns about the long-term impacts on their soils and crops. Around Moknine, the high salinity of the treated wastewater supplied by the National Sanitation Agency [Office National d' Assainissement] (ONAS) resulted in serious soil degradation. In order to drain the salts from the soil and to provide compensation, the farmers in that area now receive free conventional water from the neighbouring Nebhana dam. A high rate of suspended solids exceeding the norm of 30 mg/l in many cases has also been reported, with associated discoloration of the water. This has also led to complaints about clogging local irrigation systems, and poses a constraint to farmers adopting drip irrigation.

Table 15.4. Average quality of treated wastewater in different

regions of Tunisia, 1996.

Region	WWTPs	Mean annual conductivity EC (µS/cm)	Mean annual salinity (mg/l)	Average volume treated (MCM/annum)
Tunis	4	4,877	3,700	5.00
Northwest	4	1,698	1,300	4.77
Northeast	10	2,855	2,200	2.30
Centre	17	4,230	3,300	1.95
South	14	5,253	4,100	1.87

Source: Calculated from Ministry of Agriculture, 1998.

Evidence of microbial contamination exists and poses a health and sanitary risk to both farmers and consumers. A 1985 study jointly carried out by the Ministries of Agriculture and Public Health evaluated the impact of treated wastewater on crops and human health in the Soukra, Borj Touil, and Djebel Ammar areas. The study revealed 141 cases of gastrointestinal (GI) disease (21% of the surveyed Soukra population). Some

of the diseases could be related to treated wastewater use, but the study was not exhaustive enough to clearly identify the sources. In 1990, a study carried out by the regional health and agricultural authorities of Ariana in Borj Touil recommended strict control of wastewater use in the Soukra and Borj Touil regions (UNDP *et al.,* 1992). An ONAS survey carried out in 1992 pointed to a lack of information amongst farmers about wastewater quality, health risks related to wastewater use and impacts on crops and soils. Farmers do not systematically receive health education concerning the risks they incur, nor do they adopt the preventive measures that are advocated by the public health service. The Ministry of Public Health does not have the necessary means or organisation to effectively supervise the use of treated wastewater in irrigation. Implementation of effective disinfection for reclaimed wastewater effluents using maturation ponds or high-rate ponds could reduce the public health risks. This would also eliminate the need for extensive

and complex epidemiological studies to assess the health status of populations using treated wastewater for irrigation or living within the irrigated areas (Asano and Mujeriego, 1992).

Water Quality Standards and the Legal Framework

Treated wastewater use in agriculture is regulated by the 1975 Water Code and associated Decree No. 89-1047 (Ministry of Justice and Human Rights, Republic of Tunisia, 1989). The Water Code prohibits use of untreated wastewater in agriculture and restricts the use of reclaimed water for irrigation of any vegetable to be eaten raw. The use of secondary treated effluents for growing all types of crops except vegetables, whether eaten raw or cooked is allowed. Water quality criteria for treated wastewater use in agriculture have been developed using the 1989 WHO Guidelines as the basis and a list of crops that can be irrigated has also been established. According to the 1989 Decree No. 89–1047,

treated effluent can only be used to irrigate crops that are not directly consumable. No vegetables can be irrigated with treated wastewater. The main crops irrigated with treated wastewater are: fruit trees including citrus, grapes, olives, peaches, pears, apples, pomegranates, etc. (28.5% by area); fodder including alfalfa, sorghum, clover, etc. (45.3%); industrial crops such as sugarbeet (3.8%); and cereals (22.4%). 57% of the area equipped with irrigation facilities is sprinkler-irrigated and 48% surface irrigated. Water quality standards have also been established for wastewater disposal in receiving waters (seas, lakes and rivers). According to Bahri (2000), monitoring the quality of treated water for a set of physical-chemical parameters once a month, for trace elements once every 6 months, and for helminth eggs every 2 weeks was originally envisaged. However, due to organisational and capacity constraints in the Ministry of Public Health, such monitoring is not systematic. Nonetheless, unlike other countries of the Middle East (e.g. Syria and Egypt), there

is no evidence of the widespread use of untreated wastewater in agriculture. Compliance with existing restrictions on cropping patterns is relatively good. This is facilitated by the fact that the bulk of the wastewater (over 50%) originates in the capital Tunis, which is relatively small (population approximately 1 million) allowing the effective enforcement of existing guidelines. In small and medium-sized towns, ONAS is currently developing an indigenous low-cost technology for treatment but coordination with the new Ministry of Agriculture, Environment, and Water Resources, that was formed in 2002 when the Ministries of Agriculture and Environment merged, to determine market demand from farmers is still limited.

Economic and financial aspects of wastewater treatment

ONAS, which is responsible for the collection, treatment, and the disposal of wastewater, faces varying costs of treatment

depending on the age and type of the plant, its location, and capacity with a high of US$0.51/$m^3$ (Menzel Bouzelfa WWTP in the northeast; 1995; capacity 2065 m^3/day) to a low of US$0.02/$m^3$ (Dar Jerba WWTP in the south; 1972; capacity 1100 m^3/day). These costs include the investment,[1] and operations and maintenance (O&M) costs. The average cost of secondary treatment is estimated at US$0.14/$m^3$ but a study commissioned by ONAS in 1996 estimates that this will more than double to US$0.29/$m^3$ in the next 5 years or so, owing to the high costs of new investments (Ministry of Agriculture, 1998).

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[1] Capital costs amortised over 45 years with an interest rate of 7%; equipment amortised over 15 years at 7%.

In Tunisia, the price charged by the Commissariat Régional du Développement Agricole (CRDA), the Regional Commissioner for Agricultural Development, for the water supplied for irrigation (conventional and treated wastewater) varies by governorate. Usually the price of water includes the costs of conveyance, O&M, but not of investment. In the northern CRDA of Ariana, generalised irrigation costs are determined by the overall price of O&M, irrespective of whether the specific source is treated wastewater. In 1996, this was estimated at 103 millièmes (mmes)/m^3 ~US$0.06/$m^3$ (1 Tunisian Dinar (DT) = 1,000 millièmes; 1 DT = US$0.66).

In the Ben Arous CRDA, the O&M costs of treated wastewater were estimated at 122 mmes/m^3 including labour costs (18%), costs of electricity for pumping (68%), and other costs (14%). The estimation of the O&M costs is sensitive to the volume of water pumped and billed. For example, in the Ariana CRDA,

the quantity of water pumped in the irrigation perimeter was more than 2.9 MCM. If this volume was in reality properly accounted for, the O&M costs would have been 44 mmes/m^3, lower than those actually charged by the CRDA, i.e. 55 mmes/m^3. Table 15.5 presents the variation in treated wastewater prices among CRDAs and the differences between the prices charged for treated wastewater and conventional water (Ministry of Agriculture, 1998).

In 1997, a Presidential Decree set the price of treated wastewater at a uniform 20 mmes/m^3 or US$0.01/$m^3$ in order to encourage farmers to expand its use. This is a significant subsidy considering the average cost of treated wastewater is estimated at US$0.14/$m^3$, and is expected to rise to US$0.29/$m^3$ in the coming years as new WWTPs come on line. However, the impact of this subsidy in expanding demand has

been far lower than expected due to such reasons as poor quality, social acceptance, agronomic considerations, and sanitation. Further, despite the tariff reforms undertaken by the Government, which require the CRDAs to annually raise the price of water by 15% on average, the price of conventional water still remains very low. Where the farmers have a choice between treated wastewater and conventional water, they prefer conventional water because of the crop restrictions on treated wastewater and problems with its quality. For farmers who would not otherwise have had access to irrigation, treated wastewater is the preferred option because it has helped raise their incomes. For example, farmers living on the perimeter of Borj Touil on the northern coast had no access to surface water resources, and groundwater resources there are far too saline for their use

Table 15.5. Comparison of prices [DT/m^3 (US$/$m^3$)] for treated wastewater and conventional water in Tunisia prior to

the 1997 Government Decree.

WWTP (name)	Irrigation scheme	Price of wastewater charged by CRDA	Price of conventional water	Price of wastewater as a percentage of conventional water (%)
Cherguia	Borj Touil	0.031 (0.020)	0.091 (0.060)	34.1
Choutrana	Soukra	0.069 (0.046)	0.091 (0.060)	75.8
Sud Méliane	Mornag	0.059 (0.039)	0.090 (0.059)	65.6
SE3 Nabeul	Bir Faledh, Oued Souhil	0.059 (0.039)	0.062 (0.041)	95.2
SE4 Nabeul	Borj Khiar-Mess. Borj Romana	0.059 (0.039)	0.062 (0.041)	95.2
Sousse south	Zaouiet Sousse	0.050 (0.033)	0.104 (0.069)	48.1
Kairouan	Draa Tammar	0.032 (0.021)	0.061 (0.040)	52.5
Sfax	Hajeb	0.020 (0.013)	0.030 (0.020)	66.7

Source: Calculated from Ministry of Agriculture, 1998
Note: 1 DT = US$0.66

Institutional and Organisational Structure

Water resources are managed at the national level by the newly-consolidated Ministry of Agriculture, Environment and Water Resources (MAEW) formed by the merger of the Ministry of Environment with the Ministry of Agriculture in September 2002. Its hydraulic works section, the Direction Générale des Grands Barrages et des Grands Travaux Hydrauliques (DGBGTH), is responsible for the construction of major water resources projects. Responsibility for the water supply systems in urban areas and large rural centres is assigned to the Société Nationale d'Exploitation et de Distribution des Eaux (SONEDE), a national water supply authority that is an autonomous public entity under the MAEW. Planning, design, and supervision of small and medium water supplies and irrigation works are the responsibility of the Direction Générale du Génie Rurale (DGGR), a department of the MAEW. Responsibilities for managing investment planning and implementation of projects and agriculture activities are with the Commissariats Régionaux au Développement Agricole

(CRDAs). These were created as semiautonomous agencies in each of the country's governorates to represent the Ministry of Agriculture, now the MAEW. They now manage over 50% of public investment in the agriculture sector. A few water users groups (Associations d'Intérêt Collectifs, AICs) have also been created to handle water distribution e.g. the AIC in Monastir. In 1975, with the assistance of the World Bank, the Government created the ONAS, which is responsible for the sewerage subsector management including the collection, treatment, and disposal of wastewater in urban, industrial, and tourism zones. In 1993, ONAS's mandate was consolidated under the (then) created Ministry of Environment and Land Use Planning with increased responsibility for sewerage operations. Now ONAS has expanded into an institution responsible for the protection of the aquatic environment, working in close cooperation with the National Environmental Protection Agency (Agence Nationale de Protection de l'Environnement, ANPE, established in 1989), which is charged

with developing and enforcing regulations concerning wastewater discharge. The other key ministry involved is the Ministry of Public Health (MPH), which regulates the quality of wastewater used for irrigation and of marketed crops, as well as monitoring water pollution and enforcing control. This Ministry has an important say in pollution control and wastewater use regulations.

Lessons Learned and the Road Ahead

The results and experience gained in Tunisia on treated wastewater use place Tunisia among the leading countries in the Mediterranean area in the field of treated wastewater use in irrigation. It is one of the few countries where treated wastewater use has been made an integral part of environmental pollution control and water management strategies. The knowledge and experience gained by researchers in the Institut National de Recherche Génie Rural,

Eaux, et Forêts (INRGREF) should provide excellent guidance to other countries in arid and semi-arid regions in defining the different irrigation uses for reclaimed wastewater, quality requirements for specific uses, the treatment levels best suited to each use, and the most adequate management options available for implementing current and proposed projects. Through its planned and cautious approach together with a well-developed regulatory framework, Tunisia has significantly mitigated the environmental and public health risks associated with untreated wastewater use elsewhere in the world. As a middle-income country, Tunisia also has the benefit of an affluent, well-educated population that has helped to practically eliminate untreated wastewater use. This has not meant that wastewater use in Tunisia is without its constraints. The following important lessons have been learned from Tunisia's implementation of a conscious strategy of treated wastewater use over the decades.

Institutional

There is a multiplicity of agencies that are currently involved in treated wastewater use with often conflicting objectives and overlapping responsibilities. The lack of co-ordination has resulted in a mismatch in the supply and demand. ONAS generates treated wastewater according to its prerogatives and the established quality standards, but not necessarily to match the quality and quantity demands of the primary users – the farmers. On the other hand, the CRDAs representing farmers' interests would like to obtain treated wastewater as needed during the cropping season at certain times, in certain volumes, and of a quality appropriate for crops Currently there is no single agency with responsibility for treated wastewater reuse (regulation and enforcement of standards and procedures, management, etc.). A possibility for increased coordination among different stakeholders would be the creation of an executive commission with representatives from

the key ministries and agencies. This commission would be tasked with implementing the national strategy for treated wastewater use including supervision, coordination, control and establishment of new use initiatives, education programmes etc. Due to Government concerns about rising public expenditures in the civil services, implementation of this recommendation in the near future is unlikely, unless the wastewater commission were to be created by drawing from the staff of existing agencies.

Technical

Firstly, in order to be able to better match demand and supply, the development of associated infrastructure especially inter-seasonal storage facilities needs to be emphasised. Farmers are willing to pay more if they can be assured of a timely and reliable quantity and quality of water supply. With the growth in the number of WWTPs, ONAS has to work with MAEW,

CRDAs, and farmer representatives to determine technical and management solutions that are mutually satisfactory. Secondly, with the Government's push towards water-saving technologies on a national scale, effective filtration systems need to be devised to enable the use of treated wastewater in micro-irrigation systems such as drip irrigation without clogging.

Social/agronomic

Farmers are still reluctant to use treated wastewater and do not possess the necessary training to use it for agricultural irrigation in a safe and hygienic manner. For the farmers who do use treated wastewater, there is little evidence to suggest that chemical fertiliser use has decreased, a process that is likely to result in over-fertilisation and aquifer contamination in the long term. This points to the need to strengthen agriculture and irrigation extension services so that farmers

are appropriately trained. Extension agents themselves need to be better equipped to respond to farmers' needs and concerns.

Public outreach and education programmes are also essential if greater social acceptance of treated wastewater is to be generated. The use of treated wastewater effluents is legitimate from the Islamic religious viewpoint, and has therefore to be examined in each case from the aspects of health, cost, and public acceptance (Farooq and Ansari, 1983; Faruqui *et al.,* 2001). Building community participation through water users groups (AICs) during the planning stages of projects can help build socio-cultural acceptance.

Economic

The current standards and restrictions on cropping patterns will need to be revisited. Current restrictions on the use of

treated wastewater for higher-value crops discourage farmers from using this resource despite its highly subsidised price. This will necessitate a revision in the 1975 Water Code and the associated regulatory decrees. The Government is already thinking along these lines and will develop a revision of the Water Code that will result in a more practical pricing structure and a revision of the cropping restrictions based on the quality of treated wastewater. The Government's emphasis on treated wastewater use in irrigation has not been based on a rigorous market assessment of real demand. Too often, the rates of return on wastewater treatment and reuse projects are artificially high because they assume a rate of use that is unrealistic. There is untapped demand for industrial and recreational use of treated wastewater. Implementation of a market-based strategy of treated wastewater use will necessitate greater coordination between the different stakeholders. The absence of a single coordinating agency will be a major hurdle.

Endnote: At the time of writing, the author was a Visiting Scientist at the South Asia Regional Office of the International Water Management Institute (IWMI) in Patancheru, India and Senior Economist in the Rural Development, Water and Environment Department, Middle East and North Africa Region of the World Bank.

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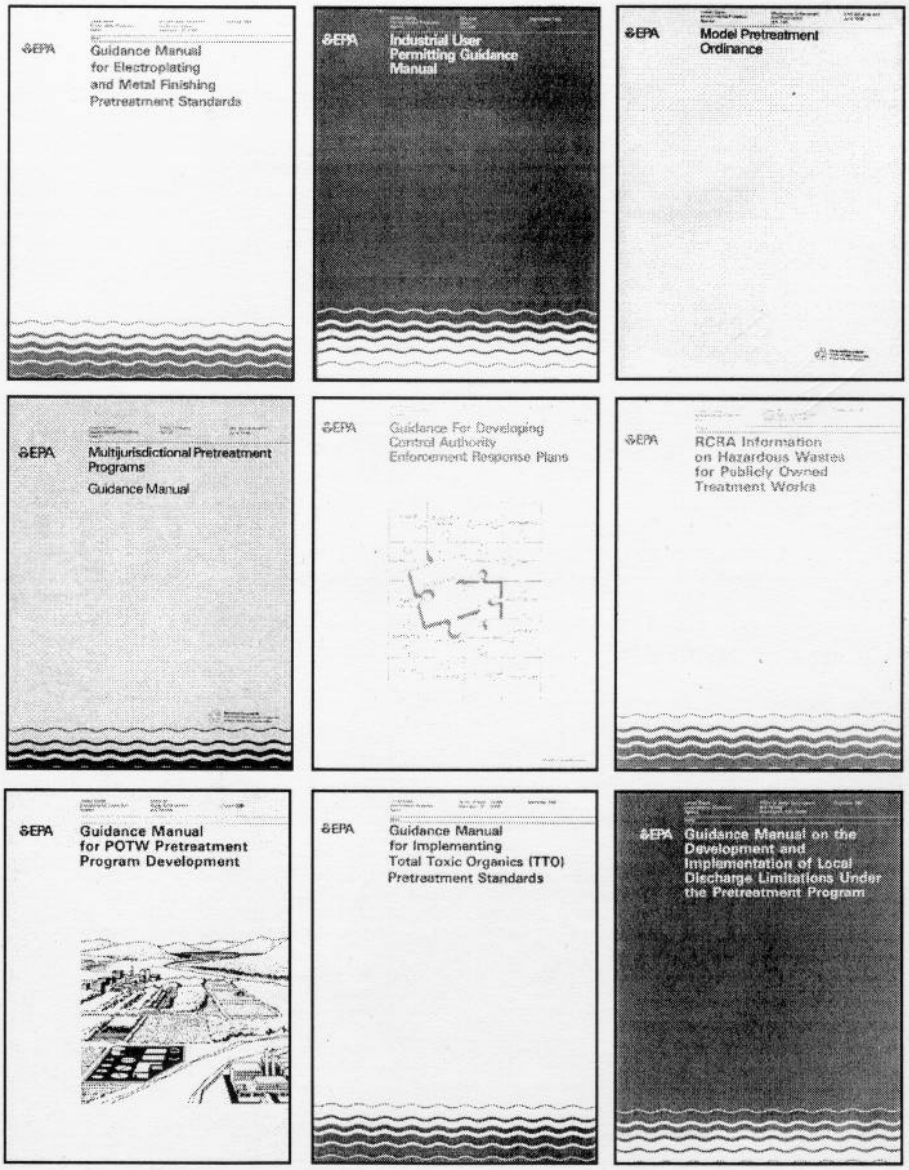
Introduction to the National Pretreatment Program



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PREFACE

The industrial boom in the United States during the 1950s and 60s brought with it a level of pollution never before seen in this country. Scenes of dying fish, burning rivers, and thick black smog engulfing major metropolitan areas were images and stories repeated regularly on the evening news. In December of 1970, the President of the United States created the U.S. Environmental Protection Agency (EPA) through an executive order in response to these critical environmental problems.

In 1972, Congress passed the Clean Water Act (CWA) to restore and maintain the integrity of the nation's waters. Although prior legislation had been enacted to address water pollution, those previous efforts were developed with other goals in mind. For example, the 1899 Rivers and Harbors Act protected navigational interests while the 1948 Water Pollution Control Act and the 1956 Federal Water Pollution Control Act merely provided limited funding for State and local governments to address water pollution concerns on their own.

The CWA required the elimination of the discharge of pollutants into the nation's waters and the achievement of fishable and swimmable water quality levels. EPA's National Pollutant Discharge Elimination System (NPDES) Permitting Program represents one of the key components established to accomplish this feat. The NPDES program requires that all point source discharges to waters of the U.S. (i.e., "direct discharges") must be permitted.

To address "indirect discharges" from industries to Publicly Owned Treatment Works (POTWs), EPA, through CWA authorities, established the National Pretreatment Program as a component of the NPDES Permitting Program. The National Pretreatment Program requires industrial and commercial dischargers to treat or control pollutants in their wastewater prior to discharge to POTWs.

In 1986, more than one-third of all toxic pollutants entered the nation's waters from publicly owned treatment works (POTWs) through industrial discharges to public sewers.[1] Certain industrial discharges, such as slug loads, can interfere with the operation of POTWs, leading to the discharge of untreated or inadequately treated wastewater into rivers, lakes, etc. Some pollutants are not compatible with biological wastewater treatment at POTWs and may pass through the treatment plant untreated. This "pass through" of pollutants impacts the surrounding environment, occasionally causing fish kills or other detrimental alterations of the receiving waters. Even when POTWs have the capability to remove toxic pollutants from wastewater, these toxics can end up in the POTW's sewage sludge, which in many places is land applied to food crops, parks, or golf courses as fertilizer or soil conditioner.

The National Pretreatment Program is unique in that the General Pretreatment Regulations require all large POTWs (i.e., those designed to treat flows of more than 5 million gallons per day) and smaller POTWs with significant industrial discharges to establish local pretreatment programs. These local programs must enforce all national pretreatment standards and requirements in addition to any more stringent local requirements necessary to protect site-specific conditions at the POTW. More than 1,500 POTWs have developed and are implementing local pretreatment programs designed to control discharges from approximately 30,000 significant industrial users.

Since 1983, the Pretreatment Program has made great strides in reducing the discharge of toxic pollutants to sewer systems and to waters of the U.S. In the eyes of many, the Pretreatment Program, implemented as a partnership between EPA, States, and POTWs, is a notable success story in reducing impacts to human health and the environment. These strides can be attributed to the efforts of many Federal, State, local, and industrial representatives who have been involved with developing and implementing the various aspects of the Pretreatment Program.

[1] **EPA, *Environmental Regulations and Technology: The National Pretreatment Program*, July 1986, p.4.**

EPA has supported the Pretreatment Program through development of numerous guidance manuals. EPA has released more than 30 manuals that provide guidance to EPA, States, POTWs, and industry on various pretreatment program requirements and policy determinations. Through this guidance, the Pretreatment Program has maintained national consistency in interpretation of the regulations.

Nevertheless, turnover in pretreatment program staff has diluted historical knowledge leaving new staff and other interested parties unaware of existing materials. With this in mind, the intent of this guidance manual, ***Introduction to the National Pretreatment Program***, is to:

(1) provide a reference for anyone interested in understanding the basics of pretreatment program requirements, and

(2) provide a roadmap to additional and more detailed guidance materials for those trying to implement specific elements of the Pretreatment Program.

While the Pretreatment Program has demonstrated significant reductions in pollutants discharged to POTWs, Congress' goals of zero discharge of toxic pollutants and fishable/swimmable water quality have not been realized. EPA is currently working to establish more cost-effective and common sense approaches to environmental protection (e.g., using watershed, streamlining, and reinvention concepts), creating new responsibilities for all those involved in the National Pretreatment Program. Many current challenges remain, while many new ones likely lie ahead. This guidance manual is intended to provide an understanding of the basic concepts that drive the Program, the current status of the Program and program guidance, and an insight into what the future holds for all those involved with implementing the Pretreatment Program.

As noted above, this guidance manual is organized to provide an overview of program requirements and to refer the reader to more detailed EPA guidance that exists on specific program elements. To accomplish this, the guidance manual incorporates two key features: 1) the first page of each chapter contains a list of EPA references applicable to the topics discussed in that chapter, and 2) abstracts of each reference are provided in Appendix A with document ordering information provided in Appendix B. Addresses of EPA and State pretreatment staff are provided in Appendix C. Additionally, Chapter 8 contains a bibliography of these guidance materials, and other materials that may be useful to the reader and describes how to obtain them.

LIST OF ACRONYMS

Acronym	**Full Phrase**
AA	Approval Authority
AO	Administrative Order
BAT	Best Available Technology Economically Achievable
BCT	Best Conventional Pollutant Control Technology
BMP	Best Management Practices
BMR	Baseline Monitoring Report
BOD_5	5-day Biochemical Oxygen Demand
BPJ	Best Professional Judgment
BPT	Best Practicable Control Technology Currently Available
CA	Control Authority
CFR	Code of Federal Regulations
CIU	Categorical Industrial User
CSO	Combined Sewer Overflow
CWA	Clean Water Act (formerly referred to as the Federal Water Pollution Control Act or Federal Water Pollution Control Act Amendments of 1972) Pub. L. 92-500, as amended by Pub. L. 95-217, Pub. L. 95-576, Pub. L. 96-483, Pub. L. 97-117, and Pub. L. 100-4, 33 U.S.C. 1251 et seq.
CWF	Combined Wastestream Formula
CWT	Centralized Waste Treater
DMR	Discharge Monitoring Report
DSE	Domestic Sewage Exclusion
DSS	Domestic Sewage Study
ELG	Effluent Limitations Guideline
EPA	Environmental Protection Agency
EPCRA	Emergency Preparedness and Community Right to Know Act
ERP	Enforcement Response Plan
FDF	Fundamentally Different Factors
FR	Federal Register
FWA	Flow Weighted Average
gpd	Gallons per Day
IU	Industrial User
LEL	Lower Explosive Limit
MAHL	Maximum Allowable Headworks Loading
MAIL	Maximum Allowable Industrial Loading
MGD	Million Gallons per Day
MSDS	Material Safety Data Sheet
NAICS	North American Industry Classification System (replaces SIC coding system in 1998)
NOV	Notice of Violation
NPDES	National Pollutant Discharge Elimination System
NRDC	Natural Resources Defense Council
NSPS	New Source Performance Standard
O&G	Oil and Grease
Acronym	**Full Phrase**

O&M	Operations and Maintenance
OCPSF	Organic Chemicals, Plastics, and Synthetic Fibers
P2	Pollution Prevention
PCI	Pretreatment Compliance Inspection
PCS	Permit Compliance System
PIRT	Pretreatment Implementation Review Task Force
POTW	Publicly Owned Treatment Works
PSES	Pretreatment Standards for Existing Sources
PSNS	Pretreatment Standards for New Sources
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
SIC	Standard Industrial Classification
SIU	Significant Industrial User
SPCC	Spill Prevention Control and Countermeasures
SNC	Significant Noncompliance
SSO	Sanitary Sewer Overflow
SUO	Sewer Use Ordinance
TCLP	Toxicity Characteristic Leaching Procedure
TIE	Toxicity Identification Evaluation
TOMP	Toxic Organic Management Program
TRE	Toxicity Reduction Evaluation
TRI	Toxic Release Inventory
TSS	Total Suspended Solids
TTO	Total Toxic Organics
USC	United States Code
UST	Underground Storage Tank
WET	Whole Effluent Toxicity
WWTP	Wastewater Treatment Plant

GLOSSARY OF TERMS

This glossary includes a collection of terms used in this manual and an explanation of each term. To the extent that definitions and explanations provided in this glossary differ from those in EPA regulations or other official documents, the definitions used herein are intended for use in understanding this manual only.

Act or "the Act" *[40 CFR §403.3(b)]*
The Federal Water Pollution Control Act, also known as the Clean Water Act, as amended, 33 USC 1251 *et.seq.*

Approval Authority *[40 CFR §403.3(c)]*
The Director in an NPDES State with an approved State Pretreatment Program and the appropriate EPA Regional Administrator in a non-NPDES State or State without an approved pretreatment program.

Approved POTW Pretreatment Program or Program *[40 CFR §403.3(d)]*
A program administered by a POTW that meets the criteria established in 40 CFR Part 403 and which has been approved by a Regional Administrator or State Director.

Approved State Pretreatment Program
A program administered by a State that meets the criteria established in 40 CFR §403.10 and which has been approved by a Regional Administrator

Approved/Authorized State
A State with an NPDES permit program approved pursuant to section 402(b) of the Act and an approved State Pretreatment Program.

Baseline Monitoring Report (BMR) *[paraphrased from 40 CFR §403.12(b)]*
A report submitted by categorical industrial users (CIUs) within 180 days after the effective date of an applicable categorical standard, or at least 90 days prior to commencement of discharge for new sources, which contains specific facility information, including flow and pollutant concentration data. For existing sources, the report must also certify as to the compliance status of the facility with respect to the categorical standards.

Best Available Technology Economically Achievable (BAT)
A level of technology based on the best existing control and treatment measures that are economically achievable within the given industrial category or subcategory.

Best Management Practices (BMPs)
Schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of waters of the U.S. BMPs also include treatment requirements, operating procedures and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

Best Practicable Control Technology Currently Available (BPT)
A level of technology represented by the average of the best existing wastewater treatment performance levels within an industrial category or subcategory.

Best Professional Judgment (BPJ)
The method used by a permit writer to develop technology-based limitations on a case-by-case basis using all reasonably available and relevant data.

Blowdown

The discharge of water with high concentrations of accumulated solids from boilers to prevent plugging of the boiler tubes and/or steam lines. In cooling towers, blowdown is discharged to reduce the concentration of dissolved salts in the recirculating cooling water.

Bypass *[40 CFR §403.17(a)]*
The intentional diversion of wastestreams from any portion of an Industrial User's treatment facility.

Categorical Industrial User (CIU)
An industrial user subject to National categorical pretreatment standards.

Categorical Pretreatment Standards
Limitations on pollutant discharges to POTWs promulgated by EPA in accordance with Section 307 of the Clean Water Act, that apply to specific process wastewater discharges of particular industrial categories [40 CFR § 403.6 and 40 CFR Parts 405-471].

Chain of Custody (COC)
A record of each person involved in the possession of a sample from the person who collects the sample to the person who analyzes the sample in the laboratory.

Chronic
A stimulus that lingers or continues for a relatively long period of time, often one-tenth of the life span or more. Chronic should be considered a relative term depending on the life span of an organism. The measurement of chronic effect can be reduced growth, reduced reproduction, etc., in addition to lethality.

Clean Water Act (CWA)
The common name for the Federal Water Pollution Control Act. Public law 92-500; 33 U.S.C. 1251 et seq.; legislation which provides statutory authority for both NPDES and Pretreatment Programs.

Code of Federal Regulations (CFR)
A codification of Federal rules published annually by the Office of the Federal Register National Archives and Records Administration. Title 40 of the CFR contains the regulations for *Protection of the Environment*.

Combined Sewer Overflow (CSO)
A discharge of untreated wastewater from a combined sewer system at a point prior to the headworks of a publicly owned treatment works. CSOs generally occur during wet weather (rainfall or snowfall). During periods of wet weather, these systems become overloaded, bypass treatment works, and discharge directly to receiving waters.

Combined Wastestream Formula (CWF) *[paraphrased from 40 CFR §403.6(e)]*
Procedure for calculating alternative discharge limits at industrial facilities where a regulated wastestream from a categorical industrial user is combined with other wastestreams prior to treatment.

Compliance Schedule
A schedule of remedial measures included in a permit or an enforcement order, including a sequence of interim requirements (for example, actions, operations, or milestone events) that lead to compliance with the CWA and regulations.

Composite Sample
Sample composed of two or more discrete samples. The aggregate sample will reflect the average water quality covering the compositing or sample period.

Concentration-based Limit
A limit based upon the relative strength of a pollutant in a wastestream, usually expressed in mg/l.

Continuous Discharge

A discharge that occurs without interruption during the operating hours of a facility, except for infrequent shutdowns for maintenance, process changes or similar activities.

Control Authority *[paraphrased from 40 CFR § 403.12(a)]*

A POTW with an approved pretreatment program or the approval authority in the absence of a POTW pretreatment program.

Conventional Pollutants

BOD, TSS, fecal coliform, oil and grease, and pH

Daily Maximum Limitations

The maximum allowable discharge of pollutants during a 24 hour period. Where daily maximum limitations are expressed in units of mass, the daily discharge is the total mass discharged over the course of the day. Where daily maximum limitations are expressed in terms of a concentration, the daily discharge is the arithmetic average measurement of the pollutant concentration derived from all measurements taken that day.

Detection Limit

The minimum concentration of an analyte(substance) that can be measured and reported with a 99% confidence that the analyte concentration is greater than zero as determined by the procedure set forth in 40 CFR Part 136, Appendix B.

Development Document

Detailed report of studies conducted by the U.S. EPA for the purpose of establishing effluent guidelines and categorical pretreatment standards.

Dilute Wastestream *[paraphrased from 40 CFR §403.6(e)(1)(i)]*

For purposes of the combined wastestream formula, the average daily flow (at least a 30-day average) from : (a) boiler blowdown streams, non-contact cooling streams, storm water streams, and demineralized backwash streams; provided, however, that where such streams contain a significant amount of a pollutant, and the combination of such streams, prior to treatment, with an industrial user's regulated process wastestream(s) will result in a substantial reduction of that pollutant, the Control Authority, upon application of the industrial user, may exercise its discretion to determine whether such stream(s) should be classified as diluted or unregulated. In its application to the Control Authority, the industrial user must provide engineering, production, sampling and analysis, and such other information so the control authority can make its determination; or (b) sanitary wastestreams where such streams are not regulated by a categorical pretreatment standard; or (c) from any process wastestreams which were, or could have been, entirely exempted from categorical pretreatment standards pursuant to paragraph 8 of the NRDC v. Costle Consent Decree (12 ERC 1833) for one more of the following reasons (see Appendix D of 40 CFR Part 403):

a. the pollutants of concern are not detectable in the effluent from the industrial user (paragraph (8)(a)(iii));
b. the pollutants of concern are present only in trace amounts and are neither causing nor likely to cause toxic effects (paragraph (8)(a)(iii));
c. the pollutants of concern are present in amounts too small to be effectively deduced by technologies known to the Administrator (paragraph (8)(a)(iii)); or
d. the wastestream contains only pollutants which are compatible with the POTW (paragraph (8)(b)(I)).

Effluent Limitations Guideline

Any effluent limitations guidelines issued by EPA pursuant to Section 304(b) of the CWA. These regulations are published to adopt or revise a national standard prescribing restrictions on quantities, rates, and concentrations of chemical, physical, biological, and other constituents which are discharged from point sources, in specific industrial categories (e.g., metal finishing, metal molding and casting, etc).

Enforcement Response Plan *[paraphrased from 40 CFR §403.8(f)(5)]*

Step-by-step enforcement procedures followed by Control Authority staff to identify, document, and respond to violations.

Existing Source

Any source of discharge, the construction or operation of which commenced prior to the publication by the EPA of proposed categorical pretreatment standards, which will be applicable to such source if the standard is thereafter promulgated in accordance with Section 307 of the Act.

Federal Water Pollution Control Act (FWPCA)

The title of Public law 92-500; 33 U.S.C. 1251 et seq., also known as the Clean Water Act (CWA), enacted October 18, 1972.

Flow Weighted Average Formula (FWA) *[paraphrased from 40 CFR §403.6(e)]*

A procedure used to calculate alternative limits where wastestreams regulated by a categorical pretreatment standard and nonregulated wastestreams combine after treatment but prior to the monitoring point.

Flow Proportional Composite Sample

Combination of individual samples proportional to the flow of the wastestream at the time of sampling.

Fundamentally Different Factors *[paraphrased from 40 CFR §403.13]*

Case-by-case variance from categorical pretreatment standards based on the factors considered by EPA in developing the applicable category/subcategory being fundamentally different than factors relating to a specific industrial user.

General Prohibitions *[40 CFR §403.5(a)(1)]*

No user shall introduce into a POTW any pollutant(s) which cause pass through or interference.

Grab Sample

A sample which is taken from a wastestream on a one-time basis with no regard to the flow of the wastestream and without consideration of time. A single grab sample should be taken over a period of time not to exceed 15 minutes.

Indirect Discharge or Discharge *[40 CFR §403.3(g)]*

The introduction of pollutants into a POTW from any non-domestic source regulated under section 307(b), (c), or (d) of the Act.

Industrial User (IU) or User *[40 CFR §403.3(h)]*

A source of indirect discharge.

Industrial Waste Survey

The process of identifying and locating industrial users and characterizing their industrial discharge.

Inhibition Concentration

Estimate of the toxicant concentration that would cause a given percent reduction (e.g., IC25) in a nonlethal biological measurement of the test organisms, such as reproduction or growth.

Interference *[paraphrased from 40 CFR §403.3(i)]*

A discharge which, alone or in conjunction with a discharge or discharges from other sources, both: (1) inhibits or disrupts the POTW, its treatment processes or operations, or its sludge processes, use or disposal; and (2) therefore is a cause of a violation of any requirement of the POTW's NPDES permit (including an increase in the magnitude or duration of a violation) or of the prevention of sewage sludge use or disposal in compliance with ... [applicable] statutory provisions and regulations or permits issued thereunder (or more stringent State or local regulations) ...

Local Limits *[paraphrased 40 CFR § 403.5(c)]*

Specific discharge limits developed and enforced by POTWs upon industrial or commercial facilities to implement the general and specific discharge prohibitions listed in 40 CFR §§403.5(a)(1) and (b).

Monthly Average

The arithmetic average value of all samples taken in a calendar month for an individual pollutant parameter. The monthly average may be the average of all grab samples taken in a given calendar month, or the average of all composite samples taken in a given calendar month.

National Pollutant Discharge Elimination System (NPDES)

The national program for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing discharge permits from point sources to waters of the United States, and imposing and enforcing pretreatment requirements, under sections 307, 402, 318, and 405 of the CWA.

National Pretreatment Standard or Pretreatment Standard or Standard *[40 CFR §403.3(j)]*

Any regulation containing pollutant discharge limits promulgated by the EPA in accordance with section 307(b) and (c) of the Act, which applies to Industrial Users. This term includes prohibitive discharge limits established pursuant to §403.5.

New Source *[40 CFR §403.3(k)]*

Any building, structure, facility or installation from which there is or may be a discharge of pollutants, the construction of which commenced after the publication of proposed Pretreatment Standards under section 307(c) of the Act which will be applicable to such source if such standards are thereafter promulgated in accordance with that section *provided that*:

(a) The building, structure, facility or installation is constructed at a site at which no other discharge source is located; or

(b) The building, structure, facility or installation totally replaces the process or production equipment that causes the discharge of pollutants at an existing source; or

(c) The production or wastewater generating processes of the building, structure, facility, or installation are substantially independent of an existing source at the same site. In determining whether these are substantially independent, factors such as the extent to which the new facility is integrated with the existing plant, and the extent to which the new facility is engaged in the same general type of activity as the existing source, should be considered.

Construction on a site at which an existing source is located results in a modification rather than a new source if the construction does not create a new building, structure, facility, or installation meeting the criteria of paragraphs (k)(1)(ii), or (k)(1)(iii) of this section but otherwise alters, replaces, or adds to existing process or production equipment.

Construction of a new source, as defined under this paragraph has commenced if the owner or operator has:

(i) Begun, or caused to begin as part of a continuous onsite construction program:

(A) Any placement, assembly, or installation of facilities or equipment; or

(B) Significant site preparation work including clearing, excavation, or removal of existing buildings, structures, or facilities which is necessary for the placement, assembly, or installation of new source facilities or equipment, or

(C) Entered into a binding contractual obligation for the purchase of facilities or equipment which are intended to be used in its operation within a reasonable time. Options to purchase or contracts which can be terminated or modified without substantial loss, and contracts for feasibility, engineering, and design studies do not constitute a contractual obligation under this paragraph.

90-Day Final Compliance Report *[40 CFR §403.12(d)]*

A report submitted by categorical industrial users within 90 days following the date for final compliance with the standards. This report must contain flow measurement (of regulated process streams and other

streams), measurement of pollutants, and a certification as to whether the categorical standards are being met.

Nonconventional Pollutants
Any pollutant that is neither a toxic pollutant nor a conventional pollutant (e.g., manganese, ammonia, etc.)

Non-Contact Cooling Water
Water used for cooling which does not come into direct contact with any raw material, intermediate product, waste product, or finished product. The only pollutant contributed from the discharge is heat.

Non-Regulated Wastestream
Unregulated and dilute wastestreams (not regulated by categorical standards).

Pass Through *[40 CFR §403.3(n)]*
A discharge which exits the POTW into waters of the United States in quantities or concentrations which, alone or in conjunction with a discharge or discharges from other sources, is a cause of a violation of any requirement of the POTW's NPDES permit (including an increase in the magnitude or duration of a violation).

Periodic Compliance Report *[paraphrased from 40 CFR §403.12(e) & (h)]*
A report on compliance status submitted by categorical industrial users and significant noncategorical industrial users to the control authority at least semiannually (once every six months).

Point Source *[40 CFR 122.2]*
Any discernible, confined, and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fixture, container, rolling stock concentrated animal feeding operation vessel, or other floating craft from which pollutants are or may be discharged.

Pollutant *[40 CFR 122.2]*
Dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials (except those regulated under the Atomic Energy Act of 1954, as amended (42 U.S.C. 2011 et seq.)), heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal and agricultural waste discharged into water.

Pretreatment *[paraphrased from 40 CFR §403.3(q)]*
The reduction of the amount of pollutants, the elimination of pollutants, or the alteration of the nature of pollutant properties in wastewater prior to or in lieu of discharging or otherwise introducing such pollutants into a POTW.

Pretreatment Requirements *[40 CFR §403.3(r)]*
Any substantive or procedural requirement related to Pretreatment, other than a National Pretreatment Standard, imposed on an Industrial User.

Pretreatment Standards for Existing Sources (PSES)
Categorical Standards and requirements applicable to industrial sources that began construction prior to the publication of the proposed pretreatment standards for that industrial category.(see individual standards at 40 CFR Parts 405-471.)

Pretreatment Standards for New Sources (PSNS)
Categorical Standards and requirements applicable to industrial sources that began construction after the publication of the proposed pretreatment standards for that industrial category. (see individual standards at 40 CFR Parts 405-471.)

Priority Pollutant

Pollutant listed by the Administrator of EPA under Clean Water Act section 307(a). The list of the current 126 Priority Pollutants can be found in 40 CFR Part 423 Appendix A.

Process Wastewater

Any water which, during manufacturing or processing, comes into contact with or results from the production or use of any raw material, intermediate product, finished product, byproduct, or waste product.

Production-Based Standards

A discharge standard expressed in terms of pollutant mass allowed in a discharge per unit of product manufactured.

Publicly Owned Treatment Works (POTW) *[40 CFR §403.3(o)]*

A treatment works as defined by section 212 of the Act, which is owned by a State or municipality (as defined by section 502(4) of the Act). This definition includes any devices or systems used in the storage, treatment, recycling, and reclamation of municipal sewage or industrial wastes of a liquid nature. It also includes sewers, pipes or other conveyances only if they convey wastewater to a POTW Treatment Plant. The term also means the municipality as defined in section 502(4) of the Act, which has jurisdiction over the Indirect Discharges to and the discharges from such a treatment works.

Regulated Wastestream

For purposes of applying the combined wastestream formula, a wastestream from an industrial process that is regulated by a categorical standard.

Removal Credit *[paraphrased from 40 CFR §403.7]*

Variance from a pollutant limit specified in a categorical pretreatment standard to reflect removal by the POTW of said pollutant.

Representative Sample

A sample from a wastestream that is as nearly identical as possible in composition to that in the larger volume of wastewater being discharged and typical of the discharge from the facility on a normal operating day.

Sanitary Sewer Overflow (SSO)

Untreated or partially treated sewage overflows from a sanitary sewer collection system.

Self-Monitoring

Sampling and analyses performed by a facility to ensure compliance with a permit or other regulatory requirements.

Sewer Use Ordinance (SUO)

A legal mechanism implemented by a local government entity which sets out, among others, requirements for the discharge of pollutants into a publicly owned treatment works.

Significant Industrial User (SIU) *[paraphrased from 40 CFR §403.3(t)]*

(1) All users subject to Categorical Pretreatment Standards under 40 CFR 403.6 and 40 CFR chapter I, subchapter N; and (2) Any other industrial user that: discharges an average of 25,000 gallons per day or more of process wastewater to the POTW (excluding sanitary, noncontact cooling and boiler blowdown wastewater); contributes a process wastestream which makes up 5 percent or more of the average dry weather hydraulic or organic capacity of the POTW treatment plant; or is designated as such by the Control Authority as defined in 40 CFR 403.12(a) on the basis that the industrial user has a reasonable potential for adversely affecting the POTW's operation or for violating any pretreatment standard or requirement (in accordance with 40 CFR 403.8(f)(6)].

Significant Noncompliance (SNC) *[40 CFR §403.8(f)(2)(vii)]*

Industrial user violations meeting one or more of the following criteria:

1) Chronic violations of wastewater discharge limits, defined here as those in which sixty-six percent or more of all of the measurements taken during a six month period exceed (by any magnitude) the daily maximum limit or the average limit for the same pollutant parameter;

2) Technical Review Criteria (TRC) violations, defined here as those in which thirty-three percent or more of all of the measurements for each pollutants parameter taken during a six-month period equal or exceed the product of the daily maximum limit or the average limit multiplied by the applicable TRC (TRC=1.4 for BOD, TSS, fats, oil, and grease, and 1.2 for all other pollutants except pH);
3) Any other violation of a pretreatment effluent limit (daily maximum or longer-term average) that the Control Authority determines has caused, alone or in combination with other dischargers, interference or pass through (including endangering the health of POTW personnel or the general public);
4) Any discharge of a pollutant that has caused imminent endangerment to human health, welfare or to the environment or has resulted in the POTW's exercise of its emergency authority under paragraph (f)(1)(vi)(B) of this section to halt or prevent such a discharge;
5) Failure to meet, within 90 days after the schedule date, a compliance schedule milestone contained in a local control mechanism or enforcement order for starting construction, completing construction, or attaining final compliance;
6) Failure to provide, within 30 days after the due date, required reports such as baseline monitoring reports, 90-day compliance reports, periodic self-monitoring reports, and reports on compliance with compliance schedules;
7) Failure to accurately report noncompliance;
8) Any other violation or group of violations which the Control Authority determines will adversely affect the operation or implementation of the local pretreatment program.

Slug Discharge *[40 CFR §403.8(f)(2)(v)]*

Any discharge of a non-routine, episodic nature, including but not limited to, an accidental spill or a noncustomary batch discharge.

Specific Prohibitions *[40 CFR §403.5(b)]*

The following pollutants shall not be introduced into a POTW:
1) Pollutants which create a fire or explosion hazard in the POTW, including but not limited to, wastestreams with a closed cup flashpoint of less than 140 degrees Fahrenheit or 60 degrees Centigrade using the test methods specified in 40 CFR Part 261.21;
2) Pollutants which will cause corrosive structural damage to the POTW, but in no case discharges with pH lower than 5.0, unless the works is specifically designed to accommodate such discharges;
3) Solid or viscous pollutants in amounts which will cause obstruction to the flow in the POTW resulting in interference;
4) Any pollutant, including oxygen demanding pollutants(BOD, etc.) Released in a discharge at a flow rate and/or concentration which will cause interference with the POTW;
5) Heat in amounts which will inhibit biological activity in the POTW resulting in interference, but in no case heat in such quantities that the temperature at the POTW treatment plant exceeds 40°C(104°F) unless the Approval Authority, upon request of the POTW, approves alternative temperature limits;
6) Petroleum oil, nonbiodegradable cutting oil, or products of mineral oil origin in amounts that will cause interference or pass through;
7) Pollutants which result in the presence of toxic gases, vapors, or fumes within the POTW in a quantity that may cause acute worker health and safety problems;
8) Any trucked or hauled pollutants, except at discharge points designated by the POTW.

Standard Industrial Classification (SIC)

A system developed by the U.S. Office of Management and Budget that is used to classify various types of business entities. Effective in 1998, the SIC scheme is replace by the North American Industry Classification System (NAICS), although EPA has not yet implemented this change.

Storm Water

Rain water, snow melt, and surface runoff and drainage.

Time Proportional Composite Sample

A sample consisting of a series of aliquots collected from a representative point in the discharge stream at equal time intervals over the entire discharge period on the sampling day.

Toxic Pollutant

Any pollutant listed as toxic under section 307(a)(1) of the CWA, or in the case of sludge use or disposal practices, any pollutant identified in regulations implementing section 405(d) of the CWA.

Toxicity Reduction Evaluation

A site-specific study conducted in a stepwise process designed to identify the causative agent(s) of effluent toxicity, isolate the sources of toxicity, evaluate the effectiveness of toxicity control options, and then confirm the reduction in effluent toxicity.

Toxicity Test

A procedure to determine the toxicity of a chemical or an effluent using living organisms. A toxicity test measures the degree of effect on exposed test organisms of a specific chemical or effluent.

Toxicity Identification Evaluation

Set of procedures to identify the specific chemicals responsible for effluent toxicity.

Unregulated Wastestream

For purposes of applying the combined wastestream formula, a wastestream not regulated by a categorical standard nor considered a dilute wastestream.

Upset *[paraphrased from 40 CFR §403.16(a)]*

An exceptional incident in which there is unintentional and temporary noncompliance with categorical Pretreatment Standards because of factors beyond the reasonable control of the Industrial User. An Upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventative maintenance, or careless or improper operation.

Water Quality Criteria

Comprised of both numeric and narrative criteria. Numeric criteria are scientifically derived ambient concentrations developed by EPA or States for various pollutants of concern to protect human health and aquatic life. Narrative criteria are statements that describe the desired water quality goal.

Water Quality Standard

A statute or regulation that consists of the beneficial designated use or uses of a waterbody, the numeric and narrative water quality criteria that are necessary to protect the use or uses of that particular waterbody, and an antidegradation statement.

Whole Effluent Toxicity

The total toxic effect of an effluent measured directly with a toxicity test.

1. POTWs AND THE NEED FOR THE PRETREATMENT PROGRAM

Chapter 1. Applicable EPA References
Environmental Regulations and Technology: The National Pretreatment Program
National Pretreatment Program: Report to Congress
Report to Congress on the Discharge of Hazardous Wastes to POTWs

The average American uses roughly 100 to 200 gallons of water a day, with less than one percent of that water actually being consumed.[2] The rest is used for activities such as washing, preparing food, watering lawns, heating and cooling, transporting wastes, and fire protection. The public is very conscious about the quality of water that comes out of their tap each day, quickly notifying authorities of changes in appearance, odor, and taste. These same Americans, on average, discharge about the same amount of wastewater to local sewage treatment plants daily.[3] This wastewater (commonly referred to as "domestic sewage") receives much less attention than drinking water, likely the result of an "out of sight, out of mind" attitude.

Most people take it for granted that once down the drain, wastes will be handled appropriately. In fact, this attitude has carried over to industry as well, as can be seen by reading the labels of many household products. These labels often recommend that waste or excess product be disposed of down the drain. Other toxic or hazardous products are actually designed to be disposed of down the drain (e.g., drain clog remover). Recall the phosphate detergent problems of the late 1960s and early 70s; large doses of phosphate, found in most detergents at the time, were passing through municipal treatment plants and overloading lakes, causing large algal blooms to form and subsequently reducing available light, food and oxygen for fish and other aquatic organisms. While great strides have been taken to address the phosphate problem, it is possible that other problematic pollutants are being dumped down the drain at the expense of human health and the environment.

SEWAGE TREATMENT

Publicly owned treatment works (POTWs) collect wastewater from homes, commercial buildings, and industrial facilities and transport it via a series of pipes, known as a collection system, to the treatment plant. Collection systems may flow entirely by gravity, or may include lift stations that pump the wastewater via a force main to a higher elevation where the wastewater can then continue on via gravity. Ultimately, the collection system delivers this sewage to the treatment plant facility. Here, the POTW removes harmful organisms and other contaminants from the sewage so it can be discharged safely into the receiving stream. Without treatment, sewage creates bad odors, contaminates water supplies, and spreads disease. Today, more than 16,000 sewage treatment plants exist in the U.S. treating more than 32 billion gallons per day of wastewater.[4]

Generally, POTWs are designed to treat domestic sewage only. Simply defined, the typical POTW treatment process consists of primary and secondary treatment, along with some form of solids handling. Primary treatment is designed to remove large solids (e.g., rags and debris) and smaller inorganic grit. Typical primary treatment operations include screening and settling. Secondary treatment removes organic contaminants using microorganisms to consume biodegradable organics. Activated sludge, trickling filters, and rotating biological contactors are examples of common secondary treatment operations. Depending on effluent discharge requirements, POTWs may perform other "advanced treatment" operations such as nitrification (to convert ammonia and nitrite to the less toxic nitrate), denitrification (to convert nitrate to molecular nitrogen),

[2] **The Nalco Water Handbook, ed. Frank N. Kemmer (New York: McGraw-Hill Book Company, 1988), pp. 35.1.**

[3] **Ibid, p. 36.1.**

[4] **1996 Clean Water Needs Survey Report to Congress: Assessment of Needs for Publicly Owned Wastewater Treatment Facilities, Correction of Combined Sewer Overflows, and Management of Stormwater and Nonpoint Source Pollution in the United States.**

physical-chemical treatment (to remove dissolved metals and organics), and disinfection (to kill any remaining pathogens). After treatment is complete, effluent is discharged to the receiving stream, typically a creek, river, lake, estuary or ocean. Some POTWs may apply treated effluent directly to golf courses, parkland, or croplands.

Both primary and secondary treatment processes generate waste solids, known as sewage sludge or biosolids. Sludges from the treatment process may be either used productively (i.e., as fertilizer or soil conditioner) or disposed of in a landfill or incinerated in a dedicated sewage sludge incinerator with the ash also disposed of in a landfill.

As described above, POTWs are designed to treat typical household wastes and biodegradable commercial and biodegradable industrial wastes. The Clean Water Act (CWA) and EPA define the contaminants from these sources as conventional pollutants. Conventional pollutants are identified in Figure 1 and include those specific pollutants that are expected to be present in domestic discharges to POTWs. Commercial and industrial facilities may, however, discharge toxic pollutants that the treatment plant is neither designed for nor able to remove.

Biochemical Oxygen Demand (BOD)
Total Suspended Solids
Fecal Coliform
pH
Oil and Grease (O&G)

Figure 1. Conventional Pollutants

NEED FOR THE PRETREATMENT PROGRAM

As noted above, POTWs are not designed to treat toxics in industrial waste. As such, these discharges, from both industrial and commercial sources, can cause serious problems. The undesirable outcome of these discharges can be prevented using treatment techniques or management practices to reduce or eliminate the discharge of these contaminants. The act of treating wastewater prior to discharge to a POTW is commonly referred to as "pretreatment." The National Pretreatment Program, published in **Title 40 Code of Federal Regulations (CFR) Part 403**, provides the regulatory basis to require non-domestic dischargers to comply with pretreatment standards (effluent limitations) to ensure that the goals of the CWA are attained. As noted in 40 CFR §403.2, the objectives of the National Pretreatment Program are to:

a. Prevent the introduction of pollutants into POTWs which will interfere with the operation of a POTW, including interference with its use or disposal of municipal sludge;

b. Prevent the introduction of pollutants into POTWs which will pass through the treatment works or otherwise be incompatible with such works; and

c. Improve opportunities to recycle and reclaim municipal and industrial wastewaters and sludges.

The two key terms used in EPA's objectives for the National Pretreatment Program, "interference" and "pass through," are defined in Figure 2.

As outlined in EPA's objectives, toxic pollutants may pass through the treatment plant into the receiving stream, posing serious threats to aquatic life, to human recreation, and to consumption of fish and shellfish from these waters. Pass through can make waters unswimmable or unfishable in direct contrast to the goals of the CWA. Or, these discharges can interfere with the biological activity of the treatment plant causing sewage to pass through the treatment plant untreated or inadequately treated.

Interference - a discharge which, alone or in conjunction with a discharge or discharges from other sources, both:

- Inhibits or disrupts the POTW, its treatment processes or operations, or its sludge processes, use or disposal, and
- therefore is a cause of a violation of any NPDES permit requirement or of the prevention of sewage sludge use or disposal in compliance with any applicable requirements.

Pass Through - a discharge which exits the POTW into waters of the U.S. in quantities or concentrations which, alone or in conjunction with a discharge or discharges from other sources, is a cause of a violation of any NPDES permit requirement.

Figure 2. Interference and Pass Through

Even where the POTW has the capability to remove these toxics, the pollutants may end up in the sewage sludge, thereby limiting sludge disposal options or escalating the cost of disposal. Incinerated contaminated sludge may release toxic emissions into the atmosphere. Toxic metals removed in primary treatment, while itself not an inhibitory process, can impact sludge digestion, a process that does utilize bacteria to stabilize sludge solids. For example, chromium can inhibit reproduction of aerobic digestion microorganisms, thereby disrupting sludge treatment and producing sludges that must be disposed of with special treatment. Uncontaminated sludge, on the other hand, can be used as fertilizer or soil conditioner, thereby improving the productivity of our land. Many municipalities apply sewage sludge to pastureland or parkland, that they could not do if the sludge were contaminated.

Volatile organics discharged to sewers can accumulate in the head space of sewers, increasing the likelihood of explosions that can cause significant damage. Probably the most well known impact from industrial discharges to POTWs in the U.S. is the explosion in Louisville, KY that occurred in 1981 as the result of excessive discharges of hexane into the collection system, eventually igniting and destroying more than 3 miles of sewers and causing $20 million in damage. Discharge limitations and management practices to control slug discharges have significantly reduced the likelihood of future catastrophes such as the explosion in Louisville.

Discharges of toxic organics can also result in the release of poisonous gas. This occurs most often when acidic wastes react with other wastes in the discharge. For example, cyanide and acid, both present in many electroplating operations, react to form highly toxic hydrogen cyanide gas. Similarly, sulfides from leather tanning can combine with acid to form hydrogen sulfide, another toxic gas. These can be highly dangerous to POTW collection system operators exposed to such conditions in the performance of their duties. Other problems associated with toxic discharges are summarized in Figure 3 and further document the urgency of keeping toxics out of collection systems and POTWs.

The National Pretreatment Program is charged with controlling the 126 Priority Pollutants from industries that discharge into sewer systems as described in the CWA (see Figure 4). These pollutants fall into two categories; metals and organics:

- Metals, including lead, mercury, chromium, and cadmium cannot be destroyed or broken down through treatment or environmental degradation. Toxic metals can cause different human health problems such as lead poisoning and cancer. Additionally, consumption of contaminated seafood and agricultural food crops has resulted in exposures exceeding recommended safe levels.

- air pollution can occur from volatilization of toxic chemicals in the POTW collection system or treatment plant, or through incineration of sewage sludge
- corrosion of collection system and treatment plant from acidic discharges or discharges containing elevated levels of sulfate (forming toxic and corrosive hydrogen sulfide)
- groundwater pollution can occur from leaks in the collection system or pollutants from contaminated sewage sludge.

Figure 3. Problems Associated With Toxic Discharges

- Toxic organics, including solvents, pesticides, dioxins, and polychlorinated biphenyls (PCBs) can be cancer-causing and lead to other serious ailments, such as kidney and liver damage, anemia, and heart failure. In 1996, EPA's Office of Science and Technology (OST) identified 2,193 waterbodies with fish and wildlife advisories, up more than 25 percent from 1995.[5]

Reductions in pollutants can ensure that industrial development vital to the economic well-being of a community is compatible with a healthy environment. As will be noted in Chapter 2, many POTWs are responsible for ensuring that industrial and commercial facilities do not cause problems resulting from their discharges. In 1991, EPA estimated that 190 to 204 million pounds of metals and 30 to 108 million pounds of organics were removed each year as a result of pretreatment program requirements.[6] This is substantiated by

[5] **EPA Office of Science and Technology, Listing of Fish and Wildlife Advisories (LFWA) database, 1998.**

[6] **U.S. Environmental Protection Agency, National Pretreatment Program: Report to Congress, 1991.**

many POTWs that report significant reductions in the loadings of toxics to their treatment plants that is directly attributable to implementation of the National Pretreatment Program.

Figure 4. Priority Pollutants

001 Acenaphthene
002 Acrolein
003 Acrylonitrile
004 Benzene
005 Benzidine
006 Carbon tetrachloride
007 Chlorobenzene
008 1,2,4-trichlorobenzene
009 Hexachlorobenzene
010 1,2-dichloroethane
011 1,1,1-trichloreothane
012 Hexachloroethane
013 1,1-dichloroethane
014 1,1,2-trichloroethane
015 1,1,2,2-tetrachloroethane
016 Chloroethane
018 Bis(2-chloroethyl) ether
019 2-chloroethyl vinyl ethers
020 2-chloronaphthalene
021 2,4,6-trichlorophenol
022 Parachlorometa cresol
023 Chloroform
024 2-chlorophenol
025 1,2-dichlorobenzene
026 1,3-dichlorobenzene
027 1,4-dichlorobenzene
028 3,3-dichlorobenzidine
029 1,1-dichloroethylene
030 1,2-trans-dichloroethylene
031 2,4-dichlorophenol
032 1,2-dichloropropane
033 1,2-dichloropropylene
034 2,4-dimethylphenol
035 2,4-dinitrotoluene
036 2,6-dinitrotoluene
037 1,2-diphenylhydrazine
038 Ethylbenzene
039 Fluoranthene
040 4-chlorophenyl phenyl ether
041 4-bromophenyl phenyl ether
042 Bis(2-chloroisopropyl) ether
043 Bis(2-chloroethoxy) methane
044 Methylene chloride
045 Methyl chloride
046 Methyl bromide
047 Bromoform
048 Dichlorobromomethane
051 Chlorodibromomethane
052 Hexachlorobutadiene
053 Hexachlorocyclopentadiene
054 Isophorone
055 Naphthalene
056 Nitrobenzene
057 2-nitrophenol
058 4-nitrophenol
059 2,4-dinitrophenol
060 4,6-dinitro-o-cresol
061 N-nitrosodimethylamine
062 N-nitrosodiphenylamine
063 N-nitrosodi-n-propylamine
064 Pentachlorophenol
065 Phenol
066 Bis(2-ethylhexyl) phthalate
067 Butyl benzyl phthalate
068 Di-N-Butyl Phthalate
069 Di-n-octyl phthalate
070 Diethyl Phthalate
071 Dimethyl phthalate
072 benzo(a) anthracene
073 Benzo(a)pyrene
074 Benzo(b) fluoranthene
075 Benzo(b) fluoranthene
076 Chrysene
077 Acenaphthylene
078 Anthracene
079 Benzo(ghi) perylene
080 Fluorene
081 Phenanthrene
082 Dibenzo(,h) anthracene
083 Indeno (1,2,3-cd) pyrene
084 Pyrene
085 Tetrachloroethylene
086 Toluene
087 Trichloroethylene
088 Vinyl chloride
089 Aldrin
090 Dieldrin
091 Chlordane
092 4,4-DDT
093 4,4-DDE
094 4,4-DDD
095 Alpha-endosulfan
096 Beta-endosulfan
097 Endosulfan sulfate
098 Endrin
099 Endrin aldehyde
100 Heptachlor
101 Heptachlor epoxide
102 Alpha-BHC
103 Beta-BHC
104 Gamma-BHC
105 Delta-BHC
106 PCB–1242
107 PCB–1254
108 PCB–1221
109 PCB–1232
110 PCB–1248
111 PCB–1260
112 PCB–1016
113 Toxaphene
114 Antimony
115 Arsenic
116 Asbestos
117 Beryllium
118 Cadmium
119 Chromium
120 Copper
121 Cyanide, Total
122 Lead
123 Mercury
124 Nickel
125 Selenium
126 Silver
127 Thallium
128 Zinc
129 2,3,7,8-TCDD

2. OVERVIEW OF THE NATIONAL PRETREATMENT PROGRAM

THE CLEAN WATER ACT

Chapter 2. Applicable EPA Guidance

Control Authority Pretreatment Audit Checklist and Instructions
Guidance for Conducting a Pretreatment Compliance Inspection
Guidance for Reporting and Evaluating POTW Noncompliance with Pretreatment Implementation Requirements
Guidance Manual for POTW Pretreatment Program Development
Pretreatment Compliance Inspection and Audit Manual For Approval Authorities
Procedures Manual for Reviewing a POTW Pretreatment Program Submission

On October 18, 1972, the 92nd Congress of the United States passed the Federal Water Pollution Control Act Amendments of 1972, declaring the restoration and maintenance of the chemical, physical, and biological integrity of the Nation's water as a National objective (see Figure 5). While procedures for implementing this act (more commonly referred to as the Clean Water Act (CWA)) have been re-evaluated and modified over time, the 1972 objective has remained unchanged in its 25 year history.

The 1972 Amendments to the CWA established a water quality regulatory approach along with EPA-promulgated industry-specific technology-based effluent limitations. The National Pollutant Discharge Elimination System (NPDES) permit program was established under the CWA to control the discharge of pollutants from point sources and served as a vehicle to implement the industrial technology-based standards. To implement pretreatment requirements, EPA promulgated 40 CFR Part 128 in late 1973, establishing general prohibitions against treatment plant interference and pass through and pretreatment standards for the discharge of incompatible pollutants from specific industrial categories.

To restore and maintain the chemical, physical, and biological integrity of the Nation's waters:

(1) it is the national goal that the discharge of pollutants into the navigable waters be eliminated by 1985;

(2) it is the national goal that wherever attainable, an interim goal of water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water be achieved by July 1, 1983;

(3) it is the national policy that the discharge of toxic pollutants in toxic amounts be prohibited;

(4) it is the national policy that Federal financial assistance be provided to construct publicly owned waste treatment works;

(5) it is the national policy that Area wide waste treatment management planning processes be developed and implemented to assure adequate control of sources of pollutants in each State;

(6) it is the national policy that a major research and demonstration effort be made to develop technology necessary to eliminate the discharge of pollutants into the navigable waters, waters of the contiguous zone, and the oceans; and

(7) it is the national policy that programs for the control of nonpoint sources of pollution be developed and implemented in an expeditious manner so as to enable the goals of this Chapter to be met through the control of both point and nonpoint sources of pollution.

Figure 5. Section 101 of the Clean Water Act (CWA)

In 1975, several environmental groups filed suit against EPA challenging EPA's criteria for identifying toxic pollutants, EPA's failure to promulgate effluent standards, and EPA's failure to promulgate pretreatment standards for numerous industrial categories. As a result of this litigation, EPA promulgated the General Pretreatment Regulations at 40 CFR Part 403 on June 26, 1978, replacing the 40 CFR Part 128 requirements. Additionally, as a result of the suit, EPA agreed to regulate the discharge of 65 categories of pollutants (making up the 126 priority pollutants presented in Figure 4) from 21 industrial categories. The list of priority pollutants is still in effect today (the original list actually had 129 pollutants, three of which have since been removed from that list) while the list of regulated industrial categories has grown to more than 51 distinct industries. A discussion of industry specific requirements are provided in Chapter 3.

THE GENERAL PRETREATMENT REGULATIONS

The General Pretreatment Regulations establish responsibilities of Federal, State, and local government, industry and the public to implement Pretreatment Standards to control pollutants which pass through or interfere with POTW treatment processes or which may contaminate sewage sludge. The regulations, which have been revised numerous times since originally published in 1978, consist of 18 sections and several appendices. A copy of the overall framework for the General Pretreatment Regulations is provided in Figure 6.

The General Pretreatment Regulations apply to all nondomestic sources which introduce pollutants into a POTW. These sources of "indirect discharge" are more commonly referred to as industrial users (IUs). Since IUs can be as simple as an unmanned coin operated car wash to as complex as an automobile manufacturing plant or a synthetic organic chemical producer, EPA developed four criteria that define a Significant Industrial User (SIU). Many of the General Pretreatment Regulations apply to SIUs as opposed to IUs, based on the fact that control of SIUs should provide adequate protection of the POTW.

These four criteria are as follows:

- an IU that discharges an average of 25,000 gallons per day or more of process wastewater to the POTW;
- an IU that contributes a process wastestream making up 5 percent or more of the average dry weather hydraulic or organic capacity of the POTW treatment plant;
- an IU designated by the Control Authority as such because of its reasonable potential to adversely affect the POTW's operation or violate any pretreatment standard or requirement; or
- an IU subject to Federal categorical pretreatment standards.

§ 403.1	Purpose and applicability
§ 403.2	Objectives of general pretreatment regulations
§ 403.3	Definitions
§ 403.4	State or local law
§ 403.5	National pretreatment standards: Prohibited discharges
§ 403.6	National pretreatment standards: Categorical pretreatment standards
§ 403.7	Removal credits
§ 403.8	Pretreatment program requirements: Development and implementation by POTW
§ 403.9	POTW pretreatment programs and/or authorization to revise pretreatment standards: Submission for approval
§ 403.10	Development and submission of NPDES State pretreatment programs
§ 403.11	Approval procedures for POTW pretreatment programs and POTW granting of removal credits
§ 403.12	Reporting requirements for POTW's and industrial users
§ 403.13	Variances from categorical pretreatment standards for fundamentally different factors
§ 403.14	Confidentiality
§ 403.15	Net/Gross calculation
§ 403.16	Upset provision
§ 403.17	Bypass
§ 403.18	Modification of POTW pretreatment programs
Appendix A:	Program Guidance Memorandum
Appendix B:	[Reserved]
Appendix C:	[Reserved]
Appendix D:	Selected Industrial Subcategories Considered Dilute for Purposes of the Combined Wastestream Formula
Appendix E:	Sampling Procedures
Appendix F:	[Reserved]
Appendix G:	Pollutants Eligible for a Removal Credit

Figure 6. The General Pretreatment Regulations

Unlike other environmental programs that rely on Federal or State governments to implement and enforce specific requirements, the Pretreatment Program places the majority of the responsibility on local municipalities. Specifically, section 403.8(a) of the General Pretreatment Regulations states that any POTW (or combination of treatment plants operated by the same authority) with a total design flow greater than 5 million gallons per day (MGD) and smaller POTWs with SIUs must establish a local pretreatment program. As of early 1998, 1,578 POTWs are required to have local programs. While this represents only about 15 percent of the total treatment plants nationwide, these POTWs account for more than 80 percent (i.e., approximately 30 billion gallons a day) of the national wastewater flow.

The General Pretreatment Regulations define the term "Control Authority" as a POTW that administers an approved pretreatment program since it is the entity authorized to control discharges to its system. Section 403.10(e) provides States authority to implement POTW pretreatment programs in lieu of POTWs. Five States have elected to assume this responsibility (Vermont, Connecticut, Alabama, Mississippi, and Nebraska). In these instances, the State is defined as the Control Authority.

As described above, all Control Authorities must establish a local pretreatment program to control discharges from non-domestic sources. These programs must be approved by the "Approval Authority" who is also responsible for overseeing implementation and enforcement of these programs. As noted in Figure 7 , a total of 44 States/Territories are authorized to implement State NPDES Permit Programs, but only 27 are authorized to be the Pretreatment Program Approval Authority (i.e, those with approved State pretreatment programs excluding the five §403.10(e) States). In all other States and Territories (including the 403.10(e) States), EPA is considered to be the Approval Authority.

POTW PRETREATMENT PROGRAMS

The actual requirement for a POTW to develop and implement a local pretreatment program is a condition of its NPDES permit. Once the Approval Authority determines that a POTW needs a pretreatment program, the POTW's NPDES permit is modified to require development of a local program and submission of the program to the Approval Authority for review and approval. Consistent with §403.8(f), POTW pretreatment programs must contain the six minimum elements presented in Figure 8.

In addition to the six specific elements, pretreatment program submissions must include:

- a statement from the City Solicitor (or the like) declaring the POTW has adequate authority to carry out program requirements;
- copies of statutes, ordinances, regulations, agreements, or other authorities the POTW relies upon to administer the pretreatment program including a statement reflecting the endorsement or approval of the bodies responsible for supervising and/or funding the program;
- a brief description and organizational chart of the organization administering the program; and
- a description of funding levels and manpower available to implement the program.

Pretreatment program submissions found to be complete proceed to the public notice process, as described in Chapter 4, Public Participation and POTW Reporting. Upon program approval, the Approval Authority is responsible for modifying the POTW's NPDES permit to require implementation of the approved pretreatment program. Once approved, the Approval Authority oversees POTW pretreatment program implementation via receiving annual reports and conducting periodic audits and inspections. As of early 1998, of the 1,578 POTWs required to develop pretreatment programs, 97 percent (1,535) have been approved.

The National Pretreatment Program regulates IUs through three types of regulatory entities: EPA, Approval Authorities, and Control Authorities. As noted above, Approval Authorities oversee Control Authorities while Control Authorities regulate IUs. General responsibilities of each of these three regulatory entities are presented in Figure 9.

State	Approved State NPDES Permit Program	Approved State Pretreatment Program
Alabama	10/19/79	10/19/79*
Arkansas	11/01/86	11/01/86
California	05/14/73	09/22/89
Colorado	03/27/75	--
Connecticut	09/26/73	06/03/81*
Delaware	04/01/74	--
Florida	05/01/95	05/01/95
Georgia	06/28/74	03/12/81
Hawaii	11/28/74	08/12/83
Illinois	10/23/77	--
Indiana	01/01/75	--
Iowa	08/10/78	06/03/81
Kansas	06/28/74	--
Kentucky	09/30/83	09/30/83
Louisiana	08/27/96	08/27/96
Maryland	09/05/74	09/30/85
Michigan	10/17/73	04/16/85
Minnesota	06/30/74	07/16/79
Mississippi	05/01/74	05/13/82*
Missouri	10/30/74	06/03/81
Montana	06/10/74	--
Nebraska	06/12/74	09/07/84*
Nevada	09/19/75	--
New Jersey	04/13/82	04/13/82
New York	10/28/75	--
North Carolina	10/19/75	06/14/82
North Dakota	06/13/75	--
Ohio	03/11/74	07/27/83
Oklahoma	11/19/96	11/19/96
Oregon	09/26/73	03/12/81
Pennsylvania	06/30/78	--
Rhode Island	09/17/84	09/17/84
South Carolina	06/10/75	04/09/82
South Dakota	12/30/93	12/30/93
Tennessee	12/28/77	08/10/83
Texas	09/14/98	09/14/98
Utah	07/07/87	07/07/87
Vermont	03/11/74	03/16/82*
Virgin Islands	06/30/76	--
Virginia	03/31/75	04/14/89
Washington	11/14/73	09/30/86
West Virginia	05/10/82	05/10/82
Wisconsin	02/04/74	12/24/80
Wyoming	01/30/75	--

*** - Denotes 403.10(e) State Approval**

Figure 7. State Program Approval Status

1. Legal Authority

The POTW must operate pursuant to legal authority enforceable in Federal, State or local courts, which authorizes or enables the POTW to apply and enforce any pretreatment regulations developed pursuant to the CWA. At a minimum, the legal authority must enable the POTW to:

I. deny or condition discharges to the POTW;
ii. require compliance with pretreatment standards and requirements;
iii. control IU discharges through permits, orders, or similar means;
iv. require IU compliance schedules when necessary to meet applicable pretreatment standards and/or requirements and the submission of reports to demonstrate compliance;
v. inspect and monitor IUs;
vi. Obtain remedies for IU noncompliance; and
vii. comply with confidentiality requirements.

2. Procedures

The POTW must develop and implement procedures to ensure compliance with pretreatment requirements, including:

I. identify and locate all IUs subject to the pretreatment program;
ii. identify the character and volume of pollutants contributed by such users;
iii. notify users of applicable pretreatment standards and requirements;
iv. receive and analyze reports from IUs;
v. sample and analyze IU discharges and evaluate the need for IU slug control plans;
vi. investigate instances of noncompliance; and
vii. comply with public participation requirements.

3. Funding

The POTW must have sufficient resources and qualified personnel to carry out the authorities and procedures specified in its approved pretreatment program.

4. Local limits

The POTW must develop local limits or demonstrate why these limits are not necessary.

5. Enforcement Response Plan (ERP)

The POTW must develop and implement an ERP that contains detailed procedures indicating how the POTW will investigate and respond to instances of IU noncompliance.

6. List of SIUs

The POTW must prepare, update, and submit to the Approval Authority a list of all Significant Industrial Users (SIUs).

Figure 8. Six Minimum Pretreatment Program Elements

EPA

Headquarters

- Oversees program implementation at all levels
- Develops and modifies regulations for the program
- Develops policies to clarify and further define the program
- Develops technical guidance for program implementation
- Initiates enforcement actions as appropriate

Regions

- Fulfill Approval Authority responsibilities for States without a State pretreatment program
- Oversee State program implementation
- Initiate enforcement actions as appropriate.

Approval Authorities (EPA Regions and delegated States)

- Notify POTWs of their responsibilities
- Review and approve requests for POTW pretreatment program approval or modification
- Review requests for site-specific modifications to categorical pretreatment standards
- Oversee POTW program implementation
- Provide technical guidance to POTWs
- Initiate enforcement actions, against noncompliant POTWs or industries.

Control Authorities (POTWs, States, or EPA Regions)

- Develop, implement, and maintain approved pretreatment program
- Evaluate compliance of regulated IUs
- Initiate enforcement action against industries as appropriate
- Submit reports to Approval Authorities
- Develop local limits (or demonstrate why they are not needed)
- Develop and implement enforcement response plan.

Industrial Users

- Comply with applicable pretreatment standards and reporting requirements.

Figure 9. Roles and Responsibilities

3. PRETREATMENT STANDARDS

As described in Chapters 3 and 4, the National Pretreatment Program identifies specific requirements that apply to all IUs, additional requirements that apply to all SIUs, and certain requirements that only apply to CIUs. The objectives of the National Pretreatment Program are achieved by applying and enforcing three types of discharge standards:

- prohibited discharge standards
- categorical standards
- local limits.

Chapter 3. Applicable EPA Guidance

Guidance Manual For Implementing Total Toxic Organics (TTO) Pretreatment Standards
Guidance Manual for Preparation and Review of Removal Credit Applications
Guidance Manual for Preventing Interference at POTWs
Guidance Manual for the Identification of Hazardous Wastes Delivered to Publicly Owned Treatment Works by Truck, Rail, or Dedicated Pipe
Guidance Manual for the Use of Production-Based Pretreatment Standards and the Combined Wastestream Formula
Guidance Manual on the Development and Implementation of Local Discharge Limitations Under the Pretreatment Program
Guidance to Protect POTW Workers From Toxic And Reactive Gases And Vapors
Prelim User's Guide, Documentation for the EPA Computer Program/Model for Developing Local Limits for Industrial Pretreatment Programs at Publicly Owned Treatment Works
Supplemental Manual On the Development And Implementation of Local Discharge Limitations Under The Pretreatment Program: Residential and Commercial Toxic Pollutant Loadings And POTW Removal Efficiency Estimation

Industry-Specific Guides

Aluminum, Copper, And Nonferrous Metals Forming And Metal Powders Pretreatment Standards: A Guidance Manual
Guidance Manual For Battery Manufacturing Pretreatment Standards
Guidance Manual for Electroplating and Metal Finishing Pretreatment Standard
Guidance Manual For Iron And Steel Manufacturing Pretreatment Standards
Guidance Manual for Leather Tanning and Finishing Pretreatment Standards
Guidance Manual for Pulp, Paper, and Paperboard and Builders' Paper and Board Mills Pretreatment Standards

PROHIBITED DISCHARGE STANDARDS

All IUs, whether or not subject to any other National, State, or local pretreatment requirements, are subject to the general and specific prohibitions identified in 40 CFR §§403.5(a) and (b), respectively. General prohibitions forbid the discharge of any pollutant(s) to a POTW that cause pass through or interference (Figure 10). Specific prohibitions forbid eight categories of pollutant discharges as follows:

(1) discharges containing pollutants which create a fire or explosion hazard in the POTW, including but not limited to, wastestreams with a closed cup flashpoint of less than 140°F (60°C) using the test methods specified in 40 CFR §261.21;
(2) discharges containing pollutants causing corrosive structural damage to the POTW, but in no case discharges with a pH lower than 5.0, unless the POTW is specifically designed to accommodate such discharges;
(3) discharges containing pollutants in amounts causing obstruction to the flow in the POTW resulting in interference;
(4) discharges of any pollutants released at a flow rate and/or concentration which will cause interference with the POTW;
(5) discharges of heat in amounts which will inhibit biological activity in the POTW resulting in interference, but in no case heat in such quantities that the temperature at the POTW treatment plant exceeds 40°C(104°F) unless the Approval Authority, upon request of the POTW, approves alternative temperature limits;
(6) discharges of petroleum oil, nonbiodegradable cutting oil, or products of mineral oil origin in amounts that will cause interference or pass through;

(7) discharges which result in the presence of toxic gases, vapors, or fumes within the POTW in a quantity that may cause acute worker health and safety problems; and
(8) discharges of trucked or hauled pollutants, except at discharge points designated by the POTW.

Pass through - A discharge which exits the POTW into waters of the US in quantities or concentrations which, alone or in conjunction with a discharge or discharges from other sources, is a cause of a violation of any requirement of the POTW's NPDES permit (including an increase in the magnitude or duration of a violation.

Interference - A discharge which, alone or in conjunction with a discharge or discharges from other sources, both (1) inhibits or disrupts the POTW, its treatment processes or operations, or its sludge processes, use or disposal; and (2) therefore is a cause of a violation of any requirement of the POTW's NPDES permit or of the prevention of sewage sludge use or disposal.

Figure 10. Interference and Pass Through

Compliance with the general and specific prohibitions is mandatory for all IUs, although a facility may have an affirmative defense in any action brought against it alleging a violation of the general prohibitions or of certain specific prohibitions [(3), (4), (5), (6) and (7) above] where the IU can demonstrate it did not have reason to know that its discharge, alone or in conjunction with a discharge or discharges from other sources, would cause pass through or interference, and the IU was in compliance with a technically-based local limit developed to prevent pass through or interference.

These prohibited discharge standards are intended to provide general protection for POTWs. However, their lack of specific pollutant limitations creates the need for additional controls, namely categorical pretreatment standards and local limits.

CATEGORICAL STANDARDS

Categorical pretreatment standards (i.e., categorical standards) are national, uniform, technology-based standards that apply to discharges to POTWs from specific industrial categories (i.e., **indirect dischargers**) and limit the discharge of specific pollutants. Categorical pretreatment standards for both existing and new sources (PSES and PSNS, respectively) are promulgated by EPA pursuant to Section 307(b) and (c) of the CWA. Limitations developed for indirect discharges are designed to prevent the discharge of pollutants that could pass through, interfere with, or otherwise be incompatible with POTW operations. Effluent limitations guidelines (ELGs), developed in conjunction with categorical standards, limit the discharge from facilities directly to waters of the U.S. (i.e., **direct dischargers**) and do not apply to indirect dischargers. ELGs include Best Practicable Control Technology Currently Available (BPT), Best Conventional Pollutant Control Technology (BCT), and Best Available Technology Economically Achievable (BAT) limitations and New Source Performance Standards (NSPS). **ELGs (i.e., BPT, BCT, BAT, and NSPS) do not apply to indirect dischargers.** The significant difference between categorical standards and effluent limitations guidelines is that categorical standards account for any pollutant removal that may be afforded through treatment at the POTW while effluent limitations guidelines do not.

Industries identified as major sources of toxic pollutants are typically targeted for effluent guideline and categorical standard development. If limits are deemed necessary, EPA investigates affected IUs and gathers information regarding process operations and treatment and management practices, accounting for differences in facility size and age, equipment age, and wastewater characteristics. Subcategorization within an industrial category is evaluated based on variability in processes employed, raw materials used, types of items produced, and characteristics of wastes generated. Availability and cost of control technologies, non-water quality environmental impacts, available pollution prevention measures[7], and economic impacts are then identified prior to EPA's presentation of findings in proposed development documents and publishing a notice of the proposed regulations in the *Federal Register*. Based on public comments on the proposed rule, EPA promulgates (i.e., publishes) the standards (Figure 11).

[7] **EPA's *Considerations of Pollution Prevention in EPA's Effluent Guideline Development Process* may be consulted for more information on this topic.**

As noted above, categorical pretreatment standards are developed both for existing (PSES) and new sources (PSNS). Facilities are classified as either PSES or PSNS based on the definition of "new source" set out in 40 CFR §403.3(k) of the General Pretreatment Regulations (see Figure 12). Dischargers subject to PSES are required to comply with those standards by a specified date, typically no more than three years after the effective date of the categorical standard. Users subject to PSNS, however, are required to achieve compliance within the shortest feasible time, not to exceed 90 days from commencement of discharge. PSNS are often more stringent than PSES based on the opportunity for new sources to install the best available demonstrated technology and operate the most efficient production processes.

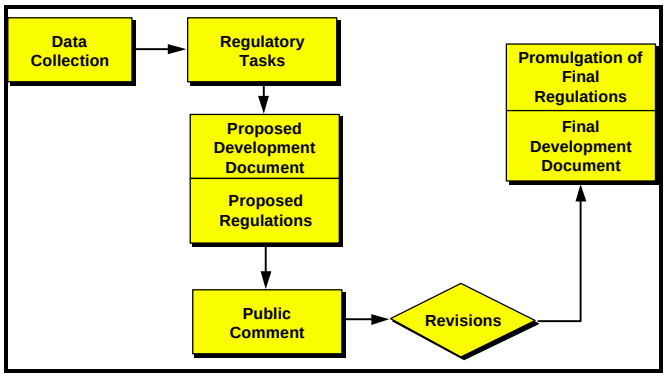

Figure 11. Development Process of Effluent Guidelines

Congress established an initial list of 21 categorical industries under Section 306 of the CWA of 1972. As a result of various court decrees and settlement agreements resulting from litigation, and from EPA's internal work plan development process, EPA has developed effluent guidelines (for direct dischargers) and/or categorical pretreatment standards (for indirect dischargers) for 51 industrial categories. Of these industrial categories, EPA implements pretreatment standards for 32 categories, and either requires compliance solely with 40 CFR Part 403 General Pretreatment Regulations or does not address pretreatment standards for the remaining categories. Plans for EPA's expansion and modification of the list is detailed in the *Effluent Guidelines Plan,* published in the *Federal Register* biennially as required in section 304(m) of the CWA. A list of the industrial categories that have categorical standards is provided as Figure 13.

New Source is defined at 40 CFR §403.3 (k)(1) to mean any building, structure, facility or installation from which there is or may be a discharge of pollutants, the construction of which commenced after publication of proposed Pretreatment Standards under Section 307(c) of the Act which will be applicable to such source if Standards are thereafter promulgated in accordance with that section, *provided that*:

(i) the building, structure, facility, or installation is constructed at a site at which no other source is located; or

(ii) the building, structure, facility, or installation totally replaces the process or production equipment that causes the discharge of pollutants at an existing source; or

(iii) the production or wastewater generating processes of the building, structure, facility or installation are substantially independent of an existing source at the same site. In determining whether these are substantially independent, factors such as the extent to which the new facility is integrated with the existing plant, and the extent to which the new facility is engaged in the same general type of activity as the existing source should be considered.

(2) Construction on a site at which an existing source is located results in a modification rather than a new source if the construction does not create a new building, structure, facility, or installation meeting the criteria of paragraphs (k)(1)(ii), or (k)(1)(iii) of this section but otherwise alters, replaces, or adds to existing process or production equipment.

(3) Construction of a new source as defined under this paragraph has commenced if the owner or operator has:

(i) begun, or caused to begin as part of a continuous onsite construction program:

(ii) any placement, assembly or installation of facilities or equipment, or

(B) significant site preparation work, including clearing, excavation, or removal of existing buildings, structures, or facilities which is necessary for the placement, assembly, or installation of new source facilities or equipment; or

(ii) entered into a binding contractual obligation for the purchase of facilities or equipment which are intended to be used in its operation within a reasonable time. Options to purchase or contracts which can be terminated or modified without substantial loss, and contracts for feasibility, engineering, and design studies do not constitute a contractual obligation under this paragraph.

Figure 12. Definition of New Source (40 CFR 403.3(k))

Categorical pretreatment standards developed can be concentration-based or mass-based. Concentration-based standards are expressed as milligrams of pollutant allowed per liter (mg/l) of wastewater discharged and are issued where production rates for the particular industrial category do not necessarily correlate with pollutant discharges. Mass-based standards are generally expressed on a mass per unit of production (e.g., milligrams of pollutant per kilogram of product produced, pounds of pollutant per million cubic feet of air scrubbed, etc.) and are issued where water conservation is an important component in the limitation development process. For a few categories where reducing a facility's flow volume does not provide a significant difference in the pollutant load discharged, EPA has established both mass- and concentration-based standards. Generally, both a daily maximum limitation and a long-term average limitation (e.g., average daily values in a calendar month) are established for every regulated pollutant.

Figure 13. Summary of Categorical Pretreatment Standards

Category	40 CFR Part	Subparts	Type of Standard	Overview of Pretreatment Standards
Aluminum Forming	467	A-F	PSES PSNS	Limits are production-based, daily maximums and monthly averages. Subpart C prohibits discharges from certain operations.
Battery Manufacturing	461	A-G	PSES PSNS	Limits are production-based, daily maximums and monthly averages. No discharge is allowed from any process not specifically identified in the regulations.
Builders' Paper and Board Mills	431	A	PSES PSNS	Limits are production-based daily maximums. These facilities may certify they do not use certain compounds in lieu of performing monitoring to demonstrate compliance.
Carbon Black Manufacturing	458	A-D	PSNS	Limits are for Oil & Grease only (no limit duration specified).
Coil Coating	465	A-D	PSES PSNS	Limits are production-based, daily maximums and monthly averages.
Copper Forming	468	A	PSES PSNS	Limits are production-based, daily maximums and monthly averages.
Electrical and Electronic Components	469	A-D	PSES PSNS	Limits are concentration-based, daily maximums and 30 day averages or monthly averages (varies per subpart and pollutant parameter). Certification is allowed in lieu of monitoring for certain pollutants when a management plan is approved and implemented.
Electroplating	413	A-B, D-H	PSES	Limits are concentration-based (or alternative mass-based equivalents), daily maximums and four consecutive monitoring days averages. Two sets of limits exist, depending on if facility discharges more or less than 10,000 gallons per day of process wastewater. Certification is allowed in lieu of monitoring for certain pollutants when a management plan is approved and implemented.
Feedlots	412	B	PSNS	Discharge of process wastewater is prohibited, except when there is an overflow resulting from a chronic or catastrophic rainfall event.
Fertilizer Manufacturing	418	A-G	PSNS	Limits may specify zero discharge of wastewater pollutants (Subpart A), production-based daily maximums and 30-day averages (Subparts B-E) or concentration-based (Subparts F-G) with no limit duration specified.
Glass Manufacturing	426	H, K-M	PSNS	Limits are either concentration- or production-based, daily maximums and monthly averages.
Grain Mills	406	A	PSNS	Discharge of process wastewater is prohibited at a flow rate or mass loading rate which is excessive over any time period during the peak load at a POTW.
Ink Formulating	447	A	PSNS	Regulations specify no discharge of process wastewater pollutants to the POTW.
Inorganic Chemicals Manufacturing	415	A-BO	PSES PSNS	Limits vary for each subpart with a majority of the limits concentration-based, daily maximums and 30-day averages, or may specify no discharge of wastewater pollutants. Numerous subparts have no pretreatment standards.
Iron and Steel Manufacturing	420	A-F, H-J, L	PSES PSNS	Limits are production-based, daily maximums and 30 day averages.
Leather Tanning and Finishing	425	A-I	PSES PSNS	Limits are concentration-based, daily maximums and monthly averages. In certain instances, production volume dictates applicable pretreatment standards.
Metal Finishing	433	A	PSES PSNS	Limits are concentration-based, daily maximums and monthly averages. Certification is allowed for certain pollutants where a management plan is approved and implemented.

Figure 13. Summary of Categorical Pretreatment Standards

Category	40 CFR Part	Subparts	Type of Standard	Overview of Pretreatment Standards
Metal Molding and Casting	464	A-D	PSES PSNS	Limits are primarily production-based, daily maximums and monthly averages. Discharges from certain processes are prohibited (Subparts A-C).
Nonferrous Metals Forming and Metal Powders	471	A-J	PSES PSNS	Limits are production-based, daily maximums and monthly averages. In some instances, the regulations prohibit the discharge of wastewater pollutants.
Nonferrous Metals Manufacturing	421	B-AE	PSES PSNS	Limits are production-based, daily maximums and monthly averages. The majority of the Subparts have both existing and new source limits, with others having solely new source requirements.
Organic Chemicals, Plastics, and Synthetic Fibers	414	B-H, K	PSES PSNS	Limits are mass-based (concentration-based standards multiplied by process flow), daily maximums and monthly averages. Standards for metals and cyanide apply only to metal- or cyanide-bearing wastestreams.
Paint Formulating	446	A	PSNS	Regulations specify no discharge of process wastewater pollutants to the POTW.
Paving and Roofing Materials (Tars and Asphalt)	443	A-D	PSNS	Limits are for Oil & Grease only (no limit duration specified).
Pesticide Chemicals	455	A, C, E	PSES PSNS	Limits are mass-based (concentration-based standards multiplied by process flow), daily maximums and monthly averages. Subpart C specifies no discharge of process wastewater pollutants but provides for pollution prevention alternatives. Subpart E specifies no discharge of process wastewater pollutants.
Petroleum Refining	419	A-E	PSES PSNS	Limits are concentration-based (or mass based equivalent), daily maximums.
Pharmaceutical Manufacturing	439	A-D	PSES PSNS	Limits are concentration-based, daily maximums and monthly averages. These facilities may certify they do not use or generate cyanide in lieu of performing monitoring to demonstrate compliance.
Porcelain Enameling	466	A-D	PSES PSNS	Limits are concentration-based (or alternative production-based), daily maximums and monthly averages. Subpart B prohibits discharges certain operations.
Pulp, Paper, and Paperboard	430	A-G, I-L	PSES PSNS	Limits are production-based daily maximums and monthly averages. These facilities may certify they do not use certain compounds in lieu of performing monitoring to demonstrate compliance. Facilities subject to Subparts B and E must also implement Best Management Practices as identified.
Rubber Manufacturing	428	E-K	PSNS	Limits are concentration- or production-based, daily maximums and monthly averages.
Soap and Detergent Manufacturing	417	O-R	PSNS	Regulations specify no discharge of process wastewater pollutants to the POTW.
Steam Electric Power Generating	423	N/A	PSES PSNS	Limits are either concentration-based, daily maximums, or "maximums for any time", or compliance can be demonstrated through engineering calculations.
Timber Products Processing	429	F-H	PSES PSNS	All PSNS (and PSES for Subpart F) prohibit the discharge of wastewater pollutants. PSES for Subparts G and H are concentration-based, daily maximums (with production-based alternatives).

Categorical standards apply to regulated wastewaters, i.e. wastewater from an industrial process that is regulated for a particular pollutant by a categorical pretreatment standard. Therefore, demonstrating compliance with categorical pretreatment standards is intended to be based on measurements of wastestreams containing only the regulated process wastewater. However, recognizing isolation of regulated wastestreams from nonregulated wastestreams was not always practicable nor desirable, EPA developed the combined wastestream formula (CWF) and flow weighted average (FWA) approach for determining compliance with combined wastestreams.

Pursuant to 40 CFR §403.6(e), the CWF is applicable where a regulated wastestream combines with one or more unregulated or dilute wastestreams (Figure 14) prior to treatment. Where nonregulated wastestreams combine with process streams after pretreatment, the more stringent approach (whether CWF or FWA) is used to adjust the limits[8] (Figure 15). The CWF and FWA approaches differ primarily in their allowances for nonregulated wastestreams. While the CWF provides a "full credit" (i.e., same pollutant levels as regulated wastestreams) for unregulated wastestreams yet no credit for dilute wastestreams, the FWA requires sampling and analysis of the untreated, nonregulated wastestreams to determine the credit to be granted (not to exceed that allowed for the regulated wastestreams).

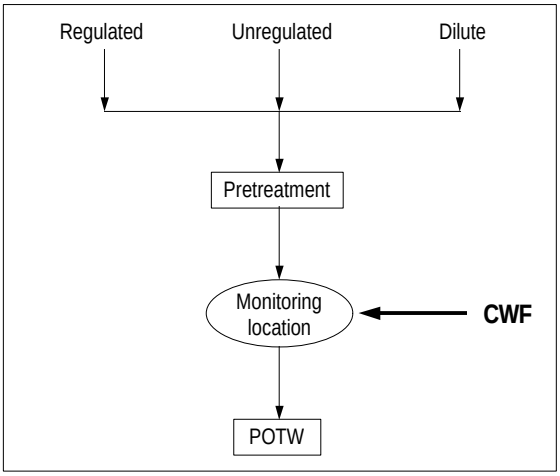

Figure 14. Combined Wastestream Formula

Application of the CWF and FWA requires proper identification, classification, and quantification of the three wastestream types (Figure 16.) Note: in circumstances where boiler blowdown, noncontact cooling water, stormwater, or demineralized wastestreams contain a significant amount of a regulated pollutant, and the treatment of the wastewater with the regulated wastestream results in substantial reduction of the regulated pollutant, the Control Authority can classify the wastestream as unregulated rather than as a dilute wastestream. Clarification on category-specific wastestream classifications may be provided by consulting the applicable regulation(s) and associated development documents, since wastestream types are addressed in the effluent guideline and categorical standard development process. When in doubt, the Control Authority can always require the CIU to monitor the wastestream(s) in question to quantify the presence (or lack thereof) of categorically regulated pollutants. Reasonably accurate flow data must also be obtained for each wastestream type flowing through the monitoring point to ensure categorical pretreatment standards are adjusted accordingly. Proper application of the CWF or FWA will result in:

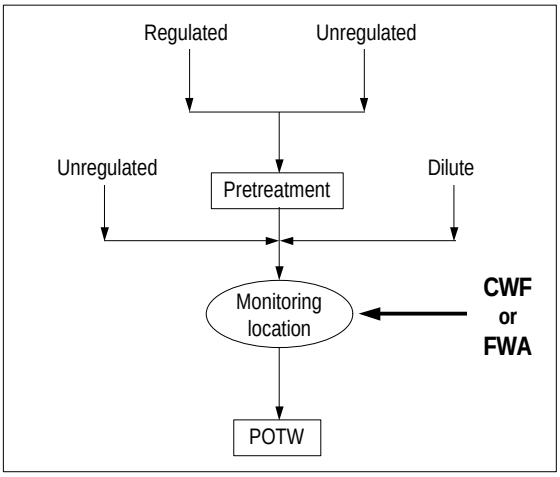

Figure 15. CWF vs. FWA

- alternative limits being established for each regulated pollutant in each regulated processes;
- both daily maximum and long-term average (i.e., 4-day, 30-day, or monthly) alternative limits being calculated for each regulated pollutant;

[8] **Where commingled wastestreams combine with nonregulated wastestreams after treatment, the CWF adjusted limitations are further adjusted by use of the CWF or FWA to address the untreated, nonregulated wastestreams (Figure 17.) For more detailed discussion of FWA, see Federal Register preamble language, 51 FR 21454 (June 12, 1986).**

- 4-day average limits being adjusted to equivalent monthly average limits when two or more categorical pretreatment standards apply to the facility and one of the applicable standards is 40 CFR Part 413; and
- calculated alternative limits remaining above the analytical detection limit for that pollutant. **NOTE**: If adjusted limit(s) are below the detection limit, the Control Authority shall instruct the IU to either:

  - separate the dilute wastestreams from the regulated wastestreams prior to the combined treatment facility, or
  - segregate all wastestreams entirely.

EPA's *Guidance Manual for the Use of Production Based Pretreatment Standards and the Combined Wastestream Formula* should be consulted for more information on the proper application and adjustment of categorical pretreatment standards.

Regulated	Nonregulated	
	Unregulated	Dilute
Wastewater from an industrial process that is regulated for a particular pollutant by a categorical pretreatment standard	Wastestreams from an industrial process that are not regulated for a particular pollutant by a categorical pretreatment standard and are not defined as a dilute wastestream, e.g.: ▸ a process wastestream for which categorical standards have been promulgated but for which the deadline for compliance has not yet been reached ▸ a process wastestream that currently is not subject to categorical pretreatment standards ▸ a process wastestream that is not regulated for the pollutant in question but is regulated for other pollutants.	Wastestreams which have no more than trace or non-detectable amounts of the regulated pollutant. Defined in 40 CFR § 403.6(e)(1) of the General Pretreatment Regulations to include sanitary wastestreams, demineralized backwash streams, boiler blowdown, noncontact cooling water, storm water, and process wastestreams from certain standards based on the findings that these wastewaters contained none of the regulated pollutant or only trace amounts of it.

Figure 16. Wastestream Types

Although categorical standards are established based on a particular industrial category, EPA provides several options for unique circumstances that justify adjustment of categorical standards for an individual facility:

Removal Credits 40 CFR §403.7 details the conditions by which a Control Authority may demonstrate consistent removal of pollutants regulated by categorical standards at their POTW, and in so doing, may extend removal credits to industries on a pollutant-specific basis to prevent redundant treatment. Removal credits are available for a pollutant if the pollutant is regulated by the sewage sludge use or disposal option employed by the POTW making the application request, or if the pollutant is listed in 40 CFR Part 403, Appendix G. Also, the availability of removal credits is not limited to Appendix G pollutants for POTWs that dispose of sewage sludge in municipal solid waste landfills. Steps for developing such a request are detailed in EPA's *Guidance Manual for the Preparation and Review of Removal Credit Applications*.

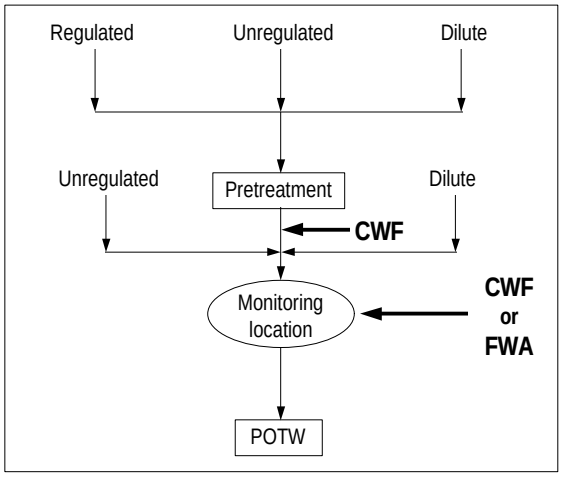

Figure 17. Multiple use of the CWF/FWA

Fundamentally Different Factors Variance Section 301(n) of the CWA authorizes adjustments of categorical pretreatment standards for existing sources who demonstrate they have factors which are fundamentally different from the factors EPA considered during standards development (40 CFR §403.13). Variance requests must be based solely on information and data submitted during the development of the categorical standards (Figure 18) and the adjusted effluent limitations must neither be more nor less stringent than justified by the fundamental difference nor result in a nonwater quality environmental impact markedly more adverse than the impact considered by EPA when developing the categorical standard.

Successful requests must detail factors well outside the range considered by EPA in establishing the standard and not merely factors deviating from the average. Further, differences must not be similar to a significant number of other facilities in the category. A facility must request a variance in writing no later than 180 days after publication of a categorical Pretreatment Standard in the Federal Register.

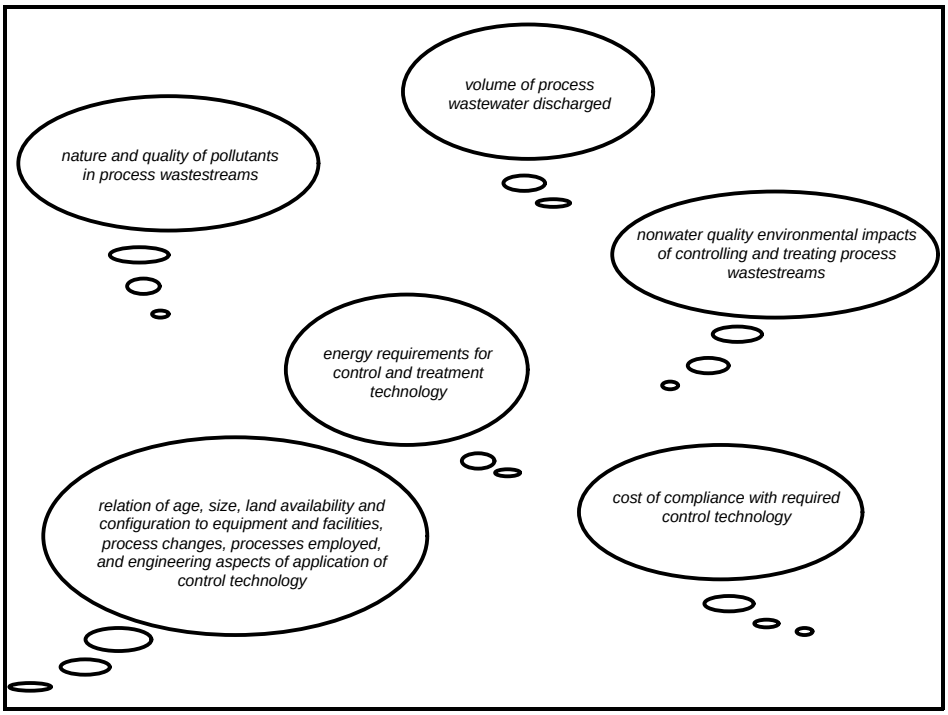

Figure 18. Factors to Consider for an FDF Variance Request

Net/Gross Adjustment Categorical pretreatment standards can be adjusted to reflect the presence of pollutants in a CIU's intake waters (40 CFR §403.15). To obtain a net/gross credit, the CIU must submit a formal written request to the Control Authority that demonstrates:

- its intake water is drawn from the same body of water that the POTW discharges into (this can be waived if the Control Authority finds no environmental degradation will result);
- the pollutants present in the intake water will not be entirely removed by the treatment system operated by the CIU; and
- the pollutants in the intake water do not vary chemically or biologically from the pollutants limited by the applicable standard.

Inherent in this provision is the requirement that the CIU employ a treatment technology capable of meeting the categorical pretreatment standard(s). Net/gross adjustments should not be granted to CIUs that have no treatment. Further, credits are only granted to the extent necessary to meet the applicable standard(s), up to a maximum value equal to the influent value.

Innovative Technology In accordance with 307(e) of the CWA, existing CIUs choosing to install an innovative treatment system may receive approval from the Control Authority for up to a two year extension to their applicable categorical pretreatment standards compliance deadline, provided:

- the innovative treatment has a reasonable potential to result in significantly greater pollutant removal or equivalent removal at a substantially lower cost than the technologies considered by EPA when developing the categorical standard;
- the innovative technique has the potential for industry-wide application; and
- the proposed compliance extension will not cause or contribute to the violation of the POTW's NPDES permit.

While policy has been established for universal categorical variance requests, occasionally, a Control Authority may merely need assistance to classify a CIU and/or to determine applicable categorical limitations. Provisions in the General Pretreatment Regulations allow POTWs and IUs to request an EPA category determination for a specific IU within 60 days after the effective date of the standard in question [40 CFR §403.6(a)]. Even after the formal timeframe for requesting a categorical determination, EPA (and states) will assist POTWs and IUs with categorization issues. Such requests, however, do not affect applicable reporting requirements, including timely requests submitted under 40 CFR §403.6(a). Additionally, EPA has addressed universal CIU questions posed by Control Authorities in various memoranda and guidance:

Research and Development (R&D) Facilities Unless specifically addressed in the categorical regulation or associated development document, R&D facilities where there is no commercial sale of products from the facility, are not subject to categorical standards.[9] Should an R&D facility need pollution controls to comply with prohibited discharge standards and/or local limits, the development documents may serve as guidance on the performance of pollution control technologies.

Certification Statements In lieu of requiring self-monitoring, some standards allow CIUs to certify that they do not use, generate or discharge a regulated pollutant [e.g. Pulp, Paper and Paperboard facilities can certify that chlorophenolic compounds are not used (40 CFR Part 430) and Pharmaceutical Manufacturing facilities can certify that cyanide is not used or generated (40 CFR Part 439)]. Facilities providing such certifications are still considered CIUs, and therefore are subject to other pretreatment standards and requirements.

Lack of specific categorical effluent limitations IUs subject to PSES or PSNS that merely require compliance with 40 CFR Part 403 are not considered CIUs. However, these users may still be classified as SIUs and are still subject to the general and specific prohibitions and any local limits.

Total Toxic Organics (TTO) Seven categorical regulations currently limit the discharge of TTO:

- 40 CFR Part 413 - Electroplating
- 40 CFR Part 433 - Metal Finishing
- 40 CFR Part 464 - Metal Molding and Casting
- 40 CFR Part 465 - Coil Coating
- 40 CFR Part 467 - Aluminum Forming
- 40 CFR Part 468 - Copper Forming
- 40 CFR Part 469 - Electrical and Electronic Components (Phase I and II)

For each of these standards, TTO refers to the sum of the masses or concentrations of certain toxic organic pollutants found in the regulated discharge at a concentration greater than 0.01 milligrams per liter (mg/l). However, the toxic organic pollutants regulated by the TTO limit are specific to each industrial category. Further, industrial categories may provide some flexibility with regard to monitoring and/or reporting requirements as follows:

[9] **June 26, 1987 letter from Ms. Rebecca W. Hanmer, Deputy Assistant Administrator for Water.**

- 40 CFR Parts 413 and 433 allow development and implementation of a Toxic Organic Management Plan (TOMP) in lieu of routine monitoring while 40 CFR Part 469 allows development and implementation of a Solvent Management Plan. Upon approval of these plans by the Control Authority, the CIU can demonstrate compliance with TTO requirements by certifying that the facility is adhering to this Plan to prevent organics from being discharged to the POTW. A specific certification statement must be signed and provided to the Control Authority on a regular basis.

- 40 CFR Parts 464, 465, 467, and 468 allow an option to demonstrate compliance with an Oil and Grease limit in lieu of demonstrating compliance with a TTO limit. The option chosen by the CIU must be utilized for all reports required (i.e., BMR, 90-day compliance report, and periodic compliance reports).

EPA's *Guidance Manual for Implementing Total Toxic Organics (TTO) Pretreatment Standards* should be consulted for more information on TTO.

LOCAL LIMITS

Prohibited discharge standards are designed to protect against pass-through and interference generally. Categorical pretreatment standards, on the other hand, are designed to ensure that IUs implement technology-based controls to limit the discharge of pollutants. Local limits, however, address the specific needs and concerns of a POTW and its receiving waters. Federal regulations at 40 CFR §§403.8(f)(4) and 122.21(j)(4) require Control Authorities to evaluate the need for local limits and, if necessary, implement and enforce specific limits as part of pretreatment program activities.

Local limits are developed for pollutants (e.g. metals, cyanide, BOD_5, TSS, oil and grease, organics) that may cause interference, pass through, sludge contamination, and/or worker health and safety problems if discharged in excess of the receiving POTW treatment plant's capabilities and/or receiving water quality standards. Typically, local limits are developed to regulate the discharge from all IUs, not just to CIUs, and are usually imposed at the "end-of-pipe" discharge from an IU (i.e., at the point of connection to the POTW's collection system). In evaluating the need for local limit development, it is recommended that Control Authorities:

- conduct an industrial waste survey to identify all IUs that might be subject to the pretreatment program;
- determine the character and volume of pollutants contributed to the POTW by these industries;
- determine which pollutants have a reasonable potential for pass through, interference, or sludge contamination;
- conduct a technical evaluation to determine the maximum allowable POTW treatment plant headworks (influent) loading for at least arsenic, cadmium, chromium, copper, cyanide, lead, mercury, nickel, silver, and zinc (Figure 19);
- identify additional pollutants of concern;
- determine contributions from unpermitted sources to determine the maximum allowable treatment plant headworks loading from "controllable" industrial sources (Figure 20);
- implement a system to ensure these loadings will not be exceeded.

Maximum Allowable Headworks Loading Method (MAHL) Pollutant by pollutant, treatment plant data are used to calculate removal efficiencies, before applying the most stringent criteria (i.e., water quality, sludge quality, NPDES permit, or pollutant inhibition levels) to back calculate the MAHLs. Subtracting out contributions from domestic sources, the available industrial loading is then either evenly distributed among the IUs, or allocated on an as needed basis to those IUs discharging the pollutant above background levels.

Figure 19. MAHL

Other local limit approaches available to Control Authorities include:

Collection System Approach Pollutants found to be present which may cause fire and

Maximum Allowable Industrial Load (MAIL) The MAIL is the total daily mass that a POTW can accept from all permitted IUs and ensure the POTW is protecting against pass through and interference.

Figure 20. MAIL

explosion hazards or other worker health and safety concerns, are evaluated for their propensity to volatilize and are modeled to evaluate their expected concentration in air. Comparisons are made with worker health exposure criteria and lower explosive limits. Where values are of concern, the Control Authority may set limits or require development of management practices to control undesirable discharges. The collection system approach may also consider the prohibition of pollutants with specific flashpoints to prevent discharges of ignitable wastes. EPA's *Guidance to Protect POTW Workers from Toxic and Reactive Gases and Vapors* details strategies for developing such local limits.

Industrial User Management Practice Plans These plans typically consist of narrative local limits requiring IUs to develop management practices (e.g., chemical management practices, best management practices, and spill prevention plans) for the handling of chemicals and wastes. The need for and suggested contents of such plans may be found in EPA's *Control of Slug Loadings to POTWs: Guidance Manual*, and *Spill Prevention, Control, and Countermeasure (SPCC) Information Guide*.

Case-by-Case Discharge Limits These numeric local limits are based on best professional judgement (BPJ) and available pollution prevention and treatment technologies which are known to be economically feasible. This approach is most often used when insufficient data are available to employ the methods outlined above.

Local Specific Prohibitions POTW specific prohibitions may be imposed in addition to the prohibitions detailed in 40 CFR § 403.5 (a) & (b) to address hydraulic, pollutant specific, and/or aesthetic concerns; e.g.:

- noxious or malodorous liquids, gases, or solids creating a public nuisance
- wastestreams which impart color and pass through the POTW treatment plant
- storm water, roof runoff, swimming pool drainage
- wastewaters containing radioactive wastes or isotopes
- removed substances from pretreatment of wastewater.

Regardless of the approaches taken by a Control Authority, local limits should correct existing problems, prevent potential problems, protect the receiving waters, improve sludge use options, and protect POTW personnel. Additional existing EPA guidance on the subject includes:

- *Guidance for Preventing Interference at POTWs*
- *Guidance Manual on the Development and Implementation of Local Discharge Limitations Under the Pretreatment Program*
- *Supplemental Manual on the Development and Implementation of Local Discharge Limitations Under the Pretreatment Program: Residential and Commercial Toxic Pollutant Loadings and POTW Removal Efficiency Estimation*
- *Toxicity Identification Evaluation: Characterization of Chronically Toxic Effluents*.

Additionally, many EPA Regions and States have developed local limits guidance to address regional and state issues.

SUMMARY OF STANDARDS

A summary of all of the pretreatment standards, including general and specific prohibitions, categorical pretreatment standards, and local limits, is provided as Figure 21.

	General and Specific Prohibitions	Categorical Pretreatment Standards	Local Limits
Development	Established at the Federal level	Established at the Federal level	Developed by Control Authorities
Reference	40 CFR 403.5(a) & (b)	40 CFR Parts 405-471	Requirements for development found in 40 CFR §§403.5(c) & 403.8(f)(4)
Applicability	All IUs	CIUs	Commonly all IUs or all SIUs, but depends on allocation method used when developing limits.
Purpose	Provide for general protection of the POTW. May be superseded by more stringent categorical pretreatment standards or local limits.	Minimum standards based on available treatment technology and pollution prevention measures for controlling nonconventional and toxic pollutants that may cause pass through, interference, etc. at the POTW. May be superseded by more stringent local limits.	Provide site specific protection for a POTW and its receiving waters. May be superseded by more stringent categorical standards.

All standards are considered pretreatment standards for the purpose of section 307(d) of the Clean Water Act. A POTW is responsible for identifying standard(s) applicable to each industrial user and applying the most stringent requirements where multiple provisions exist. Compliance with imposed standards can be achieved through implementation of best management practices, development of a pollution prevention program, and/or installation of pretreatment.

Figure 21. Summary of Standards

4. POTW PRETREATMENT PROGRAM RESPONSIBILITIES

Chapter 2 describes the basis for POTWs to develop pretreatment programs that implement Federal pretreatment standards and requirements, in addition to protecting any local concerns. This Chapter provides an overview of these POTW programs, highlighting each of the specific program areas that are to be addressed.

Chapter 4. Applicable EPA Guidance

CERCLA Site Discharges to POTWs Guidance Manual
Control of Slug Loadings To POTWs: Guidance Manual
Guidance For Developing Control Authority Enforcement Response Plans
Guidance Manual for POTWs to Calculate the Economic Benefit of Noncompliance
Industrial User Inspection and Sampling Manual For POTWs
Industrial User Permitting Guidance Manual
Model Pretreatment Ordinance
Multijurisdictional Pretreatment Programs: Guidance Manual
NPDES Compliance Inspection Manual
POTW Sludge Sampling and Analysis Guidance Document
Pretreatment Compliance Monitoring and Enforcement Guidance
RCRA Information on Hazardous Wastes for Publicly Owned Treatment Works
U.S. EPA Pretreatment Compliance Monitoring and Enforcement System: Version 3.0, User's Guide

LEGAL AUTHORITY

As discussed in Chapter 2, POTWs seeking pretreatment program approval must develop policy and procedures for program implementation and establish the legal authority to implement and enforce program requirements. The General Pretreatment Regulations do not provide Control Authorities with the legal authority to carry out their pretreatment programs; rather the regulations do set forth the minimum requirements for POTWs with pretreatment programs.

A Control Authority's legal authority actually derives from State law. Therefore, State law must confer the minimum Federal legal authority requirements on a Control Authority. Where deficient, State law must be modified to grant the minimum requirements.

In order to apply regulatory authority provided by State law, it is generally necessary for the Control Authority to establish local regulations to legally implement and enforce pretreatment requirements. Where the Control Authority is a municipality, legal authority is detailed in a Sewer Use Ordinance (SUO), which is usually part of city or county code. Regional Control Authorities frequently adopt similar provisions in the form of "rules and regulations." Likewise, State agencies implementing a State-wide program under 40 CFR §403.10(e) set out pretreatment requirements as State regulations, rather than as an SUO. [Local regulations cannot give the Control Authority greater authority than that provided by State law.] EPA's 1992 guidance, *EPA Model Pretreatment Ordinance* provides a model for POTWs that are required to develop pretreatment programs.

As POTW service areas expand, new contributions may arise from "extrajurisdictional" IUs located outside of the Control Authority's legal jurisdiction (see Figure 22). Multijurisdictional arrangements require special legal/contractual mechanisms to ensure adequate authority to implement and enforce program requirements in these other jurisdictions. Some state statutes may provide for general extraterritorial powers (i.e., a Control Authority is automatically allowed to regulate extrajurisdictional IUs

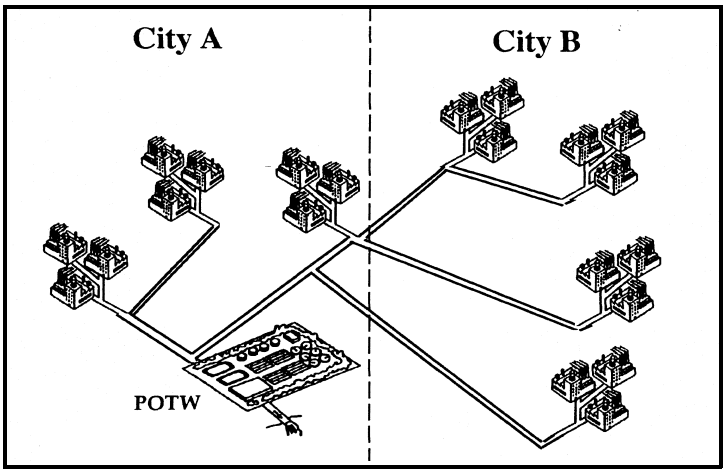

Figure 22. Multijurisdictional Programs

contributing to their system). However, the extent to which authorities (i.e., to permit, inspect, enforce, monitor, etc.) are granted may be somewhat limited, thereby, restricting a Control Authority's ability to implement and enforce a program. Where obtaining authority from the State to regulate extrajurisdictional IUs is not feasible, other options may be pursued:

- Districts The creation of an independent organization (by affected municipalities or the State) which is authorized to administer and enforce an approved pretreatment program for the entire area in which it provides services is common in areas where multiple POTWs each serve various jurisdictions.

- Agreements Affected Control Authorities may opt to enter into agreements requiring each municipality to implement and enforce the approved pretreatment program covering all IUs within their jurisdiction. The Control Authority must retain the means to regulate extrajurisdictional IUs where the contributing jurisdiction's efforts are inadequate. It is essential that agreements clearly define the roles of each party.

- Annexation Where extrajurisdictional IUs lie in unincorporated areas, a Control Authority may annex or utility annex the service area.

- Contracts A Control Authority may enter into a contract with an extrajurisdictional IU, although contracts generally limit the enforcement capabilities of the Control Authority. As such, contracts should only be pursued when all other means fail.

Since procedures for obtaining jurisdiction, creating sanitary districts, annexing service areas, etc. vary among states, Control Authority personnel should consult with their legal staff to thoroughly examine options allowed. This may include requesting State legislative changes if necessary. EPA's 1994 *Multijurisdictional Pretreatment Programs - Guidance Manual* provides more information on these jurisdictional issues, including sample language for agreements and contracts.

INDUSTRIAL WASTE SURVEYS

As part of program development and maintenance, the Federal regulations [40 CFR §403.8(f)(2)(I)] require Control Authorities to identify and locate all IUs that might be subject to the pretreatment program. While the General Pretreatment Regulations do not specify how a Control Authority is to accomplish this, it is beneficial to conduct an initial in-depth survey, then institute measures to update the list continuously. Control Authorities must ensure that the entire service area is reviewed. This may include IUs located outside the jurisdictional boundaries of the POTW. In these instances, it may be appropriate to solicit assistance from other jurisdictions in developing the list of potential dischargers. The types of resources that may be consulted in compiling and updating the master list include:

- Water and sewer billing records
- Applications for sewer service
- Local telephone directories
- Chamber of Commerce and local business directories
- Business license records
- POTW and wastewater collection personnel and field observations
- Business associations
- Internet

Once IUs are identified, the Control Authority must classify these users to determine if pretreatment standards and requirements should apply to these facilities. Typically, the Control Authority develops and distributes an Industrial Waste Survey (IWS) questionnaire to the identified IUs. The IWS questionnaire requests information regarding IU activities and the nature of wastes discharged. The Control Authority may opt to send a detailed IWS questionnaire initially or conduct the survey in two phases (i.e., send a screener requesting basic information to eliminate obvious facilities and then send a detailed IWS to those facilities with greater potential to be SIUs). Key to the IWS is to identify facilities that are subject to categorical standards (i.e., CIUs) or otherwise have the potential to impact the POTW (i.e., SIUs).

A POTW's IU inventory should include the name, location, classification, applicable standards, basis for limits imposed, volume of discharge, control mechanism status, compliance dates and other special requirements for each IU. The IWS should provide most of the information required to develop the inventory, although some supplementary information might be required from other sources, such as the permit application or monitoring data.

The IU inventory must be updated as needed [40 CFR §403.8(f)(2)(I)] and provided to the Approval Authority as part of the annual report requirement (see POTW Reports section in this Chapter). The on-going task of maintaining a complete list of IUs requires the Control Authority to implement a system to track existing IU information and/or classification changes and new user information. Some Control Authorities may proactively opt to institute a "utility connect questionnaire" program. These types of forms are completed when a customer applies for new utility service (e.g., water, sewerage, or electricity).

PERMITTING

The General Pretreatment Regulations require all IUs be controlled through permit, order, or similar means to ensure compliance with applicable pretreatment standards and requirements. Section 403.8(f)(1)(iii)(A-E) clarifies this requirement to specify that all SIUs be issued a permit or equivalent individual control mechanism which contains, at a minimum:

- statement of duration (not to exceed five years);
- statement of nontransferabililty (unless outlined provisions are met);
- effluent limitations based on applicable standards;
- self-monitoring, sampling, reporting, notification, and record keeping requirements;
- statement of applicable civil and criminal penalties; and
- a schedule of compliance (where appropriate).

EPA's 1989 *Industrial User Permitting Guidance Manual* details procedures for drafting IU discharge permits. SIU permits issued are site specific and tailored to the unique circumstances of the IU. Permit conditions must establish clear and explicit requirements for the permittee, to include using such terms such as "shall" and "must" in lieu of vague terms such as "recommend" or "may". The Control Authority must document its decision-making process when developing permits to ensure defensibility and enforceability. Adherence to sound, documented procedures will prevent any arbitrary and capricious claims by the permittee. Whether developing or reissuing a permit, the permitting process consists of three phases:

- Phase I - Collection and verification of information
- Phase II - Data interpretation and fact sheet development
- Phase III - Permit development and issuance.

As part of Phase I, Control Authorities may review and verify information contained in the permit application, perform an inspection of the IU for confirmation of facts, tally data, and potentially sample and analyze the IU's wastestream. Knowledgeable Control Authority personnel, effective communication, and SIU cooperation are essential to collection of complete and accurate information.

Phase II requires that the Control Authority interpret data and other information and document the permit decision-making rationale, preferably in a permit fact sheet. Although the contents of a fact sheet will vary by permittee, fact sheets should provide a justification of all permitting decisions. Typical components of a fact sheet are provided in Figure 23. Completed fact sheets should be included as part of the permit and provided to the Permittee to document the soundness of permitting decisions.

After all permitting decisions are made, the Control Authority must incorporate those decisions into a permit. The permit, signed by the specified Control Authority official is provided to the Permittee for comment and after comments are addressed, a final permit is issued to the IU. While many comments may be easily addressed/resolved by the Control Authority, occasionally resolution must be obtained through a formal adjudicatory hearing process where both the Permittee and Control Authority present their case to a third party.

Many POTWs also control contributions from non-SIUs using various means, such as through general permits issued to an entire industrial sector. These types of control mechanisms may not necessarily require compliance with specific pollutant limitations. For example:

- grease trap maintenance and record keeping requirements for food establishments;
- maintenance and record keeping requirements for photo processors' silver reclamation units;
- best management practices for mercury recovery by hospitals and dentists.

For CIUs:
- the basis for the categorical determination(s)
- the identity and flow volume of all wastestreams generated and discharged to the POTW, and classified accordingly (i.e., regulated, unregulated, or dilution)
- data used and/or justification for estimates used to determine categorical limitations
- basis for limits imposed for categorical parameters.

For SIUs/CIUs:
- basis for limits imposed for non-categorical parameters
- rationale for compliance schedules, special plans required, special conditions, etc.
- basis for monitoring and reporting frequencies.

Figure 23. Components of Permit Fact Sheet

Industrial sector general permitting programs are common where a real or potential POTW problem is linked to a particular pollutant discharged (e.g., collection system blockages caused by the discharge of excess oils and grease from food establishments). POTWs do have authority to enforce their SUO or rules or regulations against non-SIUs without the need for any type of individual control mechanism. Control Authorities do have the authority to require non-SIUs to comply with pretreatment standards and requirements contained in their local regulations and then take appropriate actions against IUs as noncompliance is identified.

INSPECTIONS

Control Authorities are required to inspect and sample all SIUs a minimum of once per year pursuant to 40 CFR §403.8(f)(2(v). The frequency with which a Control Authority actually inspects an SIU may vary depending on issues such as the variability of an SIU's effluent, the impact of their discharge on the POTW, and their compliance history. Inspection considerations (see Figure 24) will hinge upon the type of inspection performed (i.e., scheduled, unscheduled or demand). EPA's 1994 *Industrial User Inspection and Sampling Manual for POTWs* provides a detailed reference for inspection procedures and protocols.

Scheduled inspections are useful when the Control Authority wants to gather specific information from the facility that necessitates meeting with specific SIU contacts. However, since scheduled inspections may interrupt normal operations (e.g., altered production schedule as a result of preparative work undertaken by the IU), unscheduled inspections may more accurately reflect IU compliance status when the inspection is performed for that reason.

- Provide current data on IUs
- Confirm or determine IUs' compliance status
- Determine completeness and accuracy of the IU's performance/compliance records
- Assess the adequacy of the IU's self-monitoring and reporting requirements
- Assess the adequacy of monitoring locations and IU's sampling techniques
- Assess the adequacy of imposed limitations and pollutants of concern
- Develop rapport with IUs
- Evaluate operation and maintenance and overall performance of an IU's pretreatment system
- Assess the potential for spills and slug loadings
- Evaluate the effectiveness of slug control plan
- Reveal issues requiring action
- Identify noncompliance needing resolution
- Suggest pollution prevention opportunities
- Collect samples
- Obtain data to support enforcement actions

Figure 24. Inspection Considerations

POTWs must evaluate, at least once every two years, whether each SIU needs a plan to control slug discharges (i.e., a discharge of a non-routine, episodic nature, including but not limited to an accidental spill or non-customary batch discharge). To accurately evaluate the slug potential, Control Authorities likely will have to examine the SIU during normal operating conditions. If undetected, slug discharges can have serious impacts on the POTW. EPA's 1991 *Control of Slug Loadings to POTWs Guidance Manual* provides a description of procedures for development, implementation, and review of slug control plans.

Demand inspections are non-routine in nature and occur in response to a concern (e.g., POTW collection problems downstream from an IU, elevated enforcement actions against an IU, suspicious IU behavior, or an informer complaint).

Routine Control Authority inspections of SIUs typically consist of three activities; preparation, on-site assessment, and follow-up.

Preparation - Control Authority personnel should review POTW records for SIUs to be inspected to familiarize themselves with the facility. Information reviewed may include compliance status, compliance schedule activities, reports and plans, upcoming report and plan due dates, enforcement activities, permit applications, waste surveys, previous inspection summaries, categorical regulations, water use/billing records, and POTW collection system maps. Control Authority personnel should also be familiar with any specific issues and concerns regarding the POTW treatment plant or collection system problems receiving the SIU's discharge.

On-site Assessment - Control Authority personnel typically discuss IU operations with IU contacts and perform a walkthrough of the facility to: update IU information regarding contacts, processes, production rates, pretreatment, and other waste management activities; review records required to be kept by the IU; visually verify the need for a slug control plan; and review pretreatment system maintenance, categorical standards applicable to processes employed, metering and sampling equipment, sampling procedures, chemicals used, processes employed, management practices, containment structures, locations of floor drains, etc. Many POTWs have developed a standard inspection questionnaire to facilitate the interview process and promote consistency during the inspection.

Follow-up - An inspection report should be prepared as soon as possible after the inspector returns to the office. Unanswered questions, required permit modifications, and/or necessary enforcement actions should be processed in a timely manner.

Non-routine inspections (e.g., demand) may not encompass all the activities and steps specified above, but, like routine inspections, these activities may provide the Control Authority an opportunity to collect samples of the IU's discharge.

SAMPLING

The General Pretreatment Regulations require Control Authorities to monitor each SIU at least annually and each SIU to self-monitor semi-annually. As with inspections, the Control Authority should assess site-specific issues, such as SIU effluent variability, impact of this effluent on the POTW, and the SIU's compliance history to determine appropriate sampling frequencies (i.e., if more frequent monitoring is necessary). A more detailed discussion of IU monitoring requirements is provided in Chapter 5. For more detailed information on sampling frequencies, consult EPA's 1994 *Industrial User Inspection and Sampling Manual for POTWs*.

Sampling is the most appropriate method for verifying compliance with pretreatment standards. Monitoring location(s) are designated by the Control Authority and must be such that compliance with permitted discharge limits can be determined. Where possible, the Control Authority should not designate monitoring locations that are confined spaces or that are difficult to access or difficult to place the automated sampling equipment. Monitoring locations should:

- be appropriate for waste stream conditions;
- be representative of the discharge;
- have no bypass capabilities; and
- allow for unrestricted access at all times.

Control Authorities should measure flow to allow for collection of flow-proportioned composite samples, which are required, unless flow-proportional sampling is not feasible. Flow-proportional composite samples are preferred over time composite samples particularly where the monitored discharge is intermittent or variable. Desired analyses dictate the preparation protocols, equipment, and collection bottles to use to avoid contamination of samples or loss of pollutants through improper collection. Sampling for such pollutants as pH, cyanide, oil and grease, flashpoint, and volatile organic compounds require manual collection of grab samples. Similar to composite samples, grab samples must be representative of the monitored discharge and are to be collected from actively flowing wastestreams. Fluctuations in flow or the nature of the discharge may require collection of and hand-compositing of more than one grab sample to accurately access compliance. To ensure defensibility of data, Control Authorities should develop and implement standard operating procedures and policies detailing sample collection and handling protocols in accordance with 40 CFR Part 136.

Adherence to proper sample collection and handling protocols, 40 CFR Part 136 approved analytical methodologies, and record keeping requirements [40 CFR §403.12(o)(1)] (see Figure 25) can be verified through review of field measurement records, chain of custodies, and lab reports. Field measurement records may require information regarding sample location, condition of and programmed settings for sampling equipment, wastewater meter readings, and information for such parameters as pH and temperature which require analysis in the field. Chain of custody forms serve as a link between field personnel and the laboratory and contain information regarding sample matrix, type, and handling. Lab reports should contain the minimum information specified in 40 CFR §403.12(o)(1)(ii-iv) as well as any additional information necessary to demonstrate compliance with 40 CFR Part 136 requirements (e.g., analytical methodology, sample preparation date and time, time of analysis). Use of standardized forms which prompt recording of information necessary for demonstrating compliance with applicable requirements, will aid in ensuring it can be used as admissible evidence in enforcement proceedings or in judicial actions.

Figure 25. Sample Collection Techniques

Parameter	Sample type	Container	Preservative	Holding time
pH	Grab	Polyethylene or Glass	N/A	analyze immediately
BOD	Composite	Polyethylene or Glass	chilled to 4°C	48 hours
TSS	Composite	Polyethylene or Glass	chilled to 4°C	7 days
NH_3 as N	Composite	Polyethylene or Glass	chilled to 4°C, H_2SO_4 to pH<2	28 days
Oil and Grease	Grab	Glass	chilled to 4°C, HCl or H_2SO_4 to pH<2	28 days
Cyanide, total	Grab	Polyethylene or Glass	chilled to 4°C, NaOH to a pH >12, and 0.6g of ascorbic acid if residual chlorine is present	14 days
Metals (total) excl. Cr^{+6}, B, and Hg	Composite	Polyethylene or Glass	HNO_3 to pH<2	6 months
624 (volatiles organics)	Grab	Amber glass, w/ teflon septum lid and zero headspace	chilled to 4°C (additional laboratory preservation required)	7 or 14 days, depending on specific organic
625 (semi-volatile organics)	Composite	Amber glass w/ teflon lined lid	chilled to 4°C (additional laboratory preservation required)	7 days for sample prep; 40 days for extract

ENFORCEMENT

In addition to requirements for permitting, sampling, and inspecting IUs, the General Pretreatment Regulations also require Control Authorities to review IU reports and plans, and respond to instances of IU noncompliance in a timely, fair, and consistent manner. Enforcement of pretreatment requirements is a critical element of the Pretreatment Program, but in the past extenuating circumstances may have prevented POTWs from taking adequate enforcement. For example, political and economic pressures from local officials could keep POTW personnel from taking appropriate actions. After this was identified as a major concern, EPA promulgated regulations in 1990 (*55 FR 30082*) that require all POTWs with approved pretreatment programs to adopt and implement an Enforcement Response Plan (ERP). These ERP regulations, at 40 CFR §403.8(f)(5), establish a framework for POTWs to formalize procedures for investigating and responding to instances of IU noncompliance. With an approved ERP in place, POTWs can enforce against IUs on a more objective basis and minimize outside pressures.

To evaluate IU compliance, Control Authorities must first identify applicable requirements for each IU. In general, IU reports (discussed in Chapter 5) and POTW monitoring activities are the basis for POTW evaluation of IU compliance. Discharge permit limit exceedances, discrepancies, deficiencies, and lateness are all violations that must be resolved.

To ensure enforcement response is appropriate and that the Control Authority actions are not arbitrary or capricious, EPA strongly recommends that an Enforcement Response Guide (ERG) be included as part of the approved ERP. The ERG identifies responsible Control Authority officials, general time frame for actions, expected IU responses, and potential escalated actions based on:

- the nature of the violation
  - pretreatment standards
  - reporting (late or deficient)
  - compliance schedules
- magnitude of the violation
- duration of the violation
- frequency of the violation (isolated or recurring)
- (potential) impact of the violation (e.g., interference, pass through, or POTW worker safety)
- economic benefit gained by the violator
- attitude of the violator

The types of questions that dictate whether an ERP is adequate are presented in Figure 26. Factors that should be considered in determining appropriate enforcement responses to noncompliance events are discussed in detail in EPA's 1989 *Guidance for Developing Control Authority Enforcement Response Plans*.

Q: Is a Control Authority response required for all violations identified?
Q: Is the IU notified by the Control Authority when a violation is found?
Q: Is the IU required to respond to each violation with an explanation and, as appropriate, a plan to correct the violation within a specified time period?
Q: Where noncompliance continues and/or the IU response is inadequate, does the Control Authority's response become more formal and commitments (or schedules, as appropriate) for compliance established in an enforceable document?
Q: Is the enforcement response selected related to the seriousness of the violation?
Q: Where the violation constitutes SNC, and is ongoing, is the minimum response an administrative order?

Figure 26. How Complete is Your ERG?

The General Pretreatment Regulations set as an enforcement priority, facilities that meet the criteria for "Significant Noncompliance (SNC)" as defined in 40 CFR §403.8(f)(2)(vii) and depicted in Figure 27. A decision to seek formal enforcement is generally triggered by an unresolved instance of SNC, failure to achieve compliance in a specified time period through less formal means, or the advice of legal counsel. SNC evaluations are to be conducted in six-month increments; names of IUs found to be in SNC must be published in the local newspaper (see Public Participation in this Chapter).

Formal enforcement must be supported by well-documented records of the violations and of any prior efforts by the Control Authority to obtain compliance. Where effluent limitations have been exceeded, records must be reviewed to verify compliance with 40 CFR Part 136 test methods. If the IU has received conflicting information from the Control Authority regarding its compliance status, its status must be clarified in writing. Although not required, the Control Authority may consider a "show cause" meeting with the IU before commencing formal enforcement action. Similarly, the regulations do allow, in certain instances, an affirmative defense for violations.

The range of enforcement mechanisms available to a Control Authority depends on the specific legal authorities it has been given by city, county, and State legislatures. These mechanisms may range from a simple telephone call to suits seeking significant criminal penalties. Common enforcement mechanisms include:

- **Informal notice to IU** - This may consist of a telephone call or "reminder" letter to an appropriate IU official to notify them of a minor violation and to seek an explanation. Such informal notice may be used to correct minor instances of noncompliance.

- **Informal meetings** - Used to obtain an IU's commitment to comply with their pretreatment obligations or to inform the IU of stronger enforcement mechanisms available for unresolved and/or continued noncompliance.

- **Warning letter or Notice of Violation (NOV)** - Written notice to the IU in response to a violation of pretreatment standards or requirements. These notices should request an explanation of the noncompliance and measures that will be taken to eliminate future violations.

- **Administrative orders and compliance schedules** - These require an IU to "show cause" to the Control Authority as to why formal enforcement action should not be taken and/or sewer service discontinued, or actions that will be taken to comply with pretreatment standards or requirements. Orders as such may be negotiated (i.e., Consent Order) or issued at the reasonable discretion of the Control Authority (i.e., Compliance Order). For more egregious or serious violations, the Control Authority may issue a Cease and Desist Order.

- **Administrative fines** - Assessed by Control Authorities against IUs for violations and intended to recapture partial or full economic benefit for the noncompliance and to deter future violations.

- **Civil suits** - Formal process of filing lawsuits against IUs to correct violations and to obtain penalties for violations. Civil penalty amounts are generally limited through State or municipal laws. However, 40 CFR §403.8(f)(1)(vi) requires that Control Authorities have the legal authority to seek or assess civil or criminal penalties of at least $1,000 per day for each violation. A civil suit for injunctive relief may be used when the IU is unlikely to successfully execute the steps that the Control Authority believes are necessary to achieve or maintain compliance, when the violation is serious enough to warrant court action to deter future similar violations, or when the danger presented by an IU's lengthy negotiation of a settlement is intolerable.

  NOTE: Surcharges are not penalties or fines. Surcharges are intended to recoup the cost of treatment of wastes by the POTW and must not be used to allow discharges of toxic pollutants that cause interference or pass through.

An IU is in SNC if its violation meets one or more of the following criteria (40 CFR 403.8(f)(2)(vii):

(A) Chronic violations of wastewater discharge limits, defined here as those in which sixty-six percent or more of all of the measurements taken during a six-month period **exceed (by any magnitude)** the daily maximum limit or the average limit for the same pollutant parameter;

(B) Technical Review Criteria (TRC) violations, defined here as those in which thirty-three percent or more of all of the measurements for each pollutant parameter taken during a six-month period equal or exceed the product of the daily maximum or the average limit multiplied by the applicable TRC (TRC = 1.4 for BOD_5, TSS, fats, oil, and grease, and 1.2 for all other pollutants except pH);

(C) Any other violation of a pretreatment effluent limit (daily maximum or longer-term average) that the Control Authority determines has caused, alone or in combination with other discharges, interference or pass through (including endangering the health of POTW personnel or the general public);

(D) Any discharge of a pollutant that has caused imminent endangerment to human health, welfare or to the environment or has resulted in the POTW's exercise of its emergency authority under 40 CFR § 403.8(f)(1)(vi)(B) of this section to halt or prevent such a discharge;

(E) Failure to meet, within 90 days after the schedule date, a compliance schedule milestone contained in a local control mechanism or enforcement order for starting construction, completing construction, or attaining final compliance;

(F) Failure to provide, within 30 days after the due date, required reports such as baseline monitoring reports, 90-day compliance reports, periodic self-monitoring reports, and reports on compliance with compliance schedules;

(G) Failure to accurately report noncompliance;

(H) Any other violation or group of violations which the Control Authority determines will adversely affect the operation or implementation of the local pretreatment program.

Figure 27. Definition of Significant Noncompliance (SNC)

- **Criminal prosecution** - This type of enforcement is a formal judicial process where sufficient admissible evidence exists to prove beyond a reasonable doubt that a person has willfully or negligently violated pretreatment standards or that a person has knowingly made a false statement regarding any report, application, record, or other document required by the General Pretreatment Regulations. As noted above, Control Authorities must have the legal authority to seek or assess civil or criminal penalties of at least $1,000 per day for each violation. Examples of criminal violations include falsification of data and tampering with sampling results or equipment.

- **Termination of service (revocation of permit)** - These actions may be pursued by Control Authorities to immediately halt an actual or threatened discharge to the POTW that may represent an endangerment to the public health, the environment, or the POTW. Use of these remedies may also be used in bringing recalcitrant users into compliance.

Regardless of the response taken, the Control Authority should document and track all contact, notices, and meetings with IUs and IU responses. Control Authority responses and IU responses (or lack thereof) should be documented and include a record of any direct contact with the IU to attempt to resolve the noncompliance. Control Authorities must take timely and effective enforcement against violators. Unresolved IU noncompliance may result in the Approval Authority enforcing directly against the IU and/or the Control Authority. EPA may also take enforcement action where it deems action by the State or the Control Authority is inappropriate. An Approval Authority will routinely review the overall performance of a Control Authority in monitoring IUs, identifying violations, and in enforcing regulations. Performance will be evaluated based on POTW self-monitoring data, written enforcement response plans, audits, inspections, and pretreatment program reports. Therefore, it is essential for Control Authorities to effectively manage program information to demonstrate proper implementation.

Section 505 of the CWA allows citizens to file suit against a Control Authority that has failed to implement its approved pretreatment program as required by its NPDES permit. The Control Authority may be fined as well as required to enforce against violations of pretreatment standards and requirements in a court order.

DATA MANAGEMENT AND RECORD KEEPING

Any IU subject to pretreatment program reporting requirements is required to maintain records resulting from monitoring in a readily accessible manner for a minimum of 3 years (longer if during periods of any ongoing litigation). While the means for maintaining files is usually at the discretion of the POTW, all pretreatment activities should be documented and the documents maintained. Types of IU records that the Control Authority should maintain are summarized in Figure 28.

Tracking due dates, submissions, deficiencies, notifications, etc. and calculating effluent limitation noncompliance may be facilitated by a computerized data management system. Similarly, many Control Authorities use standardized forms (e.g., inspection questionnaires, chains-of-custody, field measurement records) and procedures (e.g., sampling, periodic compliance report reviews) to promote consistency and organization of program data.

In addition to specific IU records, Control Authorities should also maintain general program files that document specific program development and implementation activities that are not IU-specific (see Figure 29). All information should be filed in an orderly manner and be readily accessible for inspection and copying by EPA and State representatives or the public. The pretreatment regulations specify that all information submitted to the Control Authority or State must be available to the public without restriction, except for confidential business information.

- Industrial waste questionnaire
- Permit applications, permits and fact sheets
- Inspection reports
- IU reports
- Monitoring data (including laboratory reports)
- Required plans (e.g., slug control, sludge management, pollution prevention)
- Enforcement activities
- All correspondence to and from the IU
- Phone logs and meeting summaries.

Figure 28. Types of IU Records Retained

- Legal Authority (e.g., SIUO)
- Program procedures
- Program approval and modifications
- Copy of POTW NPDES permit(s)
- Local limits development
- ERP
- Correspondence to and from EPA/State
- Annual reports to the Approval Authority
- Public notices
- Funding and resource changes
- Applicable Federal and State regulations
- IU compliance and permitting records

Figure 29. Types of POTW Records Retained

PUBLIC PARTICIPATION AND POTW REPORTING

Section 101(e) of the CWA establishes public participation as one of its goals, in the development, revision, and enforcement of any regulation, standard, effluent limitation, plan, or program established by EPA or any State. The General Pretreatment Regulations encourage public participation by requiring public notices and/or hearings for program approval, removal credits, program modifications, local limits development and modifications, and IUs in SNC.

POTW pretreatment program approval requests require the Approval Authority to publish a notice (including a notice for a public hearing) in a newspaper of general circulation within the jurisdiction served by the POTW. All comments regarding the request as well as any request for a public hearing must be filed with the Approval Authority within the specified comment period, which generally last 30 days. The Approval Authority is required to account for all comments received when deciding to approve or deny the submission. The decision is then provided to the POTW and other interested parties, published in the newspaper with all comments received available to the public for inspection and copying.

Once a local pretreatment program is approved, the Control Authority must implement that program as approved. Before there is a significant change in the operation of a POTW pretreatment program, a program modification must be initiated.

For substantial program modifications (see Figure 30), the Control Authority is required to notify the Approval Authority of the desire to modify its program and the basis for the change. These changes become effective upon approval. Approval Authorities (or POTWs) are required to public notice the request for a modification, but are not required to public notice the decision if no comments are received and the request is approved without changes.

1. Modifications that relax POTW legal authorities (as described in 40 CFR §403.8(f)(1)), except for modifications that directly reflect a revision to 40 CFR Part 403, and are reported pursuant to 40 CFR §403.18(d) - Approval procedures for nonsubstantial modifications;
2. Modifications that relax local limits, except for modifications to local limits for pH and reallocations of the Maximum Allowable Industrial Loading of a pollutant that do not increase the total industrial loadings for a pollutant, which are reported pursuant to 40 CFR §403.18(d) - Approval procedures for nonsubstantial modifications;
3. Changes to POTW's control mechanism, as described in 40 CFR §403.(f)(1)(iii);
4. A decrease in the frequency of self-monitoring or reporting required of industrial users;
5. A decrease in the frequency of industrial user inspections or sampling by the POTW;
6. Changes to the POTW's confidentiality procedures; and
7. Other modifications designated as substantial modifications by the Approval Authority on the basis that the modification could have a significant impact on the operation of the POTW's Pretreatment Program; could result in an increase in pollutant loadings at the POTW; or could result in less stringent requirements being imposed on Industrial users of the POTW.

Figure 30. Substantial Modifications of POTW Pretreatment Programs (40 CFR §403.18)

Nonsubstantial modifications must also be submitted to the Approval Authority for review and approval, but these changes do not require public notice. And unlike substantial modifications, nonsubstantial modifications become effective 45 days after submission unless the Approval Authority notifies the POTW otherwise.

The POTW is also required to provide annual publication, in the largest daily newspaper in the municipality in which the POTW is located, of IUs that at any time during the previous twelve months were in SNC.

In accordance with 40 CFR §403.12(I), Control Authorities are required to submit annual reports to the Approval Authority documenting program status and activities performed during the previous calendar year. At a minimum, these reports must contain the following information:

1. List of all POTW's IUs including names, addresses, pretreatment standards applicable to each user, IUs subject to categorical pretreatment standards or a brief explanation of deletions and a list of additions (with the aforementioned information) keyed to a previously submitted list;

2. A summary of the status of the IU compliance during the reporting period;

3. A summary of compliance and enforcement activities (including inspections) conducted by the POTW during the reporting period;

4. A summary of changes to the POTW's pretreatment program that have not been previously reported to the Approval Authority; and

5. Any other relevant information requested by the Approval Authority.

The first report is due within one year after program approval and at least annually thereafter. Approval Authorities may require additional information, or require that the reports be submitted in a specific format and/or at an increased frequency (e.g., semi-annually).

5. INDUSTRIAL USER PRETREATMENT PROGRAM RESPONSIBILITIES

Industrial Users (IUs) are required to comply with all applicable pretreatment standards and requirements. Demonstration of compliance requires certain IUs to submit reports, self-monitor, and maintain records. A summary of the reporting requirements are provided in Figure 32, with details of each of these requirements discussed below.

Chapter 5. Applicable EPA Guidance

Guidance Manual For Implementing Total Toxic Organics (TTO) Pretreatment Standards
Guidance Manual for the Identification of Hazardous Wastes Delivered to Publicly Owned Treatment Works by Truck, Rail, or Dedicated Pipe
Guidance Manual for the Use of Production-Based Pretreatment Standards and the Combined Wastestream Formula
Industrial User Inspection and Sampling Manual for POTWs
RCRA Information on Hazardous Wastes for Publicly Owned Treatment Works

Industry-Specific Guides

Aluminum, Copper, And Nonferrous Metals Forming And Metal Powders Pretreatment Standards: A Guidance Manual
Guidance Manual For Battery Manufacturing Pretreatment Standards
Guidance Manual for Electroplating and Metal Finishing Pretreatment Standard
Guidance Manual For Iron And Steel Manufacturing Pretreatment Standards
Guidance Manual for Leather Tanning and Finishing Pretreatment Standards
Guidance Manual for Pulp, Paper, and Paperboard and Builders' Paper and Board Mills Pretreatment Standards

REPORTING REQUIREMENTS

Minimum Federal Pretreatment Program reporting requirements for IUs are specified in 40 CFR §403.12. Since Control Authorities are responsible for communicating applicable standards and requirements to IUs and for receiving and analyzing reports, it is essential for Control Authority personnel to understand IU reporting and notification requirements contained in the General Pretreatment Regulations. These requirements are summarized below.

Categorical Industrial User (CIU) Reporting Requirements

Baseline Monitoring Report (BMR) [40 CFR §403.12(b)]

Each existing IU that is subject to a categorical pretreatment standard (identified as a Categorical Industrial User, or CIU) is required to submit a BMR within 180 days after the effective date of the standard. If a category determination has been requested, the BMR is not due until 180 days after a final administrative decision has been made concerning the industry's inclusion in the category. The BMR must contain the following information:

- name and address of the facility and names of the operator and owners
- list of all environmental control permits held by or for the facility
- description of operations, including the average rate of production, applicable Standard Industrial Classification (SIC) codes, schematic process diagrams, and points of discharge to the POTW from regulated processes
- flow measurements (average daily and maximum daily) for regulated process wastestreams and nonregulated wastestreams, where necessary
- pollutant measurements [daily maximum, average concentration, and mass (where applicable)]and applicable standards
- certification, by a qualified professional, reviewed by a representative of the CIU, of whether applicable pretreatment standards are being met and, if not, a description of the additional operation and maintenance (O&M) or pretreatment facilities that are needed to comply with the standards
- a schedule by which the IU will provide the additional O&M or pretreatment needed to comply with the applicable pretreatment standards.

In addition to the certification noted above, BMRs must be signed and certified as detailed in 40 CFR §403.12(l) and as described later in this Chapter. If a CIU has already submitted the specific information required in a permit application or data disclosure form and this information is still current, it need not be reproduced and resubmitted in the BMR. The BMR is a one-time report, unless changed Federal categorical standards require submission of a new BMR.

At least 90 days prior to commencement of discharge, new sources are required to submit the above information, excluding the certification and compliance schedule, and information on the method that the source intends to use to meet the applicable pretreatment standards.

Compliance Schedule Progress Report [40 CFR §403.12(c)(3)]

A CIU that is not in compliance with applicable categorical standards by the time the standards are effective often will have to modify process operations and/or install end-of-pipe treatment to comply. Federal regulations require that the Control Authority develop and impose a compliance schedule for the CIU to install technology to meet applicable standards. As part of the BMR, a CIU that is unable to comply with the categorical standards must include a schedule for attaining compliance with the discharge standards. In no case can the final or completion date in the schedule be later than the final compliance date specified in the categorical standards. If deemed appropriate, the Control Authority may require compliance earlier than the final compliance date specified in the Federal regulations.

Compliance schedules are to contain increments of progress in the form of dates (not to exceed nine months per event) for commencement and completion of major actions leading to construction and operation of a pretreatment system and/or in-plant process modifications. Major activities could include hiring an engineer, completing preliminary analysis and evaluation, finalizing plans, executing a contract for major components, commencing construction, completion of construction, or testing operation.

In addition, the CIU must submit progress reports to the Control Authority no later than 14 days following each date in the compliance schedule (and final date for compliance), that include:

- a statement of the CIU's status with respect to the compliance schedule
- a statement of when the CIU expects to be back on schedule if it is falling behind, and the reason for the delay and steps being taken by the IU to return to the established schedule.

The Control Authority should review these reports as quickly as possible. When a CIU is falling behind schedule, the Control Authority should maintain close contact with the CIU. If the CIU fails to demonstrate good faith in meeting the schedule, the Control Authority may consider initiating appropriate enforcement action to correct the problem(s).

90-Day Compliance Reports [40 CFR §403.12(d)

Section 403.12(d) of the General Pretreatment Regulations requires a CIU to submit a final compliance report to the Control Authority. An existing source must file a final compliance report within 90 days following the final compliance date specified in a categorical regulation or within 90 days of the compliance date specified by the Control Authority, whichever is earlier. A new source must file a compliance report within 90 days from commencement of discharge to the POTW. These reports must contain:

- flow measurements (average daily and maximum daily) for regulated process wastestreams and nonregulated wastestreams, where necessary
- pollutant measurements [daily maximum, average concentration, and mass (where applicable)] and applicable standards
- certification, by a qualified professional, reviewed by a representative of the CIU, of whether applicable pretreatment standards are being met and, if not, a description of the additional operation and maintenance (O&M) or pretreatment facilities that are needed to comply with the standards. In addition to the certification noted above, 90-day final compliance reports must be signed and certified as detailed in 40 CFR §403.12(l) and as described later in this Chapter.

Upset Reports [40 CFR §403.16]

CIUs are allowed an affirmative defense for noncompliance with categorical standards if they can demonstrate that the noncompliance was the result of an upset (Figure 31). Conditions necessary to demonstrate an upset has occurred are detailed in 40 CFR §403.16 and require the CIU to submit at least an oral report to the Control Authority within 24 hours of becoming aware of the upset and containing the following information:

Upset is defined as an exceptional incident in which there is unintentional and temporary noncompliance with categorical standards due to factors beyond the reasonable control of the CIU. An upset does not include noncompliance to the extent caused by operational error, improperly designed or inadequate treatment facilities, lack of preventative maintenance, or careless or improper operation.

Figure 31. Definition of Upset (40 CFR §403.16)

- a description of the indirect discharge and the cause of the noncompliance
- the date(s) and times of the noncompliance
- steps being taken and/or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

If this notification is provided orally, a written report must also be submitted within five days. In any enforcement action, the IU has the burden of proof in establishing that an upset has occurred. EPA is responsible for determining the technical validity of this claim.

Categorical and Significant Industrial User (SIU) Reporting Requirements

Periodic Compliance Reports [40 CFR §403.12 (e) & (h)]

After the final compliance date, CIUs are required to report, during the months of June and December, the self-monitoring results of their wastewater discharge(s). The Control Authority must also require semi-annual reporting from SIUs not subject to categorical standards. EPA established a minimum frequency of once every six months, determining this to be adequate for small SIUs or other facilities that have little potential to cause pass-through or interference or to contaminate the sewage sludge. EPA assumed that larger IUs and those that have more potential to cause problems would be required by the Control Authority to sample and report more often. All results for self-monitoring performed must be reported to the Control Authority, even if the IU is monitoring more frequently than required. Periodic compliance reports must include:

- nature and concentration of pollutants limited by applicable categorical standards or required by the Control Authority
- flow data (average and maximum daily) as required by the Control Authority
- mass of pollutants discharged (applicable to CIUs where mass limits have been imposed)
- production rates (applicable to CIUs where equivalent limits have been imposed or where limits imposed are expressed in allowable pollutant discharged per unit of production).

A Control Authority may choose to monitor IUs in lieu of the IU performing the self-monitoring.

Additionally, 40 CFR §403.12(e) and (h) require compliance with 40 CFR Part 136 (Guidelines for Establishing Test Procedures for the Analysis of Pollutants). To demonstrate compliance with these requirements, IUs may have to submit information regarding sample handling and analytical procedures to the Control Authority. Development of standardized forms for use by IUs and their testing labs can facilitate documentation and submission of all required information and can streamline the IU and Control Authority review process.

Bypass [40 CFR §403.17]

The General Pretreatment Regulations define "bypass" as the intentional diversion of wastestreams from any portion of a users treatment facility. If a bypass results in noncompliance, even if it was due to essential maintenance, the IU must provide a report to the Control Authority detailing a description of the bypass and the cause, the duration of the bypass, and the steps being taken and/or planned to reduce, eliminate, and prevent reoccurrence of the bypass.

Oral notice must be provided to the Control Authority within 24 hours of the detection of an unanticipated bypass, with a written follow-up due within 5 days. For an anticipated bypass, the IU must submit notice to the Control Authority, preferably 10 days prior to the intent to bypass.

Notification of Potential Problems [40 CFR §403.12(f)]

All IUs are required to notify the Control Authority immediately of any discharges which may cause potential problems. These discharges include spills, slug loads, or any other discharge which may cause a potential problem to the POTW.

Noncompliance Notification [40 CFR §403.12(g)(2)]

If monitoring performed by an IU indicates noncompliance, the IU is required to notify the Control Authority within 24 hours of becoming aware of the violation. In addition, the IU must repeat sampling and analysis and report results of the resampling within 30 days. The repeat sampling is not required if the Control Authority samples the IU at least once per month or if the Control Authority samples the IU between the time of the original sample and the time the results of the sampling are received.

Notification of Changed Discharge [40 CFR §403.12(j)]

All IUs are required to promptly notify the Control Authority in advance of any substantial changes in the volume or character of pollutants in their discharge.

Notification of Discharge of Hazardous Wastes [40 CFR §403.12(p)]

IUs discharging more than 15 kilograms per month of a waste, which if otherwise disposed of, would be a hazardous waste pursuant to the RCRA requirements under 40 CFR Part 261 are required to provide a one time written notification of such discharge to the Control Authority, State, and EPA. IUs discharging any amount of waste, which if disposed of otherwise, would be an acutely hazardous waste pursuant to RCRA must also provide this notification. This written notification must contain the EPA hazardous waste number and the type of discharge (i.e., batch, continuous). If the IU discharges more than 100 kilograms per month of the hazardous waste, the written notification must also include:

- an identification of the hazardous constituent in the IU's discharge,
- an estimate of the mass and concentration of the constituents in the IU's discharge, and
- an estimate of the mass and concentration of constituents in the IU's discharge in a year.

IUs must also provide a certification accompanying this notification that a waste reduction program is in place to reduce the volume and toxicity of hazardous wastes to the greatest degree economically practical. Within 90 days of the effective date of the listing of any additional hazardous wastes pursuant to RCRA, IUs must provide a notification of the discharge of such wastes.

Signatory and Certification Requirements [40 CFR §403.12(l)]

Pursuant to 40 CFR §403.12(l), BMRs, 90-day compliance reports and periodic compliance reports from CIUs must be signed by an authorized representative of the facility and contain a certification statement attesting to the integrity of the information reported. The reports should be signed by one of the following:

- a responsible corporate officer if the IU is a corporation
- a general partner or proprietor if the IU is a partnership or sole proprietorship
- a duly authorized representative of the above specified persons if such authorization is in writing, submitted to the Control Authority and specifies a person or position having overall responsibility for the facility where the discharge originates or having overall responsibility of environmental matters for the facility.

As required in 40 CFR §403.6(a)(2)(ii), the certification statement must read as follows:

> *"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."*

While Federal regulations only require Control Authorities to require these signatures and certifications from CIUs, many POTWs have found it important to impose these requirements for all IU reports. To facilitate compliance, many Control Authorities have developed forms that include the certification statement and signatory requirements for use by all IUs.

SELF-MONITORING REQUIREMENTS

All SIUs, including CIUs must conduct self-monitoring as part of several different reporting requirements as noted above. For CIUs, this includes the BMR, 90-day compliance report and periodic compliance reports (40 CFR §§403.12(b),(d), and (e), respectively). Non-categorical SIUs are required to self-monitor as part of the periodic reporting requirements (40 CFR §403.12(h)). As noted in 40 CFR §§403.12(g)(4), sample collection and analysis for all required pretreatment program reports must be conducted using 40 CFR Part 136 procedures and amendments thereto. Refer to Chapter 4 of this manual and EPA's 1994 *Industrial User Inspection and Sampling Manual for POTWs* for additional information on sample collection and analysis procedures.

Based on the specific pollutants regulated by categorical standards, different types of samples may have to be collected. For BMR and 90-day compliance reports, a minimum of four grab samples must be collected for pH, cyanide, total phenols, oil and grease, sulfide, and volatile organics. If these pollutants are not regulated by the specific categorical standard, monitoring is not required. Twenty-four hour flow-proportional composite samples must be collected for all other pollutants. The Control Authority may waive flow-proportional composite sampling if an IU demonstrates that flow-proportional is not feasible. In these cases, time-proportional composite samples may be collected.

Self-monitoring for periodic compliance reports must be conducted in accordance with the IU's discharge permit requirements. The Control Authority must ensure that these permits specify sampling location(s), required sampling frequencies, sample types to be collected, sampling and analytical procedures (40 CFR Part 136), and associated reporting requirements. At a minimum, CIUs must monitor for all categorically regulated pollutants at least once every six months, although, permits issued by the local Control Authority may require more frequent monitoring.

In certain instances, CIUs subject to TTO standards may implement alternatives in lieu of monitoring all regulated toxic organic compounds. A listing of categories that contain TTO standards is provided in Chapter 3. For example, the electroplating and metal finishing standards allow IUs to monitor only for those toxic organic compounds that are reasonably expected to be present. Additional TTO guidance related to the electroplating and metal finishing categories can be found in EPA's 1984 *Guidance Manual for Electroplating and Metal Finishing Pretreatment Standards*.

For certain industries (i.e., electroplating, metal finishing, and electrical and electronic components) Control Authorities have the option of allowing the CIU to prepare and implement a Toxic Organic Management Plan (TOMP) in lieu of periodic monitoring. In those instances, the TOMP should identify all potential sources from which toxic organic materials could enter the wastestream and propose control measures to eliminate the possibility. Where a TOMP is allowed, an IU can demonstrate compliance through adherence to the TOMP and submission of periodic certification statements attesting to the fact that:

> *"no dumping of concentrated toxic organic pollutants has occurred and that the facility's TOMP is being implemented."*

TOMPs cannot be used in lieu of monitoring for BMRs and 90-day compliance reporting requirements.

The categorical standards for some industries (i.e., aluminum forming, copper forming, coil coating, and metal molding and casting) allow IUs to monitor oil and grease (O&G) as an alternative to TTO monitoring. This option may be used to fulfill TTO monitoring requirements of the BMR, 90-day compliance report, and periodic compliance reports and allows the IU to determine whether it wants to demonstrate compliance with the TTO or the O&G standards. A detailed description of TTO monitoring requirements is provided in EPA's 1985 *Guidance Manual for Implementing Total Toxic Organics (TTO) Pretreatment Standards*.

RECORD KEEPING REQUIREMENTS

IUs are required to maintain records of their monitoring activities [40 CFR §403.12(O)]. Information, at a minimum, shall include the following:

- sampling methods, dates and times
- identity of the person(s) collecting the samples and of the sampling location(s)
- the dates the analyses were performed and the methods used
- the identity of the person(s) performing the analyses and the results of the analyses.

These records shall be retained for at least 3 years, or longer in cases where there is pending litigation involving the Control Authority or IU, or when requested by the Approval Authority. These records must be available to the Control Authority and Approval Authority for review and copying. Historically, most Control Authorities do not dispose of any records, rather older records are archived at an off-site location.

Figure 32. Industrial User Reporting Requirements

REQUIRED REPORT AND CITATION	APPLY TO	REPORT DUE DATE	PURPOSE OF REPORT
Baseline Monitoring Report (BMR) *40 CFR §403.12(b)(1-7)*	CIUs	Existing Source - Within 180 days of effective date of the regulation or an administrative decision on category determination. New Source - At least 90 days prior to commencement of discharge.	- To provide baseline information on industrial facility to Control Authority - To determine wastewater discharge sampling points - To determine compliance status with categorical pretreatment standards
Compliance Schedule Progress Reports *40 CFR §403.12(c)(1-3)*	All IUs	Within 14 days of each milestone date on the compliance schedule; at least every 9 months.	- To track progress of the industrial facility through the duration of a compliance schedule.
90-Day Compliance Report *40 CFR §403.12(d)*	CIUs	Within 90 days of the date for final compliance with applicable categorical pretreatment standard; for new sources, the compliance report is due within 90 days following commencement of wastewater discharge to the POTW.	- To notify Control Authority as to whether compliance with the applicable categorical pretreatment standards has been achieved - If facility is noncompliant, to specify how compliance will be achieved.
Periodic Compliance Report *40 CFR §403.12(e)*	CIUs	Every June and December after the final compliance date (or after commencement of a discharge for new sources) unless frequency is increased by the Control Authority.	- To provide the Control Authority with current information on the discharge of pollutants to the POTW from categorical industries.
Notice of Potential Problems *40 CFR §403.12(f)*	All IUs	Notification of POTW immediately after occurrence of slug load, or any other discharge that may cause problems to the POTW.	- To alert the POTW to the potential hazards of the discharge.
Noncompliance Notification *40 CFR §403.12(g)(2)*	All IUs	Notification of POTW within 24 hours of becoming aware of violation.	- To alert the POTW of a known violation and potential problems which may occur.
Periodic Compliance Reports for Noncategorical Users *40 CFR §403.12(h)*	Non-Cat. SIUs	Every six months on dates specified by the Control Authority.	- To provide the POTW with current information on the discharge of pollutants to the POTW from industrial users not regulated by categorical standards.
Notification of Changed Discharge *40 CFR §403.12(j)*	All IUs	In advance of any substantial changes in the volume or character of pollutants in the discharge.	- To notify POTW of anticipated changes in wastewater characteristics and flow which may affect the POTW.
Notification of Hazardous Wastes Discharge *40 CFR §403.12(p)*	All IUs	For new discharges, within 180 days after commencement of discharge.	- To notify POTW, EPA, and State of discharges of hazardous wastes under 40 CFR Part 261.
Upset *40 CFR §403.16*	CIUs	24 hours of becoming aware of the upset (5 days where notification was provided orally)	- To notify the POTW of unintentional and temporary noncompliance with categorical standards.
Bypass *40 CFR §403.17*	All IUs	10 days prior to date of the bypass or oral notice within 24 hours of the IU becoming aware of the bypass with written notification within 5 day	- To notify the POTW of noncompliance and potential problems which may occur

6. HAULED WASTES

Chapter 6. Applicable EPA Guidance

CERCLA Site Discharges to POTWs Guidance Manual
Guidance Manual for the Identification of Hazardous Wastes Delivered to Publicly Owned Treatment Works by Truck, Rail, or Dedicated Pipe
Industrial User Inspection and Sampling Manual for POTWs
Industrial User Permitting Guidance Manual
RCRA Information on Hazardous Wastes to Publicly Owned Treatment Works
Guidance Manual for the Control of Waste Hauled to Publicly Owned Treatment Works

In addition to receiving wastes through the collection system, many POTWs accept trucked wastes, and in a few instances, wastes received via train. As specified in 40 CFR §403.1(b)(1), pollutants from non-domestic sources which are transported to the POTW by truck or rail are also subject to the General Pretreatment Regulations. Hauled wastes, like wastes received through the collection system, have the potential to impact the POTW, making regulatory control of these wastes necessary. Recent studies have shown an increasing frequency of uncontrolled discharges to POTWs from waste haulers. Because of their unique nature, waste haulers are not regulated in the same way as other types of IUs. Since no specific Federal regulatory controls exist, some POTWs have developed hauled waste control programs. For more information on hauled waste, refer to EPA's 1998 *Guidance Manual for the Control of Waste Hauled to Publicly Owned Treatment Works*.

NATURE OF HAULED WASTES

Wastes are hauled to POTWs for several reasons. By far, the majority of hauled waste is domestic septage (Figure 33). Since these wastes are domestic in nature, treatment at a POTW is the most appropriate disposal method. Other types of wastes are also regularly hauled to POTWs for a variety of reasons, such as:

- the facility is located outside the jurisdictional boundaries of the POTW (e.g., located in rural areas) and is not connected to the collection system,
- the wastes may be known to cause collection system problems, but can be treated at the POTW (e.g., grease trap cleanout wastes),
- the facility is connected to the sewer but does not have the capacity to discharge the volume of waste generated (e.g., groundwater remediation activities at an IU),
- a POTW rejects acceptance of a waste from an IU forcing the IU to haul the waste to a different POTW that agrees to accept the waste.

Domestic septage is defined as either the liquid or solid material removed from a septic tank, cesspool, portable toilet, Type III marine sanitation device, or similar treatment works that holds only domestic sewage. Domestic septage does not include liquid or solid material removed from these systems that receives either commercial wastewater or industrial wastewater and does not include grease removed from a restaurant grease trap. [40 CFR Part 503.9(f)]

Figure 33. Definition of Domestic Septage

Common to all these wastes is the fact that the POTW does not know for certain the nature and concentration of these wastes, as hauled, without implementing some type of control or surveillance program.

CONTROL PROGRAMS

Section 403.5(b)(8) of the General Pretreatment Regulations specifically prohibits the introduction of any trucked or hauled pollutants to the POTW, except at discharge points designated by the POTW. This is the

only pretreatment requirement specifically addressing hauled wastes. However, many POTWs have determined that additional controls are necessary to further limit these discharges and to prevent adverse impacts from these discharges. These control programs include practices such as permitting, sampling, manifesting, surveillance, and other forms of hauler documentation. In many instances, these control programs have shifted the hauling of waste from one POTW to other POTWs that are not implementing such a program. Most often, it is the smaller POTWs that do not have hauler control programs, including many POTWs that are not even required to implement Pretreatment Programs. The effect of this change from larger to smaller POTWs and from more to less control is that there has been an increase in negative impacts to POTWs and receiving streams. Two apparent options for addressing this concern are for: (1) the smaller and non-pretreatment POTWs to initiate waste hauler control programs; or (2) the larger POTWs to institute sound control programs that will adequately regulate these wastes yet not drive these haulers to search for other less sound disposal alternatives. POTW waste hauler control programs should address the following six elements:

Impact to POTW - Prior to acceptance of a new waste from a hauler, the POTW needs to evaluate the potential impacts to the POTW from this waste. POTWs may require haulers or generators of hauled waste to perform a treatability study to demonstrate the effectiveness of treatment on this waste. POTWs must evaluate the impacts of these waste when evaluating the adequacy of local limits as well as when developing or revising local limits.

Permitting - A permit is the most direct and efficient method of regulating waste haulers. Permits provide the opportunity to monitor and regulate haulers based on the nature of the hauled waste and the potential impacts of that waste on the POTW. Unique permit conditions may include: right of refusal, daily flow limitations, discharge time limitations, and manifesting requirements.

Discharge Point - As specified in the General Pretreatment Regulations, hauled waste can only be discharged at points designated by the POTW. This option is to provide the POTW with the ability to control and observe these discharges at specified locations thereby minimizing the potential for adverse impacts.

Monitoring - The POTW should institute a monitoring program to evaluate the nature and concentration of discharges. Both POTW monitoring and hauler self-monitoring may be appropriate. Many POTWs require that all loads of hauled waste must be sampled, but analyses are only performed on a predetermined percentage of these wastes or when problems occur. Unanalyzed samples are refrigerated and kept for several weeks or months until the POTW is certain that the waste has not impacted the POTW. The frequency of sampling may also be dependent on the variability of the waste. Each load from a hauler that delivers highly variable loads may have to be sampled and analyzed; whereas, a much smaller percentage may be appropriate for more consistent waste types. As noted earlier, all Federal, State, and local discharge limitations apply to these wastes. The POTW may also consider inspecting the waste generators to confirm the source of these wastes.

Hauler Documentation - The POTW should require waste haulers to document the source of wastes being discharged, potentially including manifests. Manifests should include general hauler information, information on the waste generator (e.g., name, address, and phone number), the type of wastes collected, volumes, known or suspected pollutants, and certification that the load is not a hazardous waste. A useful technique is to contact the waste generators to verify the information on the manifest.

Legal Authority - If not already in place, the POTW's local ordinance (and approved pretreatment program) should be modified to add language specifying all of the controls that are applicable to waste haulers. This will ensure that waste haulers and POTW personnel will know the procedures, expectations, liabilities, etc. associated with the control program.

In addition to the specific controls described above, POTWs should implement procedures to identify and eliminate illegal discharges. Procedures may include periodic sewer line sampling, surveillance of suspected illegal discharge points, education of industries regarding hauled waste, increased enforcement, and public awareness of illegal dumping.

CONCERNS

Every hauled waste discharge has the potential to impact the POTW. Unlike discharges from IUs connected to the POTW, the makeup of a load of hauled waste is virtually unknown without some type of monitoring, be it visual or analytical. Even loads of domestic septage can cause problems at a POTW. The majority of waste haulers are reputable business people who provide a valuable service to the public and industry; however, the unique attributes of hauled waste can be devastating when unethical haulers dump incompatible wastes at POTWs. Domestic septage can be partially digested, higher in metals concentrations than normal domestic wastes, or contain small amounts of household contaminants (e.g., cleaners). Similarly, disinfectants used in portable toilets have the potential to impact POTW operations.

Receipt of hauled hazardous waste (as defined in the Resource Conservation and Recovery Act (RCRA)) may not only impact POTW operations, but subject the POTW to additional reporting requirements. The Domestic Sewage Exclusion, specified in 40 CFR §261.4(a)(1)(ii), provides that hazardous wastes mixed with domestic sewage are exempt from the RCRA waste regulations. However, hazardous wastes received by truck or rail (or dedicated pipe) are not exempt from the regulations. POTWs that accept hazardous wastes from these sources are granted "permit by rule" status under RCRA (40 CFR §270.60(c)) provided that certain requirements are met. The two most significant conditions are that the POTW must be in compliance with all of its NPDES permit requirements and the waste must comply with all Federal, State, and local pretreatment requirements. Nationwide, very few POTWs are knowingly accepting hauled hazardous waste.

POTWs should be aware that hauled process wastes from facilities subject to Federal categorical pretreatment standards are still subject to those standards. This condition highlights the need for POTWs to have a clear understanding of the source of the waste since applicable standards may be based on the origin of that waste.

Another potential problematic waste is that from remedial site clean-up operations. Groundwater contaminated with gasoline or diesel fuel is by far the most common type of waste from these operations. While these wastes may contain flammable and toxic compounds (e.g., benzene and toluene), another concern is that large volumes of this waste at a small POTW may actually "flush" the treatment plant, thereby interfering with treatment operations. Similar concerns also exist for landfill leachate, another commonly hauled wastestream. Remedial wastes may also come from Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites, also known as Superfund sites. For CERCLA guidance, refer to EPA's 1990 *CERCLA Site Discharges to POTWs Guidance Manual*.

Other concerns for POTWs that accept hauled wastes include:

- Illegal dischargers may be discharging toxic pollutants that can pass through or interfere with the POTW operations;
- Grease trap wastes can coat and inhibit POTW treatment operations;
- Local limits may not account for pollutants in hauled wastes;
- Hauled wastes may contain pollutants for which local limits do not exist; thus, the impacts of this waste are not readily identifiable;
- Hauled wastes may be unmixed and/or highly concentrated.

For further information on the acceptance of hazardous waste at POTWs, refer to the *Guidance Manual for the Identification of Hazardous Wastes Delivered to Publicly Owned Treatment Works by Truck, Rail, or Dedicated Pipe*.

7. POLLUTION PREVENTION

Chapter 7. Applicable EPA Guidance
Guides to Pollution Prevention: Municipal Pretreatment Program
NPDES Compliance Inspection Manual

As the nation's environmental laws and regulations have developed over the past three decades, a new paradigm has shifted the approach to waste management. Initially, EPA focused on managing the pollution generated through treatment and disposal in an environmentally safe manner. However, we have learned that conventional treatment and disposal can transfer pollutants from one medium to another with no net reduction.[10] In striving to meet new and often more stringent environmental laws, industries have found ways to reduce or prevent pollution at the source. Recognizing that source reduction is more desirable than treatment and disposal, EPA now emphasizes preventing or eliminating the generation of waste. The Pollution Prevention Act of 1990 (PPA) established pollution prevention (referred to as “P2") as a national objective.

Pollution prevention is indirectly defined in the PPA as source reduction. Source reduction is any practice that reduces or eliminates the creation of pollutants. Thus, the amount of any hazardous substance, pollutant, or contaminant entering any waste stream or otherwise released into the environment (including fugitive emissions) is reduced prior to recycling, treatment, or disposal. Source reduction can be achieved through equipment or technology modifications, process or procedural modifications, reformulation or redesign of products, substitution of raw materials, or improvements in housekeeping, maintenance, training, or inventory control.

The PPA established a pollution prevention hierarchy as national policy, declaring that:

- Pollution should be prevented or reduced at the source.
- Pollution that cannot be prevented should be recycled in an environmentally safe manner.
- Pollution that cannot be prevented or recycled should be treated in an environmentally safe manner.
- Disposal or other release into the environment should be employed only as a last resort and should be conducted in an environmentally safe manner.

Thus, under the Pollution Prevention Act, recycling, energy recovery, treatment, and disposal are not included within the definition of pollution prevention. However, some practices commonly described as "in-process recycling" may qualify as pollution prevention. Although recycling is not pollution prevention, as indicated in the hierarchy, it is the next desirable practice where pollution cannot be prevented or reduced. Recycling conducted in an environmentally sound manner shares many of the advantages of prevention for it can reduce the need for treatment or disposal and conserve energy and resources.

EPA’s Office of Pollution Prevention and Toxic Substances (OPPTS) developed a pollution prevention strategy for incorporating pollution prevention concepts into EPA’s ongoing environmental protection efforts. The specific objectives of the strategy are to provide guidance and direction for efforts to incorporate pollution prevention within EPA’s existing regulatory and nonregulatory programs, and to set forth an initiative to achieve specific objectives in pollution prevention within a reasonable time frame. EPA’s numerous activities include the following:

[10] **For example, a wet scrubber is used to remove most of the metal emissions to the air. The metals are captured in the scrubber water. This water must be treated to remove the metals prior to discharge. The treatment process produces a sludge that contains most of the metals that were once in the water. The sludge is disposed in a landfill. The metals have been dispersed to the air, water, and land.**

- Coordinating development of regulations that will help identify the potential for multi-media prevention strategies and that reduce end of pipe compliance costs
- Examining the use of pollution prevention in enforcement actions and negotiations
- Investigating the feasibility of overcoming identified regulatory barriers to encourage cost effective(source reduction) strategies
- Working with State and local governments and trade associations to promote pollution prevention among small and medium size business that often lack the capital to make changes
- Investing in outside programs, usually States, by providing grant funds for the reduction of target chemicals, the agricultural and transportation industry, etc.
- Providing scientific and technical knowledge necessary to implement pollution prevention initiatives on a cross media basis, pursuant to the Pollution Prevention Research Strategic Plan.

POLLUTION PREVENTION AND THE PRETREATMENT PROGRAM

Although pollution prevention is not a required element of the National Pretreatment Program, source reduction is not new to the Program. The Pretreatment Program is designed to prevent toxic pollutants from being discharged to POTWs through controls on the sources that discharge these pollutants. Thus, pollution prevention may be considered an extension of current pretreatment program implementation activities. For example, Pretreatment Programs have the authority to require and enforce waste management practices in order to meet NPDES permit requirements and eliminate interference with treatment facilities. Requiring slug control plans and developing compliance schedules for improved operation and maintenance (O&M)procedures are examples of pollution prevention activities that have long been required by many Control Authorities. Other pretreatment program implementation tools available to make pollution prevention a more integral part of a pretreatment program include:

- **Inspections** - Pretreatment personnel are usually quite familiar with processes performed at their local industrial facilities and have exposure to a variety of industries performing the same or similar processes; therefore, they can easily disseminate (nonconfidential) information about actual pollution prevention measures implemented as well as identify new P2 opportunities.
- **Permits** - Where local regulations allow, questions about pollution prevention measures and plans can be made part of the permit application process. Also, a permittee may be required to undergo a pollution prevention assessment and /or develop a pollution prevention plan as a condition of the permit.
- **Local limits** - POTWs near or above maximum allowable headworks loadings may institute POTW wide-pollution prevention programs to reduce specific pollutants.
- **Enforcement negotiations** - A pollution prevention audit may be required through a consent or compliance order, or implementation of pollution prevention measures may be required as part of a settlement.

Several Control Authorities have implemented these pollution prevention activities. For example, the City of Palo Alto, CA established a silver local limit for photoprocessors and Best Management Practices (BMPs) for automotive facilities. To reduce mercury loadings from dental offices, Western Lake Superior Sanitary Sewer District (WLSSD) in Duluth, MN developed and implemented pollution prevention BMPs. These and many other POTWs that have successfully integrated pollution prevention into their pretreatment programs have become recognized environmental leaders in their communities.

While pollution prevention activities can be unique to each POTW, the following are key elements of successful pollution prevention programs:

- **Integrate pollution prevention into existing activities** - POTWs that view pollution prevention as an enhancement (instead of an additional requirement) to their existing pretreatment programs make small modifications to existing pretreatment activities efficiently and effectively.
- **Start small** - POTWs that slowly phase in new pollution prevention activities overcome impediments such as limited resources and resistance. Implementing small changes gradually can be done with

minimal resources. This approach enables pollution prevention activities to become an accepted integral part of the pretreatment program.

- **Define attainable goals and measure success** - Short-term, narrowly focused efforts have a greater chance of succeeding. For example, POTWs have targeted a specific pollutant and group of industries, established specific pollution prevention activities, and monitored the progress and success of these activities. With each new success recorded, the benefits of pollution prevention are illustrated and the demand for further activities will grow.
- **Provide incentives** - Incentives are effective tools for persuading users to investigate pollution prevention opportunities. POTWs have used a wide range of tools such as public recognition of pollution prevention achievements and reduction of regulatory requirements.

BENEFITS OF POLLUTION PREVENTION

For both IUs and POTWs, pollution prevention has many benefits (Figures 34 and 35) that can be broadly categorized under tangible economic rewards and public goodwill and support. For example, pollution prevention:

- Creates cost savings
- Enhances process efficiency
- Avoids or reduces regulatory costs
- Reduces future liabilities
- Improves protection of worker health
- Improves public image.

- Decrease pollutant loadings to water, air, and sludge
- Decrease pollutant loadings to POTW that result in lower O&M costs and reduces or eliminates need for capital expenditures for POTW treatment plant expansions
- Enables continued or expanded growth in the community without harm to the environment.

Figure 34. Benefits of Pollution Prevention to POTWs

Although the numerous benefits make pursuing pollution prevention attractive, implementation of source reduction in some situations may not be possible. Before implementing a pollution prevention practice, the benefits and barriers of the potential opportunity must be evaluated. Common impediments include the following:

- Technology
  - Decrease product quality
  - Unable to change raw materials because of currently available technology

- Financial
  - Incur high costs associated with implementing alternatives (i.e., new equipment or materials, or personnel and training)
  - Loss due to downtime during switch overs and start ups
  - Foreign competitors may have an economic advantage if they are not obligated to comply with US regulations
  - Binding contracts with existing waste haulers and Treatment, Storage and Disposal (TSD) facilities may exist

- Organizational
  - Lack of or poor communication between persons possessing the knowledge and ideas for improvements and those that can actually implement the changes
  - Limited personnel or internal resources available to investigate and/or make changes
  - Lack of coordination and cooperation among divisions in the corporation

- Behavioral
  - Alternatives may be considered inconvenient by personnel (e.g., dry sweeping then a wet wash down as opposed to just a wet wash down)

- Regulatory
  - Concentrating a pollutant for recycling may classify it as a hazardous waste (e.g., silver). As such, an industrial user may choose to discharge the pollutant rather than be subject to regulations regarding the handling, treatment and disposal of a hazardous waste.

POLLUTION PREVENTION ASSISTANCE

With the creation of the PPA came an abundance of pollution prevention related assistance. This includes direct technical assistance, training courses, and a variety of publications. POTWs can find further information on integrating pollution prevention into their pretreatment programs in EPA's 1993 *Guides to Pollution Prevention - Municipal Pretreatment Programs*. Specific industry trade associations and university technology transfer and outreach departments usually are aware of pollution prevention assistance materials, specific pollution prevention opportunities, and the costs and success of implementing these. Some further sources that disseminate pollution prevention information include:

- **Pollution Prevention Information Clearinghouse (PPIC)** - a free, nonregulatory clearinghouse available to the public which focuses on source reduction and recycling for industrial toxic wastes.

- **State Programs** - provide technical assistance to conduct pollution prevention assessments, develop guidance manuals on conducting these assessments, actually conduct these assessments, provide assistance in developing POTW-wide pollution prevention plans, provide training for industry, State and POTW personnel, and offer grants for pollution prevention projects.

- **Envirosense** - an on-line computer system (*internet address:* ***es.inel.gov***) of summary information for PPIC documents, includes pollution prevention news, upcoming events, and mini-exchanges (discrete pollution prevention topic areas, pollution prevention databases, and message center).

- **National Institute of Standards and Technology (NIST)** - an office of the Department of Commerce, NIST develops technology to improve product quality, modernize manufacturing processes, ensure product reliability, and facilitate rapid commercialization of products based on new scientific discoveries. NIST web sites for different industry sectors are available. For example, the metal finishing web site (i.e., the National Metal Finishing Resource Center) is found at "www.nmfrc.org."

- Regulatory
  - Elimination of regulated wastewater discharges, and hence, monitoring requirements
  - Reduced paperwork requirements for waste hauling and treatment
  - Compliance with RCRA reports on waste reduction (i.e., companies generating RCRA wastes are required to certify that they have a program to reduce the volume and toxicity of hazardous waste generated)
  - Compliance with land disposal restrictions and bans

- Environmental
  - Minimization of material emissions to all media resulting in reduced health risks to workers and the community

- Financial
  - Reduced landfill and treatment costs due to less waste being generated (includes reduced transportation costs as well)
  - Reduced raw material and manufacturing costs (e.g., by preventing spills or leaks, improving equipment maintenance and inventory control techniques, reuse, etc. raw materials are handled more efficiently and do not have the chance to become waste. With a greater percentage of raw material going into process, raw material use goes down in relation to volume of product produced)
  - Increased manufacturing efficiency and productivity and improved product quality with fewer offspec products

- Compliance and public relations
  - Achieving compliance with local limits and categorical standards
  - Reducing waste and implementing best management practices can improve public and community relations.

Figure 35. Benefits of Pollution Prevention to IUs

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Community Contribution for Environmental Contribution in Rural Area: Myth and Reality

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Introduction

In recent years, there has been increasing recognition of the limitations of the capacity of government agencies to effectively manage the rapidly increasing multiplicity of development programmes. As a substitute the governments have been assigning greater roles to the Non-Government Organisations (NGO), private sector and communities for greater participation. This shift in approach was observed in various sector including drinking water and sanitation services, to increase efficiency (Churchill 1994), for cost recovery (Harmeyer and Mody 1998) and sustainability of the schemes/assets (*Kahkonen* 1999), this has been experienced in many countries (Narayan 1993). In fact, the drinking water and sanitation sector received attention to promote public health, (Woods 2003; Das Gupta 2003; Esrey *et al*.1991) in turn the productivity of human resources can be enhanced, thus poverty can be reduced.

In India, just 22 per cent of the households have access to sanitation in rural area (NSS 1998; Census 2001). This level needs to rise to 53 per cent by 2015 to meet the MDG target, a huge challenge. There appears to be a shortfall of some Rs 287 billion in the financing needed from 2002-15 (Water Aid 2005). Toward this goal the Government of India is making all the efforts, traditionally relied on high level of subsidies to construct latrines. The high subsidy approach has been now replaced with the principle of demand driven and community led, with the introduction of the Total Sanitation Campaign (TSC) in 1999. The concept of sanitation has now been expanded to include liquid and solid waste disposal, personal, domestic as well as environmental hygiene.

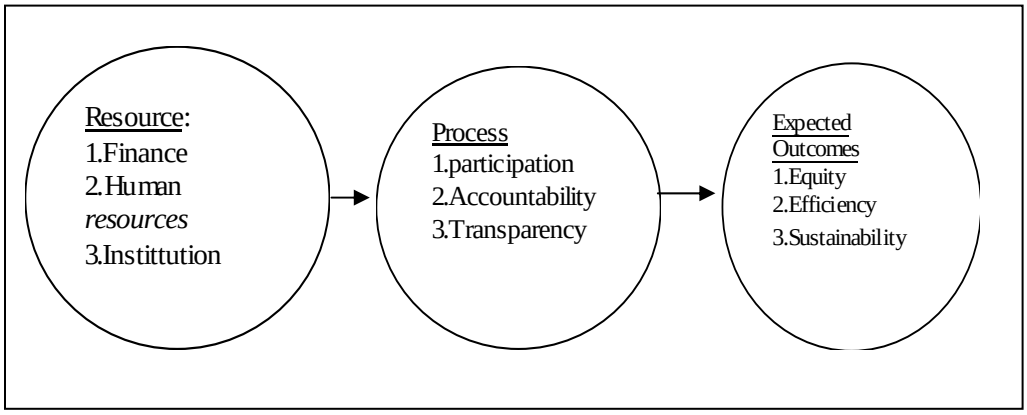
Location of Project

The Karnataka (Federal State) state implemented three major projects supported by multilateral and bilateral agencies, the new approach introduced in TSC was in-built in these projects. This study investigated how and to what extent the paradigm shift took place in demand driven and community led. For investigation, the Karnataka Integrated Rural Water Supply and Sanitation Services (KIRWSS) project was selected, which was implemented during 1994-2002, in 1104 villages (rural settlements), supported by World Bank.. Two sets of villages were selected for investigation, first set of villages were randomly selected ten per cent of the 1104, project villages. Purposively all the nine pilot phase villages spread across the state were selected for investigating impact of project at household level, the households were selected proportionately to total households. Thus, 121 villages (112+9) and 755 households were finally selected and examined. According to methodology (see Appendix), the required secondary and primary data was collected from different agencies and households.

Situation Analysis and Description of Problem

According to the latest statistics in state only 18 per cent of the households have access to latrines and 35 per cent for drainage systems (Census 2001). Of the total access to latrines only 9 per cent were have pit latrine. The reasons for the low coverage vary; however, the common factors are religious beliefs and culture, the advent of Hinduism and its caste system (Cooper 1997). The community often unable to perceive a direct relationship between the current health profile of household and sanitation services. (Veerashekharappa, 2001; 2004)

As the project was based on need and demand driven concept, the primary objective was to create awareness on impact of water and sanitation related diseases, in turn to create demand for project. For this, the Information, Education and Communication (IEC) strategy was adopted. Under the project, the entire investment on water was met by the project funds, while for environmental sanitation 30 per cent of the cost has to be met by the community in the ratio of 70:30. The NGOs, beneficiaries and private sector have participated; the beneficiary was involved in all stages of implementation through Village Water Supply and Sanitation Committees (VWSC). The concept followed in the project was with better resources and community participation; the expected outcomes can be derived. The process and expected outcomes were well defined under the project, which was reproduced here briefly.



As mentioned earlier, the community has to share 30 per cent of capital cost of sanitation. To tender water work construction, the VWSC has to mobilize 25 per cent of the 30 per cent, thus the community was made accountable for initiation of the project. Of the total 12 district (provinces) where project implemented, except in two districts, in all other districts the agreed amount was mobilized, but in none of the district the amount was entirely mobilized from the household source. The balance amount has come from non-household sources, such as Gramapanchayat, cooperative societies, contractors, etc. Of these, the role of local leaders, contractors and Gramapanchayats was important in that order, because together they met the biggest chunk of the gap left by the households, which amounted to 41.6 per cent. Of the total selected (112) villages, including four villages, where no contribution has taken place, in total 21 villages the contribution was less than 25 per cent. The major concern in this context was, of the 29 contractors, 45 per cent of them contributed an amount varying from 40 per cent and upwards of the total contribution in the village (in one village 80 per cent). Finally, the total amount mobilized at state level from all sources under community contribution was

Rs 130 million as against the expected Rs 300 million (GOK 2003), thus, 43 per cent of the agreed amount was mobilized. Within that, what was actually mobilized from the household was just around 60 million.

As mentioned earlier, 25 per cent of the agreed amount had to be mobilized for tendering villages for water works, but in practice the norms were flouted. The reasons attributed were that the tendering was done on global competition, to achieve the economy of scale and a couple of villages were combined as a slice on cluster basis. In the process, the villages that had not mobilized the agreed amount also tendered on the pretext that community would mobilize the agreed amount later. But, that could not take place at all, thus the accountability on the part of community was relaxed.

In pilot villages, the pattern of contribution was more or less same what was observed in large sample. The most identified reason for less number of household contributions was the inefficiency of NGO in convincing the household about the benefits of the project. Most of the households were under impression that `none pays' or `nothing happens even if we did not pay'. Thus, the NGO could not make much effort in changing of mindset of the household, which was very crucial for successful implementation of the project. The inefficiency of NGO was turned out be an advantage to contractors in each village. If the households had been convinced on the relation between contaminated water and health profile of the households the situation would have been different. The role of NGO, along with creation of awareness, it has to facilitate VWSC in its various functions, such as facilitated to conduct meetings, provide technical training in operation and maintenance of assets, etc. As per the norms, VWSC meetings were scheduled every fortnight, but, the minutes of meeting book show that in all the villages, in aggregate 43 per cent of meetings held as per schedule. The reasons for not holding meetings as per scheduled was attributed to the factions in village and reconstituting of VWSC in couple of villages, due to change of party in power. It is observed that women and vulnerable section of the community attended the meetings, because of appropriate reservations were made to them while constituting the committee. But, their presence was not felt in meetings.

The VWSC had been authorized to award contract for the construction of sanitation services. In practice, the persons, who played a key role in mobilizing the large amount, took the decision. In each village, the contractor was awarded to the person recommended by them. If any person questions the award of contract was cornered and suppressed with questions like 'Why should you interfere? Are you going to pay for it? Why bother who gets contract. If you want to interfere, why don't you mobilize more? Moreover, when the contractor was willing to contribute on our behalf, we have saved of paying towards our share of capital cost. Thus, there was no community participation and transparency in awarding contract, as there was nexus between elite group of village and contractor.

Thus, though finance (enough funds), human resources (NGO) and organisation (VWSC) was provided in the project as input in. But, it is noticed that there is not equity provision of services, which were biased towards wealthy localities in terms of accessibility and adequacy of water supply. Of the total households, 82 per cent of the wealthy households found the source located within short distance, 32 per cent drew water 40 lpcd and above, whereas on an average, 17 per cent of the poor drew water less than 40 lpcd. The quantity of water obtained was positively associated with the landholding and wealth status. Similarly, there was inequity in provision of sanitation

services. As mentioned earlier, sanitation services made available largely on demand based by sharing proportion of total investment cost. As a result there were large variations in the components provided and proposed, considering the mobilization of agreed amount (Appendix). For instance, the drainage construction was not taken place in one village, in three villages it was partially constructed that too in wealthy locality. The box type drainage was constructed in wealthy locality, while in other localities the L shape drainage was constructed. Of the total selected households, on an average, 17 per cent of them had Individual Household Sanitary Latrine (IHSL), against the targeted 30 per cent by the project. The 17 per cent were a cumulative figure of various other similar programmes, such as Nirmal grama yojana (NGY) implemented in respective villages. The reasons for low coverage were attributed, for linking sanction of subsidy to the household toilets with community contribution and private household connection (PHC) of water. The beneficiary had to meet at least one of these two conditions to get the benefit. This undue practice had kept away many deserving households from opting for latrines. At the same time, our investigation found a couple of households misusing the faciility, with the nexus of officials and key persons within the village, by showing latrines constructed under NGY or self initiated against the KIRWSS and claimed the subsidy.

Lessons learnt and Alternatives

The above analysis brings out that; the concept of community participation through cost sharing and recovery in development projects had been theoretically established and empirically tested in many parts of the world. The international agencies have been promoting this idea by funding directly and indirectly, countries are accepting these policies to reduce the financial burden on public exchequer of their county.

The lessons learn from this project was, the programme not deep rooted in minds of people, to achieve this, the approach has to be revised. Both the institutions (NGO and VWSC) were ineffective in various aspects, in fact the VWSC was functioning as an extended arm of the gramapanchayat. Thus most of the demerits of that institution have been inherited by this organization. As a result, neither the beneficiary shared the capital cost nor user charges were paid in many villages. In fact, the project helped the key persons in the village to capture benefits, without accountability. Subsequently, most of the villages (except 10 to 12 villages) were transferred to gramapanchayat, the operation and maintenance cost is met largely from state budgetary allocation.

Hence, there is a need to re-examine at the design of similar projects, particularly designing the process, which is most important. Particularly the job of regulator and service provision has to be separated, to achieve equity and efficiency in service provision, if necessary partially privatization can be acceptable by involving Self Help Groups (SHGs) through linking up microfinance activities. Indeed this approach might be an alternative in future.

Appendix

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Supporting Information

Table 1: Per cent of Households with sanitation facilities (2001

Sanitation Services	Karnataka			All India		
	Total	Rural	Urban	Total	Rural	Urban
Type of latrine within the house						
Pit latrine	13.38	9.48	20.70	11.5	10.3	14.6
Water closet	18.64	4.67	44.86	18	7.1	46.1
Other latrine	5.48	3.25	9.67	6.9	4.5	13
No latrine	62.50	82.60	24.77	63.6	78.1	26.3
Type of connectivity for waste water outlet						
Closed Drainage	17.26	4.28	41.64	12.5	3.9	34.5
Open Drainage	33.97	31.11	39.33	33.9	30.3	43.4
No drainage	48.77	64.61	19.03	53.6	65.8	22.1

Source: Census 2001

Table 2: Source-wise Distribution of Actual Contribution across Districts (in %)

District	House Holds	Grama Panchayats			Local Leaders	Cooperatives	Shops & Industries	Fairs & Festivals	Contra-ctors
		Loan	Grants	Auctions					
1	**2**	**3**	**4**	**5**	**7**	**8**	**9**	**10**	**11**
Bangalore	56.7	-	-	4.5	27.0	5.9	2.4	0.4	2.9
Mandya	45.4	-	7.5	-	15.3	3.4	6.4	6.7	15.3
Hassan	17.6	-	1.0	5.0	13.2	-	-	3.7	59.5
Belgaum	98.6	-	-	-	-	-	-	-	-
Gulbarga	54.1	-	1.6	3.7	21.0	0.1	1.4	-	13.6
Bellary	31.7	2.1	-	1.4	51.2	2.8	4.0	-	6.8
D.K.	100.0	-	-	-	-	-	-	-	-
Raichur	33.2	2.9	-	-	-	0.7	-	-	62.7
Shimoga	73.3	3.8	2.5	11.6	3.3	-	-	1.6	3.9
Tumkur	72.0	-	-	3.3	15.5	0.2	5.5	-	3.5
Bidar	87.3	-	-	4.6	5.9	0.3	1.4	-	0.4
Mysore	43.9	-	1.1	-	40.7	6.2	3.9	4.3	-
Average	56.3	0.9	2.0	2.8	16.9	1.9	1.3	0.5	19.4

Table 3: Distribution of villages by Source of Contribution

Class Intervals (per cent of Contribution)	Number of Villages				
	Households	GPs*	Leaders	Contractors	Others**
0	4	75	59	40	73
0.1 –10.0	4	17	12	9	16
10.1- 20.0	6	5	7	42	6
20.1- 30.0	7	5	11	3	5
30.1- 40.0	13	6	6	5	3
40.1- 50.0	12	1	3	1	3
50.1- 60.0	10	2	0	3	5
60.1- 70.0	8	0	0	2	0
70.1 and above	48	1	5	7	1
Total	112	112	112	112	112

Note: * Under this source loans, grants, proceeds from auctioning of fuel, fodder etc., and property tax have been included.

Table 4:Households Using Water and Environmental Sanitation Services (in Percentages)

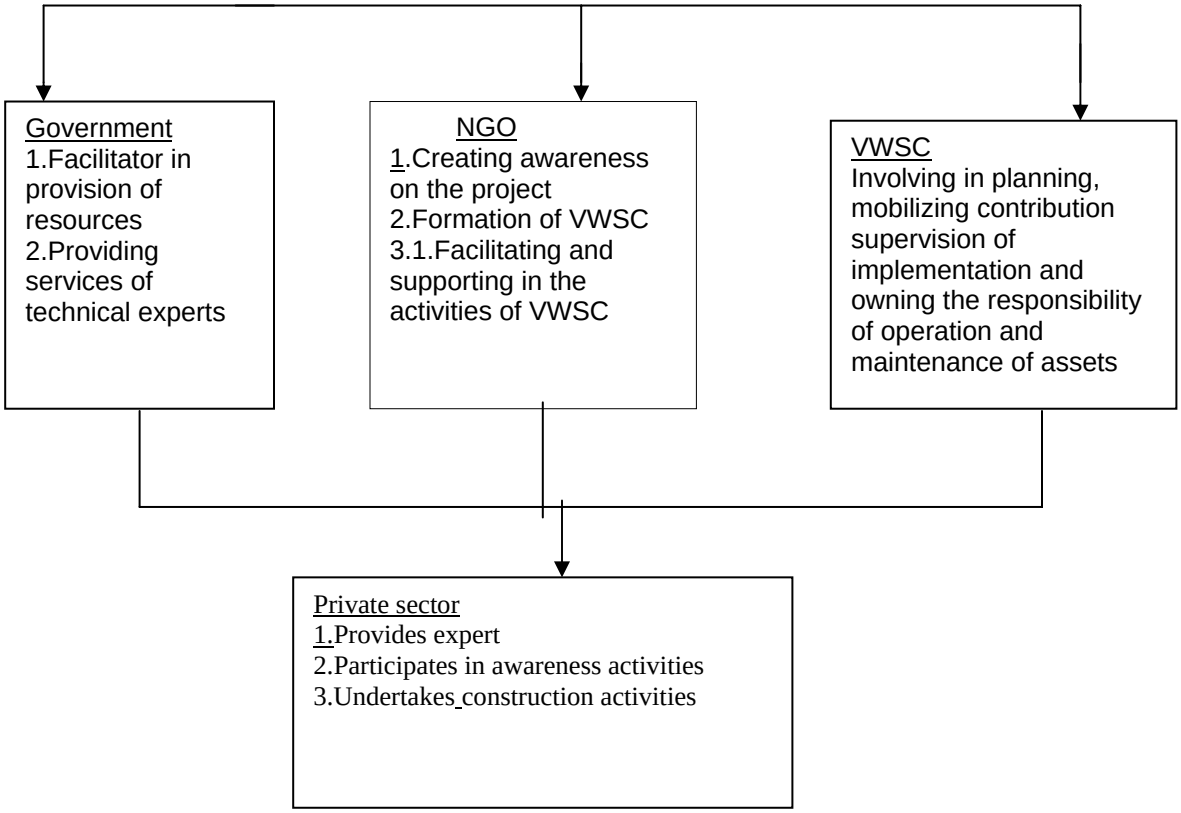
Sl No	Name of the Vilage	Water supply	Bathing cubicle	Washing platform	Cattle troughs	Street Bins	Sullage drainage	Individual-latrine*	Indvl. lat. cum biogas
1	Seegavalu	65	NA	neg	nil	NA	70	8	NA
1a	K.Koppalu	nil	NA	NIL	NIL	not in use	50	NA	NA
2	A.Nagathihalli	100	NA	neg	40	not in use	70	16	NA
3	Hombadimandadi	50	neg	nil	nil	not in use	nil	19	NA
4	Daginakatte	65	NA	nil	20	NA	60	9	NA
5	Kembliganhalli	100	NA	nil	nil	not in use	60	7	NA
6	Lakhanagaon	neg	neg	neg	NA	NA	50	1	30
7	Yelasangi	100	neg	20	20	**NA**	30	1	NA
8	Arkera	100	NA	20	20	in use	60	18	NA
9	Madlur	100	neg	20	20	NA	90	2	NA

Note: although a number of ISLs were constructed, only a few of them were used.

Approach and Methodology:

The multiple sampling method was adopted to select the villages. Of the total villages under the programme, two sets of samples were selected: 1) Ten per cent of the 1104, project villages were selected randomly, 112 villages spread across 12 districts; 2. Purposively all the nine pilot phase villages spread across the state were selected. The required secondary data were collected from Village Water Supply Committee (VWSC), NGOs and Gramapanchayats; the primary data were collected from selected households. Households selected by grouping villages into two; the first category of the villages consisted of less than five hundred households each; and the second set of villages consisted of more then five hundred households each, to have equal representation from both the groups, 30 and 15 per cent of the households were selected randomly. The tools chosen for data collection, in addition to questionnaire and group discussion, participator method was considered. As the programme based on the process of resources, deals more organisation capability of the institutions, hence some of the villages documented as case studies.

Responsibility of different Actors



3

Water Utility and City Profiles

Water Utility

CHENGDU MUNICIPAL WATER SUPPLY GENERAL COMPANY

Address : No.16 Twelve Bridge Street, Shu Du Road, Chengdu, Sichuan 610072, People's Republic of China
Telephone : (86-28) 8778 7536
Fax : (86-28) 8771 9403
Head : Ding Baoquan, General Manager

The Chengdu Municipal Water Supply General Company (CMWSC) is a state-owned enterprise involved in water production and distribution to the city's urban population. The Generale des Eaux-Marubeni Joint Venture Water Supply Company (CGE-M) produces 400,000 m^3 of treated water per day and sells it to CMWSC under an agreement.

General Data About Water Utility

Connections	: 50,077
Staff	: 1,691
Annual O&M Costs	: US$19,549,830
Annual Revenue	: US$38,940,170
Annual Capital Expenditure	: US$ 8,825,390
Source of Investment Funds	: no data

Water Resources Management

Chengdu is one of 300 cities in the People's Republic of China that have water shortage problems. The main source of Chengdu's water supply is the Minjiang River. Water pollution and reduction in forest cover in the upper reaches of the river have decreased the amount of water available, resulting in either reduced outputs (No. 2 and No. 5 waterworks) or closure (No. 3 and No. 4 waterworks) of water treatment plants. The Chengdu Government has issued laws and regulations for the protection and conservation of water supplies including groundwater sources. It began a watershed rehabilitation project in 1998 that cost CNY566 million (US$68.4 million). It is also investing CNY2.7 billion (US$326 million) in the Shahe watershed rehabilitation, which started in November 2001. The city has plans to use treated wastewater effluent for car washing, toilet flushing, irrigation, and small fountains/waterfalls in new development areas.

Tariff Structure

Category	Water Rate		Sewerage Rate	
	CNY / m^3	US$ / m^3	CNY / m^3	US$ / m^3
Domestic	1.05	0.127	0.15	0.018
Institutional	1.35	0.163	0.15	0.018
Industrial	1.30	0.157	0.30	0.036
Commercial	1.85	0.224	0.30	0.036
Special uses	2.00	0.242	0.30	0.036

Notes:
1. Meter reading and billing are done monthly. Almost all connections are metered.
2. The connection fee is based on the floor area of the building at CNY22/m^2 (US$2.66/$m^2$). It is paid by housing developers during construction.

Policy and Regulation

The Chengdu Municipal Water Supply Administrative Ordinance was enacted in January 2001. It aims to strengthen the municipal water supply administration, safeguard all kinds of water usage, maintain the rights and interests of water supply companies and users, and develop the water supply trade. With the introduction of a market economy in the PRC, all allowances and subsidies were removed from water supply companies. The Franchise Management Regulation of Chengdu encourages investment from foreign investors for build-operate-transfer (BOT) and transfer-operate-transfer (TOT) projects. The Chengdu Government sets the price for water produced by foreign investors, as in the BOT scheme of the CGE-M.

Wastewater and Sanitation

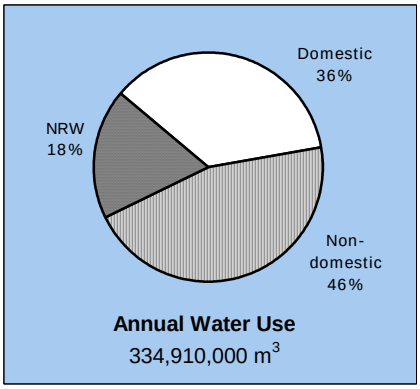
The sewerage system in the city covers 207.8 km^2 and serves 2.46 million residents. About 50% of the sewage are treated at the Chengdu Sewage Treatment Works, which has a capacity of 400,000 m^3/day. City residents are also served by 764 public toilets. In 2001, the city government spent CNY30.7 million (US$3.7 million) on environmental sanitation and CNY46.4 million (US$5.6 million) on sewage treatment and disposal facilities.

CHENGDU WATER SUPPLY

Production & Distribution

Population: 2,891,100 (2001)

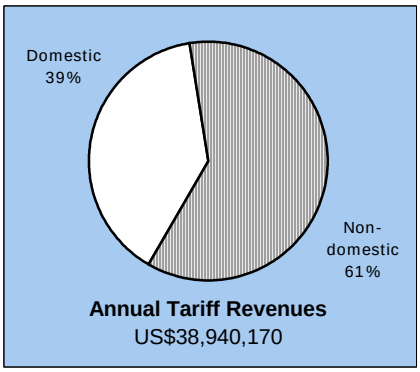
Annual Production	334,910,000 m^3
Groundwater	Nil
Surface Water	100%
Annual Consumption	
Domestic	120,540,000 m^3
Nondomestic	153,370,000 m^3
Total	273,910,000 m^3



Annual Water Use
334,910,000 m^3

Service Connections

Domestic[1]	35,217
Nondomestic	14,860
Total	50,077



Annual Tariff Revenues
US$38,940,170

Service Indicators

Service Coverage	83%
24-hour Water Availability	100%
Per Capita Consumption	138 l/c/d
Average Tariff	US$0.142/$m^3$

Efficiency Indicators

Nonrevenue Water	18%
Unit Production Cost	US$0.058/$m^3$
Working Ratio	0.50
Staff/1,000 Connections	33.8
Revenue Collection Efficiency	100%

Small-scale Water Providers

There are 69 small-scale water providers in Chengdu concentrated around the Third Loop Road. They supplied 46.34 million m^3 of water to about 497,800 people or 15% of the population in 2000. Price per m^3 ranges from CNY0.50 (US$0.06) to CNY2.00 (US$0.24), averaging CNY0.98 (US$0.12) for domestic use, CNY1.12 (US$0.14) for industrial use, CNY1.39 (US$0.17) for public service departments, and CNY2.00 (US$0.24) for commercial use and special trades. Some of these providers sell groundwater at CNY0.30 (US$0.04)/$m^3$. Total revenues of small-scale water providers in 2000 amounted to CNY27.5 million (US$3.32 million) although many made very little profit; 17 made a loss and 10 broke even.

Private Sector Participation

The Chengdu No. 6 Waterworks was constructed and is being operated under a BOT scheme by CGE-M. The company sells water to CMWSC under an agreement that requires CMWSC to purchase 400,000 m^3 of water daily. CGE-M must deliver at least the same amount; otherwise, it is penalized. CMWSC also produces water and has a total capacity of 980,000 m^3/day. The total demand is about 1 million m^3/day, but because of the agreement, CMWSC is forced to reduce its own production by 40% and buy higher priced water from CGE-M. This situation was caused by an overestimate of demand based on population growth and the abundance of groundwater, as well as the emergence of many small-scale water providers.

Flood Management

During the 20th century, Chengdu suffered from 15 major flooding disasters. The worst were in 1964 and 1981 when storm waters combined with flood flow from the upper reaches of the Minjiang River. Flood management is the responsibility of the Flood Prevention Headquarters of the People's Government of Chengdu under the Chengdu Water Conservancy Bureau. In 2001, expenditure for flood control works and management was CNY19.64 million (US$2.37 million).

Notes

[1] Average number of persons/connections was 3.1. The increase in total connections in 2001 was 111.

Data as of 2001.

Water Utility

NATIONAL WATER SUPPLY AND DRAINAGE BOARD

Address : P O Box 14, Mount Lavinia, Sri Lanka
Telephone : (94-11) 263 6449
Fax : (94-11) 263 6449
E-mail : gmnwsdb@sltnet.lk
Head : M. Wickramage, General Manager

The National Water Supply and Drainage Board (NWSDB), a government corporation formed in 1975, manages Sri Lanka's water supply, drainage, and sewerage where local authorities are unable to do so. The City of Colombo, which is governed by the Colombo Municipal Council (CMC), is part of the Greater Colombo Water Supply Area.

General Data About Water Utility

Connections	: 86,586
Staff	: 656
Annual O&M Costs	: US$ 5,224,000
Annual Revenue	: US$10,102,000
Annual Capital Expenditure	: US$ 729,940
Source of Investment Funds	: no data

Water Resources Management

The Greater Colombo Area is primarily supplied from the Labugama and Kalatuwawa impounding reservoirs and the Ambatale head works on the Kelani River. The use of groundwater is very limited. Although the river flow at Ambatale is sufficient for the present requirement of 500,000 m^3/day, low tide during low flow periods may cause the river water level to fall below the intake level and high tide may bring in saline water. The high proportion of nonrevenue water in the Greater Colombo Area (47%), especially in Colombo City, raises the prospect of severe water shortages after 2003.

Tariff Structure

Category	Rate SLRs/m^3	Rate US$/$m^3$	Category	Rate SLRs/m^3	Rate US$/$m^3$
Domestic and government quarters 1–10 m^3	1.25	0.013	Commercial/Industrial	42.00	0.451
11–15 m^3	2.50	0.027	Construction	42.00	0.451
16–20 m^3	6.50	0.070	Tourist hotels/Guest houses	42.00	0.451
21–25 m^3	20.00	0.215	Private & gov't institutions	42.00	0.451
Over 25 m^3	45.00	0.483	Shipping	140.00	1.503
Others			Bulk water supply		
Religious/Charitable 1–50 m^3	4.00	0.043	Local authorities	9.00	0.097
	12.00	0.129	Rural water supplies maintained by community based organizations	7.00	0.075
Institutions Over 50 m^3	4.00	0.043			
Gov't & gov't assisted schools	7.00	0.075			
Stand posts	26.00	0.279			
Export processing zones					
Monthly Fixed Charges	**SLRs**	**US$**	**Monthly Fixed Charges**	**SLRs**	**US$**
Domestic, religious, and charitable institutions; stand posts	50.00	0.537	All others: (Connection Size)		
			1/2 "	70.00	0.751
			3/4 "	140.00	1.503
			1" to 2"	280.00	3.006
			2" to 3"	700.00	7.514
			Above 3"	1,400.00	15.028

Notes:
1. This tariff structure has been in effect from 22 May 2002.
2. Most consumers pay on metered use. About 70% of connections are metered and working. Consumers are billed monthly and pay at banks, the utility office, or collection centers.
3. The connection fee is SLRs12,000 (US$129).
4. There is no sewerage tariff for residents connected to the sewerage system.

Policy and Regulation

The Ministry of Housing and Plantation Infrastructure has developed a policy framework for the water and sanitation sector. The goals of the Government include access to sufficient and safe drinking water to 85% of the population of Sri Lanka by 2010, and 100% by 2025; and adequate sanitation for 70% of the population by 2010, and 100% by 2025. NWSDB is the major service provider as well as the regulator for water supply and sanitation in the country.

Wastewater and Sanitation

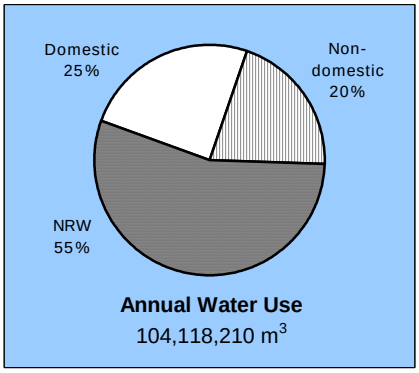
The sewerage system of Colombo was constructed in 1906. It serves about 33,000 sewer connections in the CMC area covering 33% of the population. While the system covers most of the city, many residents remain unconnected because of the high connection fee and the anticipated monthly sewerage bills. One third of the population—living in heavily developed, unsewered areas—use septic tanks, which overflow because desludging is rarely done. US$1.78 million was spent on capital expenditure for sewerage by the city during 1997–2001.

COLOMBO WATER SUPPLY

Production & Distribution

Population: 642,163 (2001)

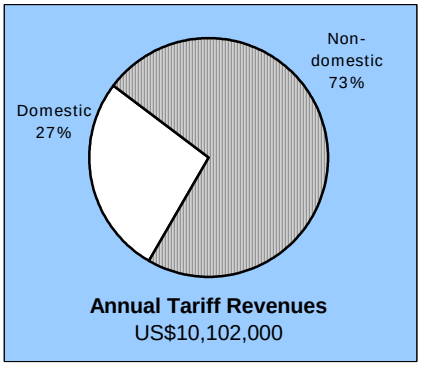
Annual Production	104,118,210 m^3
Groundwater	Nil
Surface Water	100%
Annual Consumption	
Domestic	25,729,632 m^3
Nondomestic	21,091,537 m^3
Total	46,821,169 m^3



Annual Water Use
104,118,210 m^3

Service Connections

Domestic[1]	73,772
Nondomestic	12,814
Total	86,586



Annual Tariff Revenues
US$10,102,000

Service Indicators

Service Coverage[2]	69%
24-hour Water Availability	60%
Per Capita Consumption	119 l/c/d
Average Tariff	US$0.216/$m^3$

Efficiency Indicators

Nonrevenue Water	55%
Unit Production Cost	US$0.050/$m^3$
Working Ratio	0.52
Staff/1,000 Connections	7.6
Revenue Collection Efficiency	95%

Small-scale Water Providers

The city is completely covered by NWSDB's water distribution system. Residents obtain their water from the system legally or illegally through service connections or public taps. There are no small-scale water providers. A liter of bottled water costs SLRs30 (US$0.32) or more.

Private Sector Participation

The Government's reform process encourages the private sector to enter into partnership with the Government to operate, maintain, and expand water services to improve operational efficiency, and provide finance. The Government has identified several urban water supply schemes for PSP. Schemes in Greater Negambo and the Kalutara to Galle Coastal Strip were selected in 2001 as pilot projects for immediate implementation. The lease-concession hybrid model was used with funding from the World Bank. PSP in the water supply and sanitation sector has been widely acknowledged and the attitude of the general public toward it is positive.

Flood Management

The CMC area has a well-developed storm water drainage system. The CMC is responsible for maintenance of minor canals draining into the main canals. The Sri Lanka Land Reclamation and Development Corporation (SLLRDC) is responsible for the operation and maintenance of the main canal system in the Greater Colombo Area. However, it suffers from problems of access, lack of suitable equipment, and insufficient funds. After the city was hit by the worst-ever flood on 4 July 1992, the SLLRDC began the Greater Colombo Flood Control and Environment Improvement Project with financial assistance from the Japan Bank for International Cooperation.

Notes

[1] Average number of persons/connection in 2001 was 6.0. The increase in total connections in 2001 was 4,758.
[2] This does not include about 151,860 people served by 2,531 public taps in tenement gardens.

Data as of 2001.

Water Utility

DELHI JAL BOARD

Address : Varunalaya Phase II, Jhandewalan, Karol Bagh, New Delhi 110005, India
Telephone : (91-11) 354 4795
Fax : (91-11) 355 8940, 351 6182
E-mail : djb@delhijalboard.com
Head : P. K. Tripathi, Chief Executive Officer

The Delhi Jal Board (DJB) is a statutory body created under the Delhi Jal Board Act of 1998. It is responsible for production and distribution of potable water and for treatment and disposal of wastewater for the city's population of nearly 14 million people. The utility buys raw water from the Uttar Pradesh Irrigation Board and the Bhakra Beas Management Board. DJB provides bulk water to the New Delhi Municipal Corporation (NDMC) and the Cantonment Board for distribution in their respective areas.

General Data About Water Utility

Connections	: 1,374,622
Staff	: 27,321
Annual O&M Costs	: US$ 88,314,650
Annual Revenue	: US$ 36,042,240
Annual Capital Expenditure	: US$107,206,930
Source of Investment Funds	: 48% government loan; 24% revenues; 7% grant; 21% others

Water Resources Management

Delhi draws water from the Yamuna River at Munak in Haryana State about 100 km from the city, and from the Ganges River at Muradnagar in Uttar Pradesh 32 km from the city. Water is also drawn from tubewells near the Yamuna flood plain and the Ranney wells in the south. Raw water from the rivers is of adequate quality and is treated and distributed by DJB from its 6 water treatment plants. Because Delhi is largely dependent on other states and outside sources of raw water, and groundwater extraction is limited, DJB has taken the following measures: tapping groundwater along the Yamuna River floodplain, nonrevenue water reduction by metering, mandating rainwater harvesting structures in large buildings, recycling of wastewater, and promoting water conservation through public awareness campaigns.

Tariff Structure

Category	Rate		
Metered	**Consumption**	**Rs/m³**	**US$/m³**
Domestic	0–10 m³	0.35	0.007
	11–20 m³	1.00	0.021
	21–30 m³	1.50	0.031
	Over 30 m³	3.00	0.062
Commercial	0–50 m³	5.00	0.104
	Over 50 m³	10.00	0.208
Industrial	0–50 m³	8.00	0.166
	51–100 m³	12.00	0.249
	Over 100 m³	16.00	0.332
Unmetered	**(Flat) Rate**		
Domestic	Rs30 (US$0.62)/month		
Commercial	Rs150 (US$3.11 /month		
Industrial	Rs450 (US$9.34)/month		

Notes:
1. This tariff structure has been in effect from January 2001.
2. Most of the connections are unmetered except those in the NDMC area; hence, consumption is at best an estimate or is assessed on flat rates. The connection fee is Rs100 (US$2.08).
3. There are no specific sewerage charges in tariffs, but a 50% surcharge is collected ostensibly for sewerage.

Policy and Regulation

The Government of Delhi is considering the establishment of a regulator for the sector. This follows the successful establishment of an electricity regulator associated with the recent privatization of electricity distribution in the city. An initial proposal for the electricity regulator to regulate water supply was not accepted. Legislation for the establishment of a water supply regulator is being drafted.

Wastewater and Sanitation

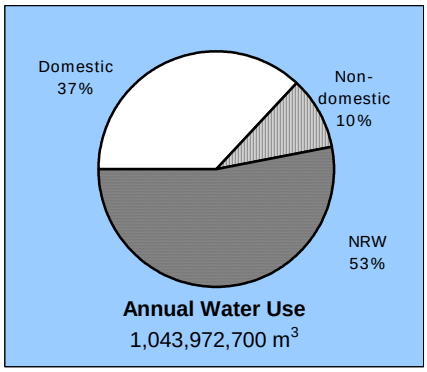
DJB estimates that around 60% of the city population have access to sewerage facilities. Residents of areas not served by sewers use septic tanks. Slums are primarily served by mobile trailer-mounted latrines that are maintained by the Slum Wing of the municipal corporation. The capacity of the wastewater treatment plant was increased from 284 million gallons per day (mgd) in 1995 to 482 mgd in 2001. This is expected to increase to 512 mgd when construction of the 16 sewage treatment plants is completed. Investment in sewerage during 1997–2001 was Rs6.56 billion (US$136 million).

DELHI WATER SUPPLY

Production & Distribution

Population: 13,783,000 (2001)

Annual Production	1,043,972,700 m^3
Groundwater	17%
Surface Water	83%
Annual Consumption	
Domestic	381,554,249 m^3
Nondomestic	108,177,508 m^3
Total	489,731,757 m^3



Annual Water Use
1,043,972,700 m^3

Service Connections

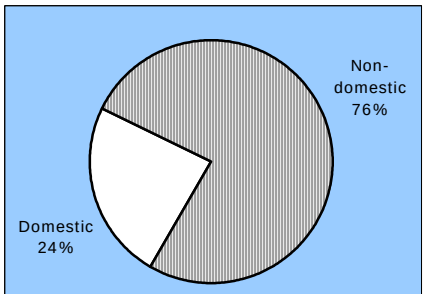
Domestic[1]	1,266,303
Nondomestic	108,319
Total	1,374,622

Service Indicators

Service Coverage	69%
24-hour Water Availability	1%
Per Capita Consumption	110 l/c/d
Average Tariff	US$0.074/$m^3$

Efficiency Indicators

Nonrevenue Water	53%
Unit Production Cost	US$0.085/$m^3$
Working Ratio	2.45
Staff/1,000 Connections	19.9
Revenue Collection Efficiency	70%



Annual Tariff Revenues
US$36,042,240

Small-scale Water Providers

Most small-scale water providers operate in areas of acute shortages, where the water utility is not operating, and during summer. Some operate side by side with the water utility, the only difference being that the water utility is providing water free. Water carriers, who fetch water in 10–20 liter plastic canisters from public hydrants and deliver it to houses, are paid on a monthly basis. Some operators deliver water in tankers at the cost of about Rs500–600 (US$10.38–12.45) for 8,000–10,000 liters of water in highly deficient areas. Other private operators in slums pump groundwater and supply residents on a regular basis. Bottled water costs about Rs30 (US$0.62) per 20–liter container.

Private Sector Participation

PSP has been limited to the operation of a few newly built sewage treatment plants, one small water treatment facility (6–mgd capacity), and tubewells. Efforts to place large existing treatment facilities under PSP have not been fruitful. The initial introduction of PSP took some effort, but PSP is now an integral part of new capital works, especially treatment facilities and bulk metering. The main obstacles to PSP are the absence of independent regulation, poor economic viability, lack of long-term policy support, and inertia and apprehension by DJB employees about PSP initiatives.

Flood Management

The Yamuna River bisects Delhi, with 65% of the population living in the elevated area west of the river. Most of the eastern part was built recently on land reclaimed from the floodplain of the river and protected by elaborate embankments. The city has a Flood Control Department responsible for maintaining the embankments, dredging the river, and coordinating with the river and storage authorities upstream of Delhi, especially during the monsoons. Expenditure for flood control during 1997–2002 totaled Rs811.8 million (US$16.8 million).

Notes

[1] The average number of persons per connection in 2001 was 5.1. The increase in total connections in 2001 was 46,899.

Data as of 2001.

Water Utility

DHAKA WATER SUPPLY AND SEWERAGE AUTHORITY

Address : 98 Kazi Nazrul Islam Avenue, Kawran Bazar, Dhaka-1215, Bangladesh
Telephone : (880-2) 811 6792
Fax : (880-2) 811 2109
E-mail : mddwasa@bangla.net
Head : A. N. H. Akhtar Hussain, Managing Director

The Dhaka Water Supply and Sewerage Authority (DWASA) is a government corporation established in 1963 to take over the responsibility for water supply and sewerage services in Dhaka and the nearby city of Narayanganj from the Department of Public Health Engineering. It was reconstituted in 1996 to run on a commercial basis and was made the sole authority to plan, develop, and maintain the water supply and sewerage and drainage facilities in the city.

General Data About Water Utility

Connections	: 185,866
Staff	: 2,151
Annual O&M Costs	: US$13,000,000
Annual Revenue	: US$14,660,000
Annual Capital Expenditure	: US$26,005,790
Source of Investment Funds	: 46% government grant; 22% foreign loan; 31% foreign grant; 1% tariff

Water Resources Management

DWASA supplies 1,300 million liters per day (mld) of the estimated water demand of 1,600 mld; most of the supply is from deep tubewells. This huge abstraction of groundwater has resulted in lowering of the groundwater table at an alarming rate. The Government recently harnessed surface water with the commissioning of a 225 mld capacity water treatment plant. Rainwater harvesting is also being promoted to meet a part of the water demand. Steps are being taken to protect the raw water quality of the nearest surface water sources, the Buriganga and Shitalakhya rivers. The Department of Environment has established 6 monitoring stations on the rivers around Dhaka to monitor surface water quality and at a number of points to monitor wastewater.

Tariff Structure

Category	Rate	
Metered	**Tk/m³**	**US$/m³**
Domestic	4.50	0.079
Commercial and industrial	15.00	0.263
Unmetered		
Domestic and community	29.0% of valuation of holding per annum	
Commercial and industrial	29.5% of valuation of holding per annum	

Notes:
1. About 51% of connections have meters that are working.
2. Billing is done monthly and consumers pay through banks.
3. Connection fees are Tk1,650 (US$28.95) for 18 mm and Tk3,442 (US$60.39) for 25 mm pipes, respectively.
4. Sewerage charge is 100% of the water bill for connected users.

Policy and Regulation

The Government framed a National Policy for Safe Water Supply and Sanitation in 1998 to improve the standard of public health and the environment. The policy made water supply and sewerage authorities responsible for providing safe drinking water in urban areas including slums and squatter settlements, setting tariffs, reducing nonrevenue water, and promoting PSP and NGO participation in water supply activities. Tariffs can be reviewed yearly but adjustments can only be made every 5 years, subject to government approval. At a workshop in 2001, there was consensus for the establishment of a national regulatory body that would comprise representatives from government, local bodies, national professional agency, water providers, consumers' association, engineering university, and lawyers' council. However, no appreciable progress has been made toward forming this regulatory body.

Wastewater and Sanitation

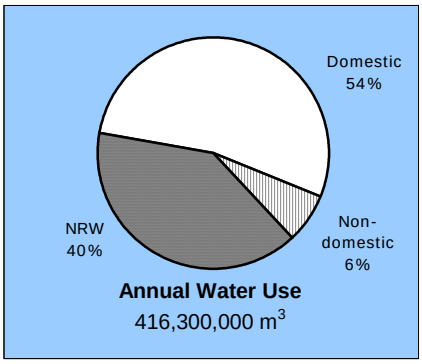
The existing sanitation facilities of Dhaka are insufficient. Only about 30% of the city's population are connected to the sewerage system. Some households not connected to the system use septic tanks that are desludged manually. Others dispose of wastewater through surface drains, or in low-lying areas, natural drains, or water bodies that find their way to storm sewers. Indiscriminate disposal of untreated industrial effluent to rivers is common. Laws to prevent environmental pollution are not enforced. Investment in this sector during 1997–2001 was Tk456 million (US$8 million).

DHAKA WATER SUPPLY

Production & Distribution

Population[1]: 10,358,000 (2001)

Annual Production	416,300,000 m^3
Groundwater	98%
Surface Water	2%
Annual Consumption	
Domestic	223,400,000 m^3
Nondomestic	27,600,000 m^3
Total	251,000,000 m^3



Annual Water Use
416,300,000 m^3

Service Connections

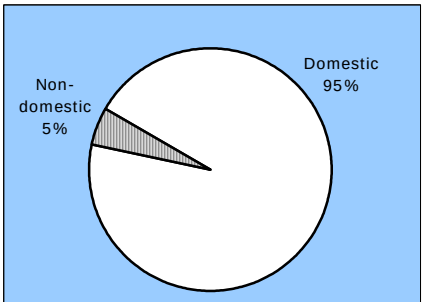
Domestic[2]	176,823
Nondomestic	9,043
Total	185,866

Service Indicators

Service Coverage [3]	72%
24-hour Water Availability	nil
Per Capita Consumption	115 l/c/d
Average Tariff	US$0.058/$m^3$

Efficiency Indicators

Nonrevenue Water	40%
Unit Production Cost	US$0.031/$m^3$
Working Ratio	0.89
Staff/1,000 Connections	11.6
Revenue Collection Efficiency	82%



Annual Tariff Revenues
US$14,660,000

Small-scale Water Providers

DWASA is the only organization designated to supply water to Dhaka residents; there are no small-scale water providers on a commercial basis in the city. NGOs have established 126 locations at which they buy water from DWASA and sell it to slum dwellers on cash basis at Tk15 (US$0.26)/$m^3$. Other residents jointly undertake the sinking of tubewells for their water supply. There are a few water vendors selling water from tubewells or water from the utility at Tk1.00 (US$0.02)/20 liters. Also, there are about 60 bottled water companies producing a total of 80,000–100,000 liters of bottled water daily in the city. Bottled water is sold at Tk10 (US$0.18)/liter.

Private Sector Participation

There are no plans for private sector participation in the water sector in Dhaka. One stumbling block is the lack of a regulatory body to oversee private sector involvement in the sector.

Flood Management

Bangladesh is flat and flood prone. Strong floods, caused by intense rainfall during the monsoon season, occur every 8–9 years on average, causing immense damage to properties, crops, and infrastructure. After the worst flood in 1988, a flood protection program started including the construction of an embankment around the city, improvement of internal drainage systems, and pumping out of floodwaters. The Bangladesh Water Development Board is responsible for the construction and maintenance of flood protection works around the city and DWASA is responsible for internal flood management including pumping out of floodwaters. Average annual operation and maintenance cost of flood management is Tk12 million (US$210,000).

Notes

[1] The population served by DWASA was about 7.4 million people at the end of 2001.
[2] The average number of persons per connection in 2001 was 30. The increase in total connections in 2001 was 6,025.
[3] Coverage is the proportion of the total population served by the utility. Persons not connected to DWASA obtain water from public taps, NGO-established water points, private wells, or rivers and ponds.

Data as of 2001.

Water Utility

HO CHI MINH CITY WATER SUPPLY COMPANY

Address : 1 Cong Truong Quoc Te, District 3, Ho Chi Minh City, Vietnam
Telephone : (84-8) 829 1777, 829 1974
Fax : (84-8) 824 1644
E-mail : hcmcwater@hcm.vnn.vn
Head : Vo Dung, Director

The Ho Chi Minh City (HCMC) Water Supply Company (WSC) is a government enterprise formed in 1966. It is under the city's Department of Transportation and Public Works. WSC manages the water supply system of HCMC's 17 urban and 5 rural districts, which have a population of about 5.3 million.

General Data About Water Utility

Connections	: 332,336
Staff	: 1,147
Annual O&M Costs	: US$39,622,500
Annual Revenue	: US$35,683,770
Annual Capital Expenditure	: US$23,876,360
Source of Investment Funds	: no data

Water Resources Management

HCMC is in the northeastern part of the Mekong Delta in the downstream regions of the Sai Gon and the Dong Nai river basins. The Dong Nai River is the main water supply source for HCMC. This supply is augmented by the Sai Gon River, especially for the old urban districts. Groundwater is the primary source for drinking water outside the old districts, particularly in the northern half of the city and new development areas. There are plans to double the amount of water to be drawn from the two rivers by 2010 and up to three times the present amount by 2020.

Tariff Structure

Category	Rate	
	D / m^3	US$ / m^3
Domestic		
0–4 m^3/capita/month	1,700	0.113
4–6 m^3/capita/month	2,500	0.166
6–10 m^3/capita/month	3,200	0.212
Above 10 m^3/capita/month	4,000	0.265
Administration and Public Organization		
0–1 m^3/capita/month	2,200	0.146
Above 1 m^3/capita/month	3,000	0.199
Industries	4,000	0.265
Business and Service	6,500	0.431
Water Supply by Water Truck	10,000	0.663

Notes: 1. All consumers pay on metered use. They are billed monthly and pay at designated banks, at utility offices, or to bill collectors.
2. Tariff setting aims at full cost recovery with profit including sufficient counterpart funds for project loans and contingencies for cost escalation and reserves for long-term development.
3. The connection fee is D800,000 (US$53.00)–1,200,000 (US$80.00) payable in advance.

Policy and Regulation

The Ministry of Construction's national water supply strategy study, begun in December 1994, recommended service level targets based on a national water supply policy that conformed to the general policy guidelines on economic development set by the Government. Ministerial decisions in late 1998 and early 1999 set out general planning parameters for HCMC in terms of total and per capita water demands for 2010 and 2020. The decisions gave guidelines on urban water supply management and development including water loss targets and human resources development. Surface water allocation is administered by the Ministry of Irrigation. Groundwater regulation is the responsibility of the Ministry of Heavy Industry. The Ministry of Health is responsible for regulating drinking water quality, and wastewater quality and pollution control are enforced by the Ministry of Science, Technology, and Environment.

Wastewater and Sanitation

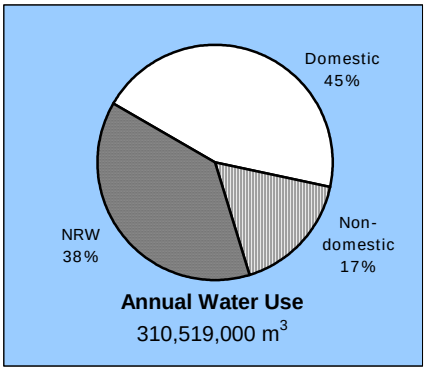
The sewerage system in HCMC is combined with the storm drainage system and covers about 12% of the city. Coverage is particularly low in the new urban (1.0%) and rural districts (0.3%), which comprise about 73% of the city's total area. The old urban districts have coverage of 42%. About 79% of households in HCMC discharge their waste in septic tanks.

HO CHI MINH CITY WATER SUPPLY

Production & Distribution

Population[1]: 5,285,454 (2001)

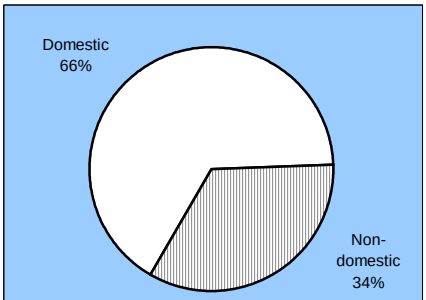
Annual Production	310,519,000 m^3
Groundwater	42%
Surface Water	58%
Annual Consumption	
Domestic	140,459,674 m^3
Nondomestic	51,461,182 m^3
Total	191,920,856 m^3



Annual Water Use
310,519,000 m^3

Service Connections

Domestic[2]	321,485
Nondomestic	10,851
Total	332,336



Annual Tariff Revenues
US$35,683,770

Service Indicators

Service Coverage [3]	84%
24-hour Water Availability	75%
Per Capita Consumption	167 l/c/d
Average Tariff	US$0.183/$m^3$

Efficiency Indicators

Nonrevenue Water	38%
Unit Production Cost	US$0.128/$m^3$
Working Ratio	1.13
Staff/1,000 Connections	3.5
Revenue Collection Efficiency	99%

Small-scale Water Providers

HCMC has small-scale private water providers in areas not served by WSC, such as the new urban areas and rural areas. Some of these providers resell water from WSC. Several drill their own wells and distribute groundwater that requires no treatment. The Phuc Doan Co. Ltd. pumps groundwater directly to 400 households in District 12 for D3,300 (US$0.22)/$m^3$, and has the capacity to distribute 720 m^3/day. Hiep An Co. Ltd., an investment company in District 8, has about 100 households connected to its water system, which has a capacity of 1,000 m^3/day—enough for 1,000 households. Water delivered in tankers costs about D10,000 (US$0.66)/$m^3$. Bottled water costs about D3,200 (US$0.21)/liter.

Private Sector Participation

The Binh Anh water treatment plant is supplying water to WSC at the rate of 100,000 m^3/day under an agreement with a Malaysian firm that constructed the facility through a BOT agreement with the HCMC Government. Another BOT project is the construction of the Thu Duc No. 2 water treatment plant with a capacity of 300,000 m^3/day to be undertaken by Ondeo Services (formerly Lyonnaise Des Eaux). To augment the supply in water-deficient areas, WSC is exploring the possibility of buying water from small companies that are developing groundwater sources in these areas.

Flood Management

Parts of Ho Chi Minh City experience floods several times each year during the rainy season (June-November) and the high tide season (October–January). The Ho Chi Minh City Drainage Company is responsible for the city's drainage system and the Department of Agriculture and Rural Development is responsible for the canal systems. Annual expenditure by HCMC is more than D50 billion (US$3.3 million) for the upkeep of the drainage system and D20–30 billion (US$1.3–2.0 million) for dredging the canals.

Notes

[1] The population in the WSC service area was about 2,750,000 people at the end of 2001.
[2] The average number of persons per connection in 2001 was 9. The increase in total connections in 2001 was 26,787.
[3] Coverage means the proportion of the total population in the service area served by the utility.

Data as of 2001.

Water Utility

WATER SUPPLIES DEPARTMENT

Address : 48/F Immigration Tower, 7 Gloucester Road, Wanchai, Hong Kong, China
Telephone : (85-2) 2829 4500
Fax : (85-2) 2824 0578
E-mail : wsdinfo@wsd.gov.hk
Head : William G. C. Ko, Director

The Water Supplies Department (WSD) of the Government of Hong Kong Special Administrative Region of the People's Republic of China (Government of the HKSAR) is tasked with developing and managing water services for the city. The utility, which dates back to 1863, buys about 78% of its water supply from mainland People's Republic of China, treats the water, and distributes it to the urban population of 6,865,600 people. It also distributes seawater for flushing purposes.

General Data About Water Utility

Connections	: 2,430,000
Staff	: 5,673
Annual O&M Costs	: US$794,151,600
Annual Revenue	: US$329,870,460
Annual Capital Expenditure	: US$279,466,460
Source of Investment Funds	: 100% government grant

Water Resources Management

Since 1960, the Government of the HKSAR has made agreements with Guangdong authorities for the supply of raw water from the East River. In 2001, this river contributed about 78% of the water supply; rainwater, impounded in 120 km of channels and 17 reservoirs, supplied the remaining 22%. The freshwater supply is supplemented by a unique seawater supply system, which saves about 20% of freshwater needs.

Tariff Structure

Category	Rate (4-month period)	
	HK$ / m^3	US$ / m^3
Domestic		
First 12 m^3	Free	Free
Next 31 m^3	4.16	0.534
Next 19 m^3	6.45	0.827
Remainder	9.05	1.161
Nondomestic		
Trade	4.58	0.587
Construction	7.11	0.912
Shipping		
Ocean going	10.93	1.402
Nonocean going	4.58	0.587
Flushing Water		
First 30 m^3	Free	Free
Remainder	4.58	0.587

Notes:

1. This tariff structure has been in effect since 16 February 1995.
2. Charges are for 4-month periods. Flushing water is billed separately to registered customers.
3. All consumers pay on metered use and most are billed every 4 months; large consumers are billed monthly.
4. Consumers pay at banks, post offices, automated teller machines, the utility office or at government collection offices.
5. The connection fee for pipes up to 20 mm in diameter and for any length up to 100 meters is HK$1,140 (US$146.21).
6. There is a sewerage surcharge of approximately 20% in the water bill.

Policy and Regulation

The water policy objective of the Government of the HKSAR is to ensure the provision of reliable, adequate, and quality water and an efficient water supply service, as stated in the vision, mission, and values statements of WSD. In setting water charges, the major factors considered are the financial impact on customers, cost recovery and return on assets, prevention of waste, and avoidance of cross subsidy. WSD is a government utility and is self-regulated, but is accountable to the Waterworks Account Committee. Other government departments monitor health (Health Department), radiological (Hong Kong Observatory), and environmental (Environmental Protection Department) aspects of the water supply.

Wastewater and Sanitation

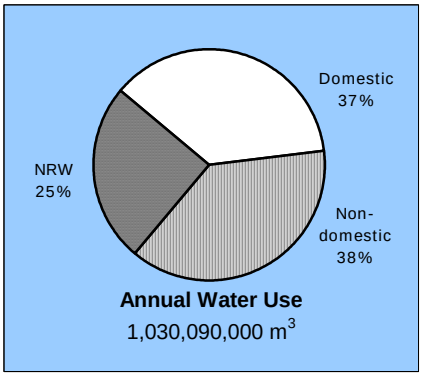
The entire city population of Hong Kong has access to sewerage. Septic tanks are used only in remote villages where desludging is done by tankers. The Environmental Protection Department regulates industrial effluent disposal and water pollution control including issuance of standards for effluents discharged into the drainage and sewerage systems and coastal waters. The Drainage Services Department invested about US$1,140 million in sanitation during 1997–2002.

HONG KONG WATER SUPPLY

Production & Distribution

Population: 6,865,600 (2001)

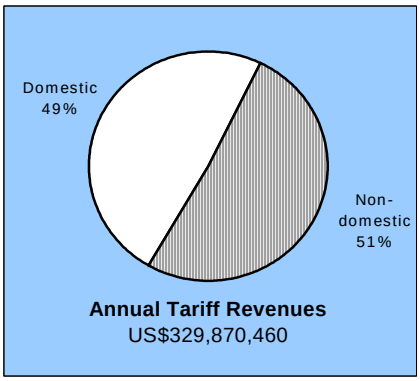
Annual Production[1]	1,030,090,000 m^3
Groundwater	nil
Surface Water	100%
Annual Consumption[2]	
Domestic	468,000,000 m^3
Nondomestic	472,000,000 m^3
Total	940,000,000 m^3



Annual Water Use
1,030,090,000 m^3

Service Connections

Domestic[3]	2,170,000
Nondomestic	260,000
Total	2,430,000



Annual Tariff Revenues
US$329,870,460

Service Indicators

Service Coverage	100%
24-hour Water Availability	100%
Per Capita Consumption	187 l/c/d
Average Tariff	US$0.351/$m^3$

Efficiency Indicators

Nonrevenue Water[4]	25%
Unit Production Cost	US$0.845/$m^3$
Working Ratio	2.41
Staff/1,000 Connections	2.3
Revenue Collection Efficiency	99.8%

Small-scale Water Providers

There is no market for small-scale water providers in the city. Out of the total population, only about 8,000 people living in 50 remote villages are not yet served by WSD. These people depend on local supply systems constructed and operated by the Home Affairs Department and the water is derived from local wells or streams. WSD will have covered most of this group by 2010, when it will practically serve the entire population. The price of bottled water in Hong Kong is about HK$4.00 (US$0.51)/liter.

Private Sector Participation

WSD has contracted out a number of civil works—on maintenance, transport, and waste detection works—but there is no plan for PSP. Management is keeping an open mind on the matter although among the staff, there are those who view PSP as an opportunity for career development while others think it may bring forced redundancies. A review of institutional arrangements for WSD will be carried out by the Government of the HKSAR in 2004.

Flood Management

Despite being in the main path of tropical cyclones in the region, the city does not suffer from serious flooding except in the natural floodplains, the low-lying areas of the northern part of the New Territories, and in the old urban areas like West Kowloon. The Drainage Services Department is implementing a US$897 million flood prevention program in the New Territories and a US$513 million urban drainage improvement program in West Kowloon. During 1997–2001, the department spent about US$493 million on flood management.

Notes

[1] Combined freshwater supply from Guangdong Province and local impounding reservoirs.
[2] All consumption figures include unaccounted-for water.
[3] The average number of persons per connection in 2001 was 3. There were 91,000 new connections in 2001.
[4] Data given by WSD.

Data as of 2001.

Water Utility

JAKARTA WATER SUPPLY ENTERPRISE (PAM JAYA)

Address : Jalan Penjernihan II, Pejompongan, Jakarta 10210, Indonesia
Telephone : (62-21) 570 4250
Fax : (62-21) 571 1796
E-mail : rose@stfahli.pamjaya.co.id
Head : H. M. Haryadi Priyohutomo, President Director

The Jakarta Water Supply Enterprise (Pam Jaya), a government corporation established in 1977, was responsible for water supply and sewerage services in Jakarta until early 1998, when two private companies started operating Jakarta's water supply systems under separate 25-year concession contracts with Pam Jaya. PT Pam Lyonnaise Jaya (Palyja) serves West Jakarta and PT Thames Pam Jaya (TPJ) serves East Jakarta.

General Data About Water Utility

Connections	: 610,806
Staff	: 3,256
Annual O&M Costs	: US$54,135,750
Annual Revenue	: US$67,498,460
Annual Capital Expenditure	: US$28,633,330
Source of Investment Funds	: 70% loan; 30% equity

Water Resources Management

Jakarta's water supply comes from surface water sources, drawing water from the Jatiluhur Water Reservoir, which is operated by Perum Jasa Tirta II (PJTII), a state-owned company. Palyja and TPJ buy raw water from PJII to be treated in their respective treatment plants. Palyja also purchases treated water from Perusahaan Daerah Air Minum (PDAM) Tangerang. The Jakarta local government, through the imposition of groundwater tax, regulates abstraction of groundwater, especially in areas where the two operators have distribution systems. Uncontrolled exploitation of groundwater in the past resulted in lowering of groundwater tables, land subsidence in central Jakarta and in the south, and saltwater intrusion in aquifers.

Tariff Structure

Category	Rate (per Month)					
	0–10 m^3		11–20 m^3		Over 20 m^3	
	Rp/m^3	US$/$m^3$	Rp/m^3	US$/$m^3$	Rp/m^3	US$/$m^3$
Group I: Orphanages, dormitories, public taps	375	0.036	375	0.036	375	0.036
Group II: Very modest houses and apartments	375	0.036	375	0.036	850	0.082
Group III A: Modest houses and apartments	1,035	0.100	1,330	0.128	1,560	0.150
Group III B: Moderate houses and apartments	1,335	0.128	1,520	0.146	2,100	0.202
Group IV A: Luxurious houses, government offices, small commercial buildings	2,500	0.240	2,500	0.240	3,500	0.337
Group IV B: Hotels, industries, luxurious apartments	5,200	0.500	5,200	0.500	5,200	0.500
Group V: Harbor	7,000	0.673	7,000	0.673	7,000	0.673

Notes:
1. This tariff structure has been in effect since 29 March 2001.
2. All connections are metered and 98.8% are working. Customers pay on metered use and are billed monthly.
3. The fee for a 20 mm connection is Rp80,000 (US$7.69)–130,000 (US$12.50) for Group I to Group III customers.

Policy and Regulation

The provision of water supply in Jakarta is governed by the concession agreements between Pam Jaya and Palyja and TPJ. Economic regulation of the water industry in the city is under the Jakarta Water Supply Regulatory Body, which was established by the Jakarta government in September 2001. Its functions include reviews of tariff proposals and recommendations to the local government for approval. Environmental regulations—covering industrial waste pollution, groundwater abstraction, and domestic waste disposal—are under the Jakarta Environmental Protection Agency. Health regulations on the quality of raw and drinking water are under the Ministry of Health.

Wastewater and Sanitation

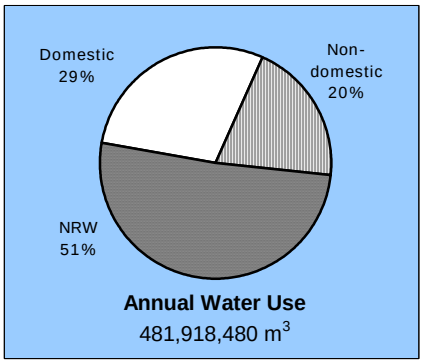
The sewerage service in Jakarta covers only 1.9% of the population, mainly serving high-rise buildings and a small number of households. This sewage is treated in an aerated lagoon. The system is operated by the Jakarta Sewerage Enterprise (PD PAL). About 39% of the population use septic tanks and 20% use pit latrines. Investment in the sector during 1991–2002 was Rp36 billion (US$3.46 million), financed by grants from donor countries, the Jakarta government budget, and PD PAL revenue. The sewerage charge to domestic customers is about 81% of the water charge, based on the floor area of buildings connected to the system.

JAKARTA WATER SUPPLY

Production & Distribution

Population: 9,695,600 (2001)

Annual Production	481,918,480 m^3
Groundwater	Nil
Surface Water	100%
Annual Consumption	
Domestic	138,695,645 m^3
Nondomestic	98,496,574 m^3
Total	237,192,219 m^3



Annual Water Use
481,918,480 m^3

Service Connections

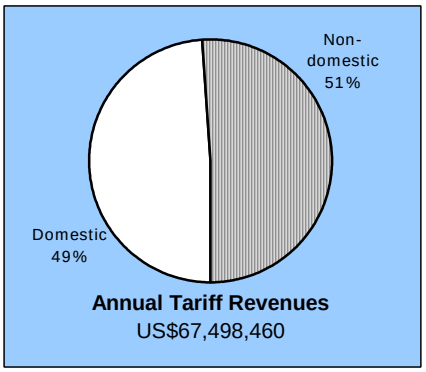
Domestic[1]	567,718
Nondomestic	43,088
Total	610,806

Service Indicators

Service Coverage	51%
24-hour Water Availability	92%
Per Capita Consumption	77 l/c/d
Average Tariff	US$0.285/$m^3$

Efficiency Indicators

Nonrevenue Water	51%
Unit Production Cost	US$0.112/$m^3$
Working Ratio	0.80
Staff/1,000 Connections	5.3
Revenue Collection Efficiency	98%



Annual Tariff Revenues
US$67,498,460

Small-scale Water Providers

Small-scale water service providers abound both within and outside the service areas of the two concessionaires. In areas near public taps, water vendors buy water at Rp100 (US$0.01)/5-gallon container, which they sell at Rp750 (US$0.07). There are about 5–6 vendors per public tap, each selling an average of 322 m^3/month. Private tankers deliver water at Rp10,000 (US$0.96)/$m^3$. Bottled water from water refilling stations is sold at Rp2,500 (US$0.24)/5-gallon bottle.

Private Sector Participation

Since February 1998, two private operators have been responsible for the management, operation, and maintenance of the city's water supply system including the provision of capital investment, billing, and collection. Palyja's foreign partner is Ondeo Services and that of TPJ is Thames Water International. The Jakarta Water Supply Regulatory Body monitors and regulates compliance with the terms of the agreements by the involved parties.

Flood Management

With 13 rivers flowing through the city, half of Jakarta's land area is prone to flooding. The situation is worst north of Jakarta when high river flows coincide with high tide from the Java Sea. About 40% of the city (24,000 hectares) are below sea level during high tide and only a quarter of this area is protected by dikes (in polder systems), leaving the remaining areas subject to yearly flooding. Expenditure in flood control in 1997–2001 amounted to Rp239 billion (US$23 million).

Notes

[1] The average number of persons per connection in 2001 was 7.6. The increase in total connections in 2001 was 48,551.

Data as of 2001.

Water Utility

KARACHI WATER AND SEWERAGE BOARD

Address : Block-D 9th Mile Karsaz, Karachi, Pakistan
Telephone : (92-21) 923 1882, 923 1883
Fax : (92-21) 923 1814, 923 1815
E-mail : water@cyber.net.pk
Head : Brig. Muhammad Bahram Khan, Managing Director

The Karachi Water and Sewerage Board (KWSB) is a semi-autonomous body formed in 1983. It manages the water supply and sewerage of Karachi, a city with a population of 10,947,000 people.

General Data About Water Utility

Connections	: 1,283,200
Staff	: 8,162
Annual O&M Costs	: US$38,840,820
Annual Revenue	: US$38,840,820
Annual Capital Expenditure	: US$ 8,389,220
Source of Investment Funds	: 100% government grant

Water Resources Management

The Indus River provides about 93% of the city's water supply and the Hub River provides nearly all the remainder, although the supply from this river varies greatly. Groundwater from shallow wells along the alluvial bed of the Malir River also provides a small quantity—less than 1% of the city's water supply. The quality of water from these sources is good and only filtration and chlorination are required before distribution. The National Authority on the Water Distribution of Indus River has been requested to increase the share of Karachi by another 2.5 million m^3/day.

Tariff Structure

Category	Tariff Rate
Residential	Monthly rate is PRs26 (US$0.43)–787 (US$12.93) for houses with a ground floor area of 60–2,500 square yards. Each additional floor is charged at 50% of the ground floor rates.
Flats/Apartments	Monthly rate is PRs34 (US$0.56)–1,141 (US$18.75) for flats with covered areas of 500 to more than 5,000 square feet.
Bulk Supply (Metered)	Domestic: PRs44/1,000 gallons (US$0.159/$m^3$) Industrial: PRs73/1,000 gallons (US$0.264/$m^3$) Commercial: PRs73/1,000 gallons (US$0.264/$m^3$)

Notes:

1. This tariff structure has been in effect since 1 July 2001.
2. Billing is biannual for unmetered consumers and monthly for metered consumers. Only about 0.3% of connections have working meters.
3. Connection fee is US$2.50 with 2 years advance charges and a security deposit.
4. Sewerage charges are 32.7–37.4% of the water tariff for residential houses, 25.0–37.8% for flats, and 25% for others.

Policy and Regulation

In September 2002, KWSB prepared a draft water policy that includes development of alternative sources, recycling of wastewater, reduction in water losses, asset renewal and expansion, improved services and revenue collection, and cost recovery. Elected bodies at the local and provincial levels work with the provincial government in deciding policy issues and tariff structures. Tariffs, which are regulated by the provincial government, are based on social and political factors rather than cost recovery.

Wastewater and Sanitation

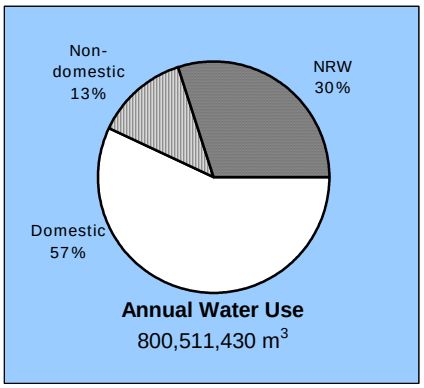
About 50% of the city population are connected to sewers. Some 5% still use septic tanks. Industries are required to treat their sewage to meet national environmental quality standards before discharging it into city sewers, but only the tanneries in Korangi have installed a treatment plant. About 315 million gallons of sewage is produced daily in the city, of which about 30% are treated by the KWSB sewage treatment plants. The balance is drained to the sea untreated. Investments in sanitation over the last 5 years have mainly been on rehabilitation and expansion of existing trunk and interceptor sewers; upgrading of two treatment plants and installation of a new treatment plant were completed in 1998. Total expenditure during 1997–2001 amounted to US$10.48 million.

KARACHI WATER SUPPLY

Production & Distribution

Population: 10,947,000 (2001)

Annual Production	800,511,430 m^3
Groundwater	0.3%
Surface Water	99.7%
Annual Consumption	
Domestic	459,493,390 m^3
Nondomestic	100,864,465 m^3
Total	560,357,855 m^3

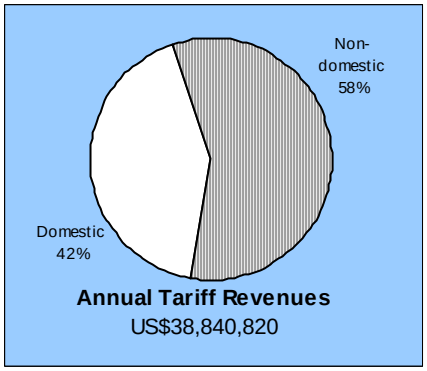


Service Connections

Domestic[1]	1,280,000
Nondomestic	3,200
Total	1,283,200

Service Indicators

Service Coverage	58%
24-hour Water Availability[2]	nil
Per Capita Consumption	197 l/c/d
Average Tariff	US$0.070/$m^3$



Efficiency Indicators

Nonrevenue Water	30%
Unit Production Cost	US$0.049/$m^3$
Working Ratio	1.0
Staff/1,000 Connections	6.4
Revenue Collection Efficiency	99.8%

Small-scale Water Providers

There are three types of small-scale water vendors, serving about 20% of the city's population: operators of tanker lorries (5,450 liters), operators of donkey carts (500–1,000 liters), and persons who manually transport leather bags (30 liters). In low-income areas and the central business district, drinking water is purchased and groundwater is used for washing and cleaning. The main water outlets are KWSB hydrants around the city. This water, which generally needs to be boiled for drinking, costs US$0.27/$m^3$. However, private vendors obtain water from these hydrants at much lower, illegal, rates. Their profitability is, therefore, very high. KWSB receives very little revenue from the hydrants. About 30% of squatter settlements (*kachi abadis*) are supplied water by KWSB through tankers without charge. Bottled water costs about US$0.50/20 liters.

Private Sector Participation

There has been no PSP in the water sector. However, PSP has been obtained for the operation and maintenance of the Mauripur Sewage Treatment Plant. A build-operate-own-transfer contract, which was supported enthusiastically by the city government and the association of industries, has been signed by KWSB for treating effluent from the SITE Treatment Plant (TP-1) for industrial use.

Flood Management

KWSB is not responsible for storm water drainage, which is the responsibility of the city government (formerly the Karachi Municipal Corporation). Rainfall is low and occurs only once in 4–5 years; thus, flooding from this source is not a problem. Flooding of the Malir River inundated areas in the past, until the Government built flood protection dikes along its banks.

Notes

[1] The average number of persons per connection in 2001 was 5. The increase in total connections in 2001 was about 3,600.
[2] Except for bulk consumers, water supply is on alternate days for 2-4 hours only.

Data as of 2001.

Water Utility

NEPAL WATER SUPPLY CORPORATION

Address : Tripureswor Marg, Kathmandu, Nepal
Telephone : (977-1) 262 202, 259 845
Fax : (977-1) 262 229, 259 824
E-mail : nwsc@mos.com.np
Head : Kaushal Nath Bhattarai, General Manager

The Nepal Water Supply Corporation (NWSC) is a government corporation set up in 1990 from the former Water Supply and Sewerage Board. It is responsible for water supply and sewerage for Greater Kathmandu and 11 other towns.

General Data About Water Utility

Connections	: 123,062
Staff	: 1,865
Annual O&M Costs	: US$2,938,200
Annual Revenue	: US$2,821,850
Annual Capital Expenditure	: US$2,108,470
Source of Investment Funds	: 17% grant; 57% loan; 26% tariff

Water Resources Management

The main water supply for the urban areas in Kathmandu consists of several subsystems fed by surface water sources and 37 deep wells. About two thirds of the total supply are from surface water. The quality of the surface sources is satisfactory except during the rainy season when turbidity increases. However, the groundwater has high levels of iron and ammonia. The government has embarked on a long-term program for augmenting the water supply in Kathmandu Valley towns through inter-basin transfer from the Melamchi River, new water treatment plants, extension of the bulk distribution network, and additional storage capacity.

Tariff Structure

Metered		Domestic				Government				Industrial and Commercial			
Tap (")	Min. Allow (m^3)	Minimum Charge NRs	Minimum Charge US$	Rate Above Minimum ($/m^3$) NRs	Rate Above Minimum ($/m^3$) US$	Minimum Charge NRs	Minimum Charge US$	Rate Above Minimum ($/m^3$) NRs	Rate Above Minimum ($/m^3$) US$	Minimum Charge NRs	Minimum Charge US$	Rate Above Minimum ($/m^3$) NRs	Rate Above Minimum ($/m^3$) US$
0.5	10	50	0.65	11.90	0.156	75	0.98	0.5	10	50	0.65	11.90	0.156
						11 – 100 m^3		16.00					
						Over 100 m^3		22.00					
0.75	27	720	9.41	26.00	0.340	790	10.33	0.75	27	720	9.41	26.00	0.340
1	50	1260	16.48	26.50	0.347	1385	18.11	1	50	1260	16.48	26.50	0.347
1.5	140	3520	46.03	27.00	0.353	3870	50.60	1.5	140	3520	46.03	27.00	0.353
2	235	5905	77.21	28.00	0.366	6495	84.93	2	235	5905	77.21	28.00	0.366
3	700	17590	230.01	28.50	0.373	19345	252.96	3	700	17590	230.01	28.50	0.373
4	1400	35175	459.95	29.50	0.386	38690	505.92	4	1400	35175	459.95	29.50	0.386
Unmetered		Unmetered connections are assessed at monthly rates of NRs215 (US$2.81)–70,340 (US$919.78) for ½–4" main domestic connections; NRs240 (US$3.14)–77,375 (US$1,011.77) for main government connections, and NRs360 (US$4.71)–94,960 (US$1,241.71) for main industrial/commercial connections of the same size range. Monthly rates for additional branch taps are about one third of main connection rates.											

Notes:
1. This tariff structure has been in effect since February 2002.
2. Consumers pay on metered use or a flat rate; not all connections are metered. Only about 38% of connections have working meters.
3. The connection fee in 2001 was NRs1,600 (US$21).
4. The sewerage charge is 50% of the water bill.

Policy and Regulation

The Government's National Water Supply and Sanitation Sector Policy of 1998 supports the involvement of the private sector in the operation and management of water supply and sanitation services in Kathmandu Valley towns and the establishment of a regulatory agency for economic regulation of service providers. It provides for full cost recovery for urban areas and recovery of at least O&M costs for rural areas. Preparation of legislation for the creation of the regulatory agency is ongoing.

Wastewater and Sanitation

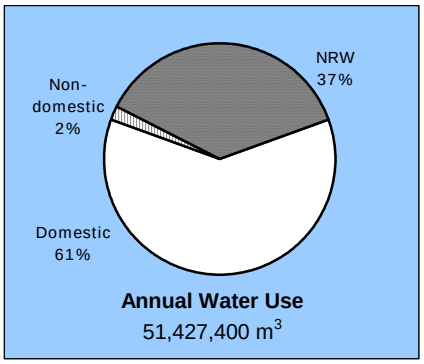
The sewerage system in Kathmandu is combined with storm drainage, with rivers acting as sinks for domestic sewage, street discharges, and industrial effluents. There are 4 major wastewater treatment plants managed by NWSC, with a total capacity of 19 million liters per day. About 22% of the valley population are connected to the sewerage system, comprising 48,000 households (10,000 of them illegally). Septic tanks are used by most of the remainder. Investment from the different agencies for sewerage and drainage during 1997–2001 amounted to NRs155,133,000 (US$1.98 million).

KATHMANDU WATER SUPPLY

Production & Distribution

Population: 1,519,410 (2001)

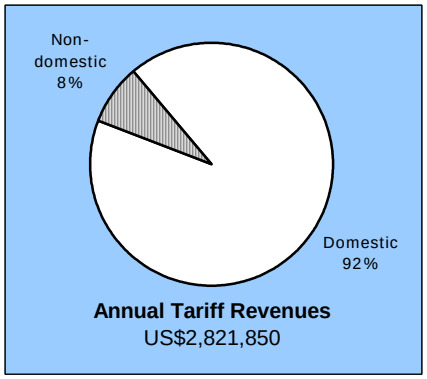
Annual Production	51,427,405 m^3
Groundwater	38%
Surface Water	62%
Annual Consumption	
Domestic	31,201,660 m^3
Nondomestic	1,198,295 m^3
Total	32,399,955 m^3



Annual Water Use
51,427,400 m^3

Service Connections

Domestic[1]	119,891
Nondomestic	3,171
Total	123,062



Annual Tariff Revenues
US$2,821,850

Service Indicators

Service Coverage	83%
24-hour Water Availability	nil
Per Capita Consumption	68 l/c/d
Average Tariff	US$0.087/$m^3$

Efficiency Indicators

Nonrevenue Water	37%
Unit Production Cost	US$0.057/$m^3$
Working Ratio	1.04
Staff/1,000 Connections	15.2
Revenue Collection Efficiency	70%

Small-scale Water Providers

A private water market has emerged to meet the gap in domestic water supply left by the municipal system. High-income households use water from tankers, especially during the dry season when there are shortages in the municipal water supply. Other households use cheaper water sources: traditional stone taps and NWSC stand posts. NWSC tankers provide treated water at a higher cost (US$2.05/$m^3$) than that from private tankers (US$1.28/$m^3$) whose sources are wells or springs. Small-scale water providers serve about 4.7% of the total households in Kathmandu Valley with an annual turnover of about NRs95 million (US$1.24 million).

Private Sector Participation

The Government is committed to reform the sector to strengthen the role of the public in policy and regulation and improve accountability by delegating service delivery to the private sector under a management lease contract. In 1997, the Government decided to privatize management of the water supply in the Kathmandu Valley and constituted a high-level private sector participation committee to facilitate the process. The necessary acts to support these moves are being passed through parliament. The pace is slow because residents are concerned that privatization might result in a big increase in water tariffs.

Flood Management

About 25% of Kathmandu households are affected by drainage problems. Low-lying areas along the banks of the Hanumante River are also vulnerable to floods. River and flood control works are now the responsibility of the Water Induced Disaster Control Department of the Ministry of Local Development. Government investment in flood control in Kathmandu during 1997–2002 through the Department of Irrigation amounted to NRs30,550,000 (US$399,480).

Notes

[1] The average number of persons per connection in 2001 was 10.5. The increase in total connections in 2001 was 5,100.

Data as of 2001.

Water Utility

SELANGOR WATER MANAGEMENT CORPORATION, LTD.

Address : P. O. Box 5001, Jalan Pantai Bahru, 59990 Kuala Lumpur, Malaysia
Telephone : (60-3) 2282 6244
Fax : (60-3) 2282 7535
E-mail : puasbhd@puas.com.my
Head : Dato' Mohd Sinon Mudzakir, Chief Executive Officer

The water utility operator for Kuala Lumpur is the Selangor Water Management Corporation Ltd. (SWMC), previously the Selangor Water Supply Department, which became a corporation in March 2002. SWMC is wholly owned by the State Government of Selangor and is responsible for the distribution of water, and development and maintenance of the distribution system including billing and collection in the State including Kuala Lumpur's population of 1.4 million people.

General Data About Water Utility

Connections	: 173,561
Staff	: 250
Annual O&M Costs	: US$52,359,550
Annual Revenue	: US$39,202,630
Annual Capital Expenditure	: US$30,000,000
Source of Investment Funds	: 100% tariff

Water Resources Management

The city relies mainly on surface water sources, drawing its supply from three reservoirs. Water is reserved mainly for public water supplies, with Kuala Lumpur having an allocation of 627,000 m^3/day out of a total capacity of 3,304,000 m^3/day. The Selangor Water Management Board, established in 1999, provides regulation and enforcement in matters relating to integrated and comprehensive water resources management within the State.

Tariff Structure

Category	Rate		Minimum Charge/Month	
	RM/m^3	US$/$m^3$	RM	US$
Domestic Supplies				
Residential homes/government quarters				
0–20 m^3	0.57	0.15	5.00	1.32
21–35 m^3	0.91	0.24		
Over 35 m^3	1.70	0.45		
Flats/apartments/condominiums without facilities	0.70	0.18	30.00	7.89
Condominiums with facilities	1.20	0.32	150.00	39.47
Industrial/Commercial Supplies 0–35 m^3	1.80	0.47	30.00	7.89
Over 35 m^3	1.92	0.51		
Bulk Supply				
Public higher learning institutes/army camps/police	1.40	0.37	15.00	3.95
Private higher learning institutes/industrial estates				
0–35 m^3	1.80	0.47	30.00	7.89
Over 35 m^3	1.92	0.51		
Government Offices	1.40	0.37	15.00	3.95
Religious Institutions	0.40	0.11	5.00	1.32
Charitable Institutions	0.50	0.13	5.00	1.32
Ships	3.68	0.97	--	--

Notes:
1. This tariff structure has been in effect since April 2001, 10 years after the last increase.
2. All consumers pay on metered use. Domestic consumers are billed every 2 months and pay at banks, utility payment centers, or automated teller machines.
3. Connection fees are priced between US$13 for domestic consumers and actual cost plus 25% for large consumers, with a minimum of US$53.

Policy and Regulation

With the formation of SWMC, an independent regulatory body was established with a senior government official as regulator. The regulator monitors all the activities of SWMC including setting the water tariffs and establishing service levels. The regulator also monitors all public complaints and acts on them. Major policies are generally announced through the media.

Wastewater and Sanitation

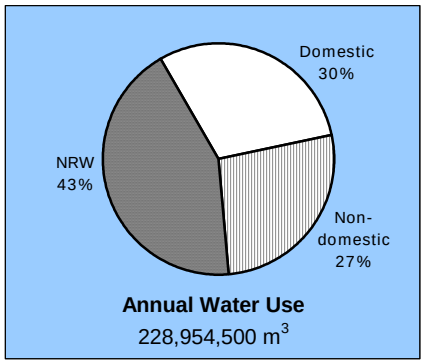
About 80% of the city population have access to a sewerage system that includes both regional and local treatment plants. Septic tanks are also used in Kuala Lumpur. Desludging services for septic tanks are provided by Indah Water Consortium, a private company appointed by the Federal Government to undertake sewerage services nationwide. All new housing subdivisions are required to provide adequate central sewerage systems as well as to make capital contributions for the development of regional plants.

KUALA LUMPUR WATER SUPPLY

Production & Distribution

Population: 1,420,000 (2001)

Annual Production	228,954,500 m^3
Groundwater	nil
Surface Water	100%
Annual Consumption	
Domestic	68,171,775 m^3
Nondomestic	61,493,266 m^3
Total	129,665,041 m^3



Annual Water Use
228,954,500 m^3

Service Connections

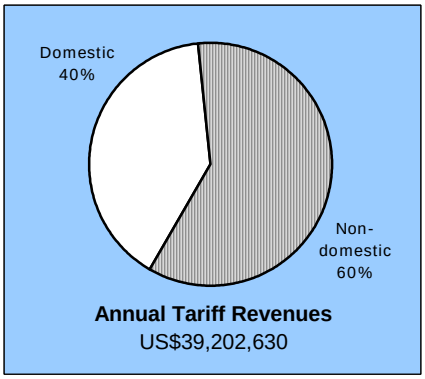
Domestic[1]	137,032
Nondomestic	36,529
Total	173,561

Service Indicators

Service Coverage	100%
24-hour Water Availability	100%
Per Capita Consumption	132 l/c/d
Average Tariff	US$0.302/$m^3$

Efficiency Indicators

Nonrevenue Water	43%
Unit Production Cost	US$0.229/$m^3$
Working Ratio	1.34
Staff/1,000 Connections	1.4
Revenue Collection Efficiency	95%



Annual Tariff Revenues
US$39,202,630

Small-scale Water Providers

There are no small-scale service providers in Kuala Lumpur because all consumers are connected to piped water supplied by SWMC. The cost of bottled water averages US$0.26/liter and consumption is increasing.

Private Sector Participation

The operation and maintenance/management of utility works including the water treatment plants have been privatized through long-term (25–30 year) concession agreements with several companies. Some of these agreements involve capital works based on BOT. There are three such companies selling treated water to SWMC, which distribute this water to consumers. These companies have invested US$1,183 million in capital works. SWMC is also responsible for planning and developing future water sources, and it is planning to merge with the private companies producing water in joint-venture operations that will produce and distribute water to consumers throughout Selangor.

Flood Management

Low-lying areas of the city are susceptible to flooding during heavy downpours. However, the floods generally subside within 5–6 hours. Flood management in the city is the responsibility of the city government assisted by the Federal Government through the Drainage and Irrigation Department for master planning and funding of major projects. The annual budget for flood management is about US$14–16 million.

Notes

[1] The average number of persons per connection in 2001 was 5. The increase in total connections in 2001 was 3,910.

Data as of 2001.

Water Utility

METROPOLITAN WATERWORKS AND SEWERAGE SYSTEM

Address : MWSS Building, Katipunan Road, Balara, Quezon City, Metro Manila, Philippines
Telephone : (63-2) 922 2969; 922 3757
Fax : (63-2) 921 2887
E-mail : mwssoch@itextron.com
Head : Orlando C. Hondrade, Administrator

The Metropolitan Waterworks and Sewerage System (MWSS) is a government corporation organized in 1971 from what used to be Manila's waterworks authority that dates back to 1878. In 1997, water distribution came under the control of two private corporations under separate 25-year concession agreements with MWSS. The MWSS service area covers 13 cities and 24 municipalities of Metro Manila and two adjoining provinces with a total population of 12.6 million.

General Data About Water Utility

Connections	: 955,500
Staff	: 4,177
Annual O&M Costs	: US$95,579,020
Annual Revenue	: US$78,522,080
Annual Capital Expenditure	: US$16,820,000
Source of Investment Funds	: 100% concessionaires

Water Resources Management

Almost all the water supply for Metro Manila comes from surface water, mainly from the Angat and Umiray rivers located in two provinces north and northeast of Metro Manila. The rest comes from deep wells serving the needs of the municipalities in the adjoining provinces within the MWSS service area. Future requirements can be met by water from the Kaliwa River, Kanan River and Laguna de Bay, a freshwater lake adjacent to Metro Manila. Additional water from groundwater sources is unlikely, because overpumping has resulted in saline intrusion and contamination of aquifers.

Tariff Structure

Category	Residential		Semi-Business	
	P / month	US$ / month	P / month	US$ / month
First 10 m^3	15.06	0.293	25.32	0.493
	P / m^3	US$ / m^3	P / m^3	US$ / m^3
Next 10 m^3	1.84	0.036	3.06	0.060
Next 20 m^3	3.49	0.068	3.80	0.074
Next 20 m^3	4.60	0.089	4.83	0.094
Next 20 m^3	5.37	0.104	5.62	0.109
Next 20 m^3	5.62	0.109	5.87	0.114
Next 50 m^3	5.87	0.114	6.13	0.119
Next 50 m^3	6.13	0.119	6.38	0.124
Over 200 m^3	6.38	0.124	8.65	0.168
Category	**Business Group I**		**Business Group II**	
	P / month	US$ / month	P / month	US$ / month
First 10 m^3	68.56	1.334	69.57	1.354
	P / m^3	US$ / m^3	P / m^3	US$ / m^3
Next 90 m^3	6.88	0.134	7.48	0.146
:	:	:	:	:
Next 500 m^3	7.64	0.148	9.00	0.175
Over 10,000 m^3	7.66	0.149	9.05	0.176

Notes:
1. This tariff structure has been in effect since 1 January 2002.
2. Semi-business refers to small enterprises; Business Group I is mostly commercial; and Business Group II is mostly industrial.
3. The above tariff structure is for Manila Water Company, Inc. for the east zone. The west zone has a similar tariff structure and consumption blocks with tariffs of about 2.55 times the above values.

Policy and Regulation

Economic regulation of Metro Manila's water supply is based on the concession agreement between MWSS and the two concessionaires and is lodged with the MWSS Regulatory Office. It allows standard tariff rates to be adjusted for inflation (annually), for extraordinary price adjustment (due to financial consequences of unforeseen events beyond the control of concessionaires), and for rate negotiation (every 5 years). The regulatory office also monitors the operations and customer service performance of the concessionaires for conformance with the terms of the concession agreements.

Wastewater and Sanitation

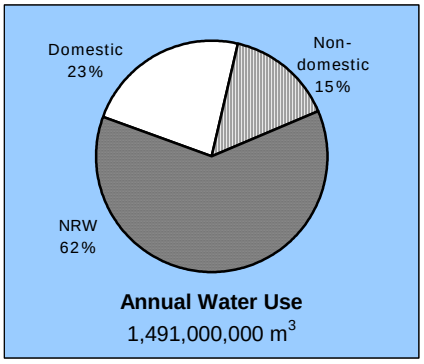
Only about 7% of the population in the service area have access to the sewerage system. The existing system is very old and no significant improvement has been undertaken by MWSS in the last 10 years. Many households rely on individual septic tanks with effluents discharged to storm drains. For consumers connected to the MWSS system, the concessionaires offer regular septic tank desludging services and there are many private companies offering such services. Sewage is generally treated at the Dagat-Dagatan treatment facility near Manila Bay.

MANILA WATER SUPPLY

Production & Distribution

Population[1]: 16,740,000 (2001)

Annual Production	1,491,000,000 m^3
Groundwater	2%
Surface Water	98%
Annual Consumption	
Domestic	338,900,000 m^3
Nondomestic	221,520,000 m^3
Total	560,420,000 m^3



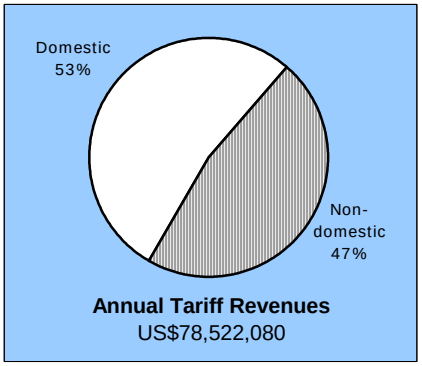
Annual Water Use
1,491,000,000 m^3

Service Connections

Domestic[2]	794,827
Nondomestic	160,673
Total	955,500

Service Indicators

Service Coverage[3]	58%
24-hour Water Availability	88%
Per Capita Consumption	127 l/c/d
Average Tariff	US$0.140/$m^3$



Annual Tariff Revenues
US$78,522,080

Efficiency Indicators

Nonrevenue Water	62%
Unit Production Cost	US$0.064/$m^3$
Working Ratio	1.22
Staff/1,000 Connections	4.4
Revenue Collection Efficiency	97.3%

Small-scale Water Providers

A study of households in the National Capital Region comprising most of Metro Manila indicated that as much as 23% of households obtain their water from small-scale private water vendors reselling MWSS water or from tubewells at rates of about P150 (US$2.92)/$m^3$. About 5% of households get water from small-scale private operators with their own deep well sources and small distribution networks at costs that are 20–50% higher than the MWSS rates. Bottled water costs about P50 (US$0.97)–180 (US$3.50)/20 liters.

Private Sector Participation

In 1997, the operations of MWSS were turned over to two private companies through 25-year concession contracts for the east zone (Manila Water Company, Inc.) and the west zone (Maynilad Water Service, Inc.) of the service area, respectively. Both companies are consortiums.

Flood Management

There is recurrent flooding in Metro Manila from the combined effects of water outflow from the Pasig-Marikina River, the Laguna Lake basin, and an inadequate urban drainage system. Flash floods also occur in some areas due to local drainage problems and clogging of drains. Flooding caused by high tides combined with the river outflows affects low-lying municipalities adjacent to Manila Bay. The Government is undertaking repairs of river banks and improving pumping stations, floodgates, and drainage channels with funding from the Japan Bank for International Cooperation.

Notes

[1] This is the population of Metro Manila. The population in the MWSS service area is about 12,661,000.
[2] The average number of persons per connection is 9.2. The increase in connections in 2001 was 66,357.
[3] Those not served by either of the two concessionaires are connected to piped systems in private subdivisions or are served by small-scale service proviers or water vendors. Others have their own household wells.

Data as of 2001.

Water Utility

OSAKA MUNICIPAL WATERWORKS BUREAU

Address : 1-14-16, Nanko-kita, Suminoe-ku, Osaka 559-8558, Japan
Telephone : (81-6) 6616 5403
Fax : (81-6) 6616 5409
E-mail : osaka-ww@mxw.mesh.ne.jp
Head : Osamu Terakawa, Director General

The Osaka Municipal Waterworks Bureau is a government enterprise under the Osaka Municipal Government. It is responsible for the water supply of the city's population of 2.6 million.

General Data About Water Utility

Connections	: 1,397,732
Staff	: 2,366
Annual O&M Costs	: US$697,618,330
Annual Revenue	: US$643,871,370
Annual Capital Expenditure	: US$313,400,710
Source of Investment Funds	: 95% bonds; 3% subsidy; 2% others

Water Resources Management

The city depends entirely on Lake Biwa and the Yodo River for its water. Other cities drain wastewater into the upper reaches of these rivers. Thus, preservation of water quality of the river system is important for Osaka and other downstream users. Pollution prevention and water quality preservation committees have been formed to protect these water sources. Groundwater use reached extreme levels in the 1950s leading to land subsidence and repeated inundations from high tides. Restrictions on groundwater pumping subsequently restored groundwater levels and kept subsidence under control.

Tariff Structure

Category	Water Rate		Sewerage Rate	
	¥/connection	US$/connection	¥/connection	US$/connection
First 10 m^3	997.0	8.040	577.0	4.650
	¥/m^3	US$/$m^3$	¥/m^3	US$/$m^3$
Next 10 m^3	101.9	0.822	64.1	0.517
Next 10 m^3	130.2	1.050	87.1	0.703
Next 20 m^3	176.4	1.423	108.2	0.873
Next 50 m^3	241.5	1.948	124.9	1.008
Beyond 100 m^3 use formulas below based on water consumption C (m^3)				
101–200 m^3	(¥230 x C - ¥9,960) x 1.05		(¥119 x C - ¥3,800) x 1.05	
201–400 m^3	(¥293 x C - ¥22,560) x 1.05		(¥136 x C - ¥7,200) x 1.05	
401–1,000 m^3	(¥342 x C - ¥42,160) x 1.05		(¥159 x C - ¥16,400) x 1.05	
1,001–2,000 m^3			(¥180 x C - ¥37,400) x 1.05	
2,001–10,000 m^3	(¥368 x C - ¥94,160) x 1.05		(¥215 x C - ¥107,400) x 1.05	
More than 10,000 m^3			(¥234 x C - ¥297,400) x 1.05	

Notes:
1. These water rates have been in effect since 1 June 1997; the sewerage rates since 1 June 2001.
2. Consumers pay on metered use and may opt to pay every month or every 2 months. Payment is made at the water utility offices, payment centers, or automated teller machines.
3. The connection fee is about ¥187,000 (US$1,506), paid in advance at utility offices or payment centers. Arrangements have been made with a local bank for loans up to a maximum of ¥300,000 (US$2,420) to be paid in 24 monthly installments.
4. The sewerage charge is about 60% of the water bill.

Policy and Regulation

Under the Waterworks Law, municipalities operate waterworks in Japan as local public enterprises with independent budgets and subject to enterprise accounting systems. Water rates require approval of the local assembly. The Waterworks Law also makes it obligatory for the water utility to provide information on water supply matters to consumers including water rates, operating costs, water quality inspection results, plans and implementation of projects, condition of facilities, etc. This information is found in the website of the waterworks bureau.

Wastewater and Sanitation

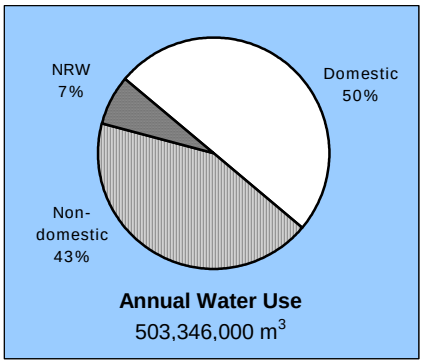
Virtually all of Osaka's population is covered by the city's sewerage system. There are 12 sewage treatment plants with a total capacity of 2,844,000 m^3/day. Sewage from nearby cities is also treated in these plants. Effluents from factories are treated in their own treatment plants prior to discharge to receiving rivers or the sea or to the sewerage system after preliminary treatment. Investments in sewerage and sanitation during 1997–2001 amounted to ¥336.4 billion (US$2.71 million).

OSAKA WATER SUPPLY

Production & Distribution

Population: 2,611,528 (2001)

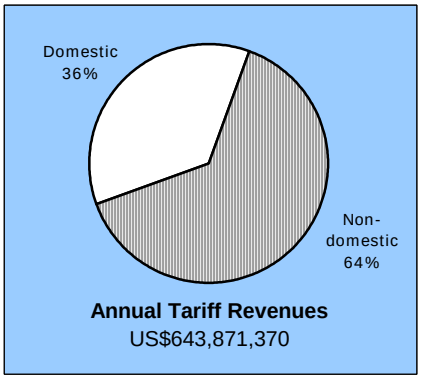
Annual Production	503,346,000 m^3
Groundwater	nil
Surface Water	100%
Annual Consumption	
Domestic	250,538,665 m^3
Nondomestic	218,536,164 m^3
Total	469,074,829 m^3



Annual Water Use
503,346,000 m^3

Service Connections

Domestic[1]	1,223,835
Nondomestic	173,897
Total	1,397,732



Annual Tariff Revenues
US$643,871,370

Service Indicators

Service Coverage	100%
24-hour Water Availability	100%
Per Capita Consumption	263 l/c/d
Average Tariff	US$1.373/$m^3$

Efficiency Indicators

Nonrevenue Water	6.8%
Unit Production Cost	US$1.386/$m^3$
Working Ratio	1.08
Staff/1,000 Connections	1.7
Revenue Collection Efficiency	87.2%

Small-scale Water Providers

There are no small-scale water providers in Osaka. All consumers are covered by the services of the Osaka Municipal Waterworks Bureau. Bottled water costs about ¥118 (US$0.95)/liter.

Private Sector Participation

In 2002, the Waterworks Law was revised to allow the management and operation of water treatment plants by third parties. A law was also passed that allowed the use of private financing for investments in the water utilities; this has been introduced in several cities. While nighttime security and cleaning services have been contracted out by the Osaka Municipal Waterworks Bureau, private financing and private operation of its water treatment functions are still under study.

Flood Management

The responsibility for flood management in the city lies with the Construction Bureau for river-related floods and the Urban Environment Bureau for internal drainage, because storm waters drain through the sewerage system. Flooding from river overflows has been rare in the last 20 years. Around ¥22.5 billion (US$181.5 million) were spent on flood management during 1997–2001.

Notes

[1] The average number of persons per connection in 2001 wass 2.2. The increase in total connections in 2001 was 14,517.

Data as of 2001.

Water Utility

PHNOM PENH WATER SUPPLY AUTHORITY

Address : St. 108, Phnom Penh 122001, Cambodia
Telephone : (855-16) 820 777
Fax : (855-23) 428 969
E-mail : eksonnchan@bigpond.com.kh
Head : Ek Sonn Chan, Director General

The Phnom Penh Water Supply Authority (PPWSA) is an autonomous public enterprise established under the Phnom Penh Municipal Government in December 1996. It replaces the original utility, which dates back to 1895, and is responsible for water production and distribution to the city's population of nearly 1 million people.

General Data About Water Utility

Connections	: 74,945
Staff	: 402
Annual O&M Costs	: US$ 3,102,250
Annual Revenue	: US$ 6,794,450
Annual Capital Expenditure	: US$15,181,580
Source of Investment Funds	: 78% loan; 20% tariffs; 2% government grant

Water Resources Management

PPWSA takes raw water from the Mekong, Tonle Sap, and Bassac rivers. There are 3 water treatment plants, with a total production capacity of 120,000 m^3/day (2001). Cambodia is a member of the Mekong River Commission and follows the Agreement on Cooperation for the Sustainable Development of the Mekong River Basin.

Tariff Structure

Category	Consumption (m^3/month)	Rate	
		(KR/m^3)	(US$/$m^3$)
Domestic (Residential)	0–7	550	0.141
	8–15	770	0.197
	16–50	1,010	0.259
	Over 50	1,270	0.325
Commercial and industrial	0–100	950	0.243
	101–200	1,150	0.294
	201–500	1,350	0.346
	Over 500	1,450	0.371
Administration (Government) and community connections	Uniform Rate	1,030	0.264

Notes:
1. This tariff structure has been in effect since January 2001.
2. Consumers are billed bimonthly. Almost all connections are metered.
3. The fee for a 15 mm connection is KR338,400 (US$86.66)–720,000 (US$184.38) depending on the length of branch extension. Payment can be made in 12 or 20 monthly installments with 10% annual interest.

Policy and Regulation

The Government has prepared an urban water supply policy and guidelines, which are yet to be finalized and institutionalized. The framework of the water policy centers on financial autonomy of public utilities, cost recovery, private sector participation, protecting the poor, and a regulatory mechanism. There is provision for the establishment of an independent body to provide a credible, competent, and impartial regulatory mechanism for the operation of public, private, and autonomous utilities.

Wastewater and Sanitation

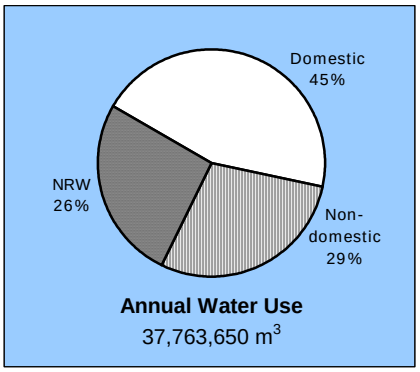
According to a 1999 survey, most households have access to flush toilets connected either to a sewerage system (41%) or septic tanks (37%), and 12% have no toilet facility. The combined drainage system is in poor condition, however, and there is no treatment of sewage after collection; all sewers discharge directly into a river or low-lying areas. A municipal law requires households to construct a septic tank to treat household wastes, but is hard to monitor and enforce because most septic tanks are covered or buried in concrete. The Wastewater Cleaning Authority of Phnom Penh was established in March 2000 as an autonomous body that is financially independent and self-sustaining through charges levied on customers. It is responsible for the transportation and disposal of septic tank and industrial effluents. A draft national policy on urban sanitation was formulated in 1999 but has not been implemented.

PHNOM PENH WATER SUPPLY

Production & Distribution

Population[1]: 981,805 (2001)

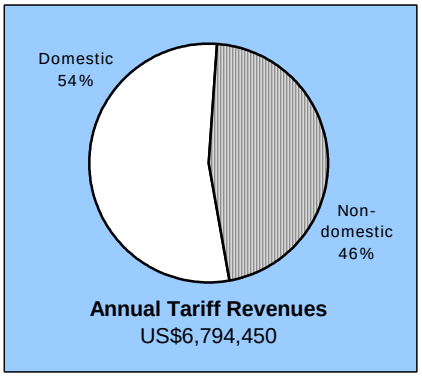
Annual Production	37,763,647
Groundwater	Nil
Surface Water	100%
Annual Consumption	
Domestic	16,988,665 m^3
Nondomestic	10,867,034 m^3
Total	27,855,699 m^3



Annual Water Use
37,763,650 m^3

Service Connections

Domestic[2]	64,035
Nondomestic	10,910
Total	74,945



Annual Tariff Revenues
US$6,794,450

Service Indicators

Service Coverage	84%
24-hour Water Availability	100%
Per Capita Consumption	104 l/c/d
Average Tariff	US$0.244/$m^3$

Efficiency Indicators

Nonrevenue Water	26%
Unit Production Cost	US$0.082/$m^3$
Working Ratio	0.46
Staff/1,000 Connections	5.4
Revenue Collection Efficiency	99.6%

Small-scale Water Providers

In Phnom Penh, private water networks supply water to households, particularly those located in the vicinity of the Tonle Sap, Mekong, and Bassac rivers. These private networks pump water directly from the river and supply untreated water (although some treat it with aluminum sulfate) to individual connections, for which consumption is either metered or unmetered. Average price is about KR1,500 (US$0.38)/$m^3$. Others perform further treatment on water from PPWSA and sell it as bottled water at an average cost of US$1.00/20 liters. Still others resell PPWSA water to households without connections at KR7,500 (US$1.92)–KR20,000 (US$5.12)/m^3.

Private Sector Participation

In its draft water policy, the Government of Cambodia encourages PSP in all areas of service provision including service contracts, management contacts, lease contracts, concession contracts, BOT contracts, and build-operate-own contracts. However, to date, there is no PSP in water supply in Phnom Penh.

Flood Management

The city is susceptible to flooding from the surrounding rivers and water backup during peak flood events caused by flood regulation measures in downstream Viet Nam. Flood protection and drainage facilities in Phnom Penh consist of outer and inner ring dikes, 10 drainage pumping stations, drainage channels, and the sewer network. The Kop Srov and Tompun dikes are eroded and major drainage channels are clogged with debris and sediments in many parts. The Emergency Flood Rehabilitation Project funded by ADB is rehabilitating these dikes at a cost of US$54 million.

Notes

[1] The population in the service area is 532,130.
[2] The average number of persons per connection in 2001 was 7. The increase in total connections in 2001 was 7,929.

Data as of 2001.

Water Utility

SEOUL METROPOLITAN GOVERNMENT (Office of Waterworks)

Address : 27-1 Hap-dong, Seodaemun-gu, Seoul, Korea 120-030
Telephone : (82-2) 390 7332
Fax : (82-2) 362 3653
E-mail : admin@water.seoul.go.kr
Head : Won Sei-Hoon, Assistant Mayor

The Office of Waterworks is part of the Seoul Metropolitan Government and is responsible for water supply and distribution in the city of Seoul with a population of 10,330,000 people. The utility buys raw water from the Korea Water Resource Corporation. Source of the water is the Corporation's Paldang Reservoir on the Han River, upstream of the city.

General Data About Water Utility

Connections	: 2,144,000
Staff	: 2,923
Annual O&M Costs	: US$308,350,000
Annual Revenue	: US$538,320,000
Annual Capital Expenditure	: US$214,700,000
Source of Investment Funds	: 83% tariff; 9% grant; 8% loan

Water Resources Management

Seoul depends entirely for its drinking, industrial, and agricultural water supply on the Han River that passes through the city. However, upstream urban activities and livestock farm wastes are degrading the water quality. The Ministry of Environment imposed land-use restrictions in the upstream watershed to protect water quality in the river. However, upstream residents have to be compensated for economic losses because of lower crop production. Groundwater is used as another source but provides only about 3% of the water requirement of the city. The city government has instituted laws on water conservation including water recycling, use of rainwater, and adopting appropriate water quality criteria for recycled water for various uses.

Tariff Structure

Base Rate			Usage Rate / m^3									
Diameter (mm)			Volume (m^3)	Residential		Business		Commercial		Public Bath	
	W	US$		W	US$	W	US$	W	US$	W	US$
13	1,080	0.82	0–30	320	0.244	470	0.358	800	0.609	270	0.206
20	3,000	2.28	31–40	510	0.388	:	:	:	:	:	:
25	5,200	3.96	41–50	570	0.434	470	0.358	:	:	:	:
32	9,400	7.15	51–100	790	0.601	600	0.457	800	0.609	:	:
40	16,000	12.18	101–200	:	:	:	:	900	0.685	:	:
50	25,000	19.03	201–300	:	:	600	0.457	1,100	0.837	:	:
65	38,900	29.62	301–500	:	:	680	0.518	:	:	270	0.206
75	52,300	39.82	501–1,000	:	:	:	:	1,100	0.837	320	0.244
:	:	:	1,001–2,000	:	:	:	:	1,260	0.959	320	0.244
400 +	615,000	468.21	Over 2,000	790	0.601	680	0.518	1,260	0.959	430	0.327

Notes:
1. Households that use less than 10 m^3 per month are charged W190/m^3 (US$0.146/$m^3$). All consumers pay on metered use. They are billed monthly, except residential users who are billed bimonthly. Bills are settled through online payment.
2. The fee for 13 mm connection is about US$850. The water bill includes a 35% sewerage surcharge.

Policy and Regulation

The Waterworks Law designated the Ministry of Environment to be responsible for licensing waterworks activities, such as those of local governments and the Korea Water Resources Corporation. Water tariffs have to be approved by the Ministry of Budget and Economy and then passed by the local assembly to balance them with rates of other utilities, such as gas, electricity, and gasoline. Because local governments are independent of central government and other administrative structures, Seoul's waterworks are self-regulated. However, the Board of Audit and Inspection monitors management performance. The Internet has enhanced the transparency of the city administration; its homepage gives information on source and tap water quality, annual financial budget, waterworks office structure, construction bids, and contracts.

Wastewater and Sanitation

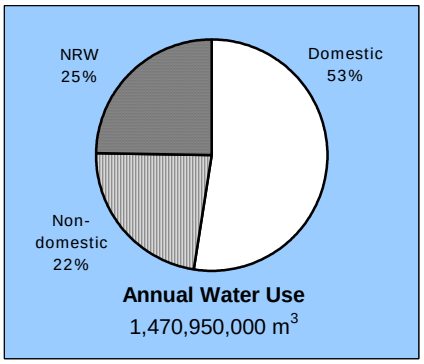
Sewerage coverage among Seoul's population is 98.5%; only those in remote mountains and valleys are not connected to sewer lines. Sewers are combined with the drainage system. Treated wastewater is discharged into the Han River. Sludge generated at the sewage treatment plants is disposed of in landfills. The city government spent about US$1.11 billion during 1997–2001 to rehabilitate its sewerage treatment plants.

SEOUL WATER SUPPLY

Production & Distribution

Population: 10,330,000 (2001)

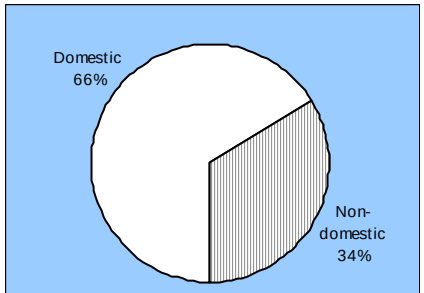
Annual Production	1,470,950,000 m^3
Groundwater	3%
Surface Water	97%
Annual Consumption	
Domestic	773,800,000 m^3
Nondomestic	332,150,000 m^3
Total	1,105,950,000 m^3



Annual Water Use
1,470,950,000 m^3

Service Connections

Domestic[1]	1,864,000
Nondomestic	280,000
Total	2,144,000



Annual Tariff Revenues
US$538,320,000

Service Indicators

Service Coverage	100%
24-hour Water Availability	100%
Per Capita Consumption	205 l/c/d
Average Tariff	US$0.487/$m^3$

Efficiency Indicators

Nonrevenue Water	25%
Unit Production Cost	US$0.210/$m^3$
Working Ratio	0.57
Staff/1,000 Connections	1.4
Revenue Collection Efficiency	93%

Small-scale Water Providers

The only water provider in the city is the Seoul Metropolitan Government. It sells excess capacity to the nearby cities of Guri and Namyangjoo, which manage their own water supply distribution. Bottled water costs about US$0.41/500 ml.

Private Sector Participation

The Office of Waterworks commissioned a private company to conduct its bimonthly meter reading and billing operations. Privatization of sewage treatment started in 1999 with positive results in terms of operational efficiency. The Seoul Government is considering privatizing its waterworks operations, but is worried by the prospect of workers' union strikes, which are allowed in private companies but not in government enterprises.

Flood Management

The city suffered from major floods in 1990, 1998, and 2001, caused by the Han River, monsoon rains, and inadequate drainage capacity, especially in low-lying areas. During the last 10 years, annual flood damage in Seoul amounted to US$2 million. The city invested an average of US$60 million annually for flood protection over the same period.

Notes

[1] The average number of persons per connection in 2001 was 5.5. The increase in connections in 2001 was 5,410.

Data as of 2001.

Water Utility

SHANGHAI WATER BUREAU

Address : No. 257 Tongren Road, Shanghai 200040, People's Republic of China
Telephone : (86-21) 6247 6232
Fax : (86-21) 6247 8411
Head : Jiayi Zhang, Director

The Shanghai Water Bureau is responsible for water resources management and water issues throughout Shanghai. There are about 158 water supply companies, categorized as large-scale companies (5) that supply water in urban areas; district or county companies (9) that serve district and county towns; and township companies (144) that serve townships and rural areas.

General Data About Water Utility

Connections	: 2,995,000
Staff	: 17,000
Annual O&M Costs	: US$169,093,950
Annual Revenue	: US$156,101,980
Annual Capital Expenditure	: US$112,489,720
Source of Investment Funds	: 100% grant

Water Resources Management

The main drinking water sources for Shanghai are the Huangpu River and the Baoshan segment of the Changjiang (Yangtze) River. Groundwater is used in the suburban and rural areas of the city and this has led to land subsidence in these areas. The Government began restricting the use of groundwater in the city in 1996. Nevertheless, subsidence continued at an average of 11 mm per year in the city center in 1998–2000. The shortfall in supply will be made up by using more water from the Changjiang River, which will be treated at the Ling Qiao water treatment plant.

Tariff Structure

Category	Water Rate		Wastewater Rate	
	CNY / m^3	US$ / m^3	CNY / m^3	US$ / m^3
Residence	1.03	0.124	0.70	0.085
Industry & Administration	1.30	0.157	0.70	0.085
Commerce/Other Business	1.50	0.181	0.70	0.085
Beverage Production	2.00	0.242	0.70	0.085
Sauna Baths	5.00	0.604	0.70	0.085
Bulk Supply	0.90	0.109	0.70	0.085

Notes:

1. This tariff structure has been in effect since 1 December 2001.
2. All consumers pay on metered use. Billing is done through a meter reader or by a remote metering system.

   Payment is made in designated banks. An innovative system in some areas is payment through prepaid cards that activate control valves to release water.
3. The connection fee is about CNY684 (US$83).
4. The volume of wastewater is taken as 90% of water consumption.

Policy and Regulation

Both central and local government policies guide the development of the water supply sector in Shanghai through the State Water Law and laws governing tariffs and regulation of urban water supplies. The Shanghai Water Bureau is responsible for water resources management and all water issues. The current thrust of the Shanghai Government is continuation of ongoing reforms based on market mechanisms, reduction of the water supply deficit, improvement of service to consumers, and rehabilitation of the Suzhou River.

Wastewater and Sanitation

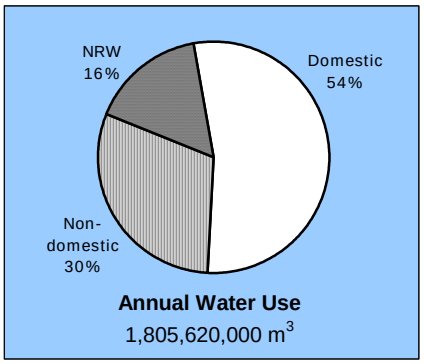
About 68% of wastewater produced are collected through the combined sewer system in the urban and rural areas of Shanghai. Most of the households connected to the sewer systems have septic tanks discharging effluents to the sewers. Latrines remain important in Shanghai, especially in the old city and rural areas. Public latrines are located in shopping centers, parks, hotels, bazaars, recreation grounds, and other public areas; a fee for use is required in about half of them. Transfer tanks for excrement in nonsewered areas are a special sanitation facility in Shanghai; residents deposit their waste to be collected by trucks for treatment at wastewater treatment plants.

SHANGHAI WATER SUPPLY

Production & Distribution

Population[1]: 10,500,000 (2001)

Annual Production	1,805,620,000 m^3
Groundwater	30%
Surface Water	70%
Annual Consumption	
Domestic	962,760,000 m^3
Nondomestic	545,410,000 m^3
Total	1,508,170,000 m^3



Annual Water Use
1,805,620,000 m^3

Service Connections

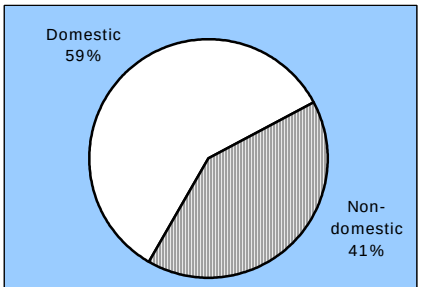
Domestic[2]	2,972,053
Nondomestic	22,947
Total	2,995,000

Service Indicators

Service Coverage	100%
24-hour Water Availability	100%
Per Capita Consumption	251 l/c/d
Average Tariff	US$0.104/$m^3$

Efficiency Indicators

Nonrevenue Water	16%
Unit Production Cost	US$0.094/$m^3$
Working Ratio	1.08
Staff/1,000 Connections	5.7
Revenue Collection Efficiency	93.5%



Annual Tariff Revenues
US$156,101,980

Small-scale Water Providers

Of the 158 water supply companies in Shanghai, 64 have supply capacities of only 2,000–10,000 m^3/day. These small suppliers provide only 3.9% of the total water supply and serve about 9% of the population with piped water in the rural areas of Shanghai. The Government plans to either close or merge most of these small companies because many are not profitable due to low tariffs and poor management. By doing this, the Government hopes to increase supply capacity, improve efficient use of water resources, improve water quality, and reduce costs. Small-scale providers that distribute water by tankers do not exist in Shanghai.

Private Sector Participation

Pudong-Vivendi Water Supply Co., Ltd. is the only large-scale joint venture by the Government with a private company, with Vivendi Water holding 50% of the stocks of the company. It mainly supplies water to Pudong region's urban districts, providing 1.7 million m^3 of water daily to a population of 1.71 million. This is the first case in the PRC in which a private company participates not only in water treatment operations but also in piped water distribution.

Flood Management

Shanghai is in the lower reaches of the Taihu watershed, bounded in the east and north sides by a long coastline; the Huangpu and Suzhou rivers cross the center of the city. The city's flat topography and alluvial nature make it susceptible to flooding, even in the city center. The storm drainage system covers only 60% of the urban areas. Expenditure for flood management and control in 1996–2000 was about CNY6.063 billion (US$732 million).

Notes

[1] Total population of Shanghai including those in the suburban and rural areas was 16,740,000 in 2001.
[2] The average number of persons per connection in 2001 was 3.5. The increase in total connections was 33,000.

Data as of 2001.

Water Utility

TASHKENT STATE UNITARY ENTERPRISE (Suvsoz)

Address : #2 Chekhova Street, Tashkent 700060, Uzbekistan
Telephone : (998-71) 152 1955
Fax : (998-71) 152 1938
E-mail : none
Head : Rauf Kurbanov, Director

The Tashkent State Unitary Enterprise (Suvsoz) is a government enterprise established in 1931. It is responsible for water supply and sanitation services for the city's population of 2,130,600 through its city water and sewerage departments. These departments have corresponding independent district departments in each of the city's 11 districts. In 2001, Suvsoz established departments for installation and repair of water meters.

General Data About Water Utility

Connections	: 567,398
Staff	: 3,156
Annual O&M Costs	: US$3,874,930
Annual Revenue	: US$8,274,520
Annual Capital Expenditure	: US$1,577,710
Source of Investment Funds	: 36% tariff; 14% central government grant; 50% others

Water Resources Management

Tashkent's water supply is from surface water in the Bozsu Canal and groundwater from the Chatkai-Kuramin watershed. Water from these sources is considered satisfactory. Priority for use of both surface water and groundwater is given to domestic consumption. Rights for surface water use are regulated by the Ministry of Agriculture and Water Resources; groundwater rights are regulated by the Ministry of Geology. Water conservation by recycling is encouraged among city enterprises. The present production capacity is more than adequate for the present and near future demand, although some facilities need rehabilitation.

Tariff Structure

Category	Rate	
	(SUM / m^3)	(US$ / m^3)
Water Supply		
Domestic	16.00	0.023
Enterprises (Bulk Consumers)	39.66	0.058
Sewerage Services		
Domestic	8.00	0.012
Enterprises (Bulk Consumers)	14.07	0.020

Notes:
1. Only about 8.3% of connections are metered and working. Almost all domestic consumers pay a flat rate based on established per capita consumption. Consumers are billed monthly and pay at banks in cash. Bulk consumers pay by deposit to a Suvsoz bank account.
2. The connection fee is SUM21,950 (US$32).
3. The sewerage charge is 50% of the water bill for domestic consumers.

Policy and Regulation

Policies on water supply management are found in the Law on Water and Water Use (adopted by the Republic of Uzbekistan on 6 May 1993) and subsequent decrees of the cabinet ministries and resolutions of the Mayor of Tashkent. Some of these decrees and resolutions are specific to water management and metering in houses and apartments. The Anti-monopoly Committee of the City Administration, an independent body, regulates tariff issues. Reasons for tariff increases are announced and explained through print and broadcast media. The operational and financial performance of Suvsoz is subject to annual review by the City Administration and the City Communal Services Operational Association, but these are not published by the media.

Wastewater and Sanitation

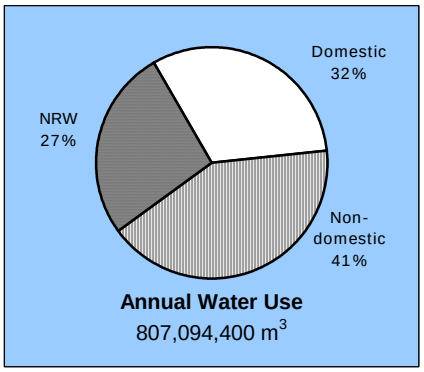
The centralized sewerage system covers 85% of the city's population. There are three wastewater treatment stations and facilities with a total capacity of almost 2 million m^3/day. Snowmelt and rainwater are drained separately through ditches, canals, and rivers. Some organizations and enterprises not connected to the sewerage system have their own wastewater treatment facilities. Smaller enterprises use cesspits that are desludged by special trucks or sludge collectors.

TASHKENT WATER SUPPLY

Production & Distribution

Population: 2,130,600 (2001)

Annual Production	807,094,400 m^3
Groundwater	31%
Surface Water	69%
Annual Consumption	
Domestic	255,233,540 m^3
Nondomestic	335,369,900 m^3
Total	590,603,440 m^3



Annual Water Use
807,094,400 m^3

Service Connections

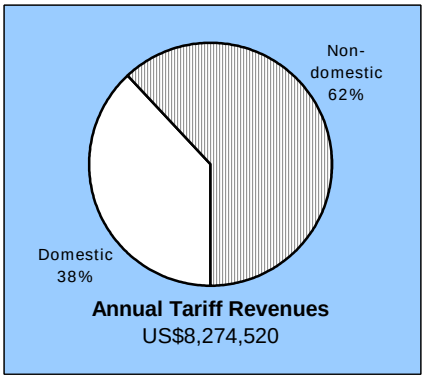
Domestic[1]	557,668
Nondomestic	9,730
Total	567,398

Service Indicators

Service Coverage	99%
24-hour Water Availability	100%
Per Capita Consumption	328 l/c/d
Average Tariff	US$0.014/$m^3$

Efficiency Indicators

Nonrevenue Water	27%
Unit Production Cost	US$0.005/$m^3$
Working Ratio	0.47
Staff/1,000 Connections	5.6
Revenue Collection Efficiency	77%



Annual Tariff Revenues
US$8,274,520

Small-scale Water Providers

There are no small-scale water providers in Tashkent. Suvsoz serves 98.6% of the city population through a centralized piped water supply system. Those not connected use water from wells or water distributed by Suvsoz by tankers without charge. Some city industrial enterprises have their own water supply systems that are independent of the city's system.

Private Sector Participation

There is no PSP in the water supply sector. Decree No.97 of the Cabinet Ministries dated 26 March 2002 promotes measures to ensure implementation of programs on decentralization and privatization and attracting foreign investments, as well as reorganization of Suvsoz into a joint-stock company.

Flood Management

Strong flows in the Chirchik River and Bozsu Canal during spring and fall months cause substantial increases in water turbidity. Formerly, these occurrences affected supplies from the Bozsu headworks and the Kibray water facilities. The construction of the Charvak Hydrosystem for flood protection in 1962 controlled the flow from the river and canal. The city has not experienced flooding since then.

Notes

[1] The average number of persons per connection in 2001 was 3.8. There were 292 additional connections in 2001.

Data as of 2001.

Water Utility

ULAANBAATAR CITY WATER SUPPLY AND SEWERAGE SYSTEM CO., LTD.

Address : Khukh Tengeriin Gudamj 5, Ulaanbaatar 49, Mongolia
Telephone : (976-11) 455 055
Fax : (976-11) 450 120
E-mail : usag@magicnet.mn
Head : Osoryn Erdenebaatar, Chairman

The Water Supply and Sewerage System Co., Ltd. (USAG) is a state enterprise established in 1975 under the Municipality of Ulaanbaatar. It is responsible for water supply and sewerage in the city and the peri-urban *ger* (round canvas-and-felt tents) areas with a total population of 743, 000 people, excluding distant subdistricts. USAG distributes water partly through piped connections and partly by tanker trucks to public water kiosks. A bulk supply is provided to most apartments through OSNAAKs (refer to Note 2 below), which manage distribution to apartment residents and bill residents at 150 liters per capita per day.

General Data About Water Utility

Connections	: 1,426
Staff	: 1,174
Annual O&M Costs	: US$5,795,600
Annual Revenue	: US$6,991,100
Annual Capital Expenditure	: US$2,820,900
Source of Investment Funds	: no data

Water Resources Management

The water distributed by USAG comes from groundwater pumped from 160 production wells in 4 alluvial areas known as upper source, central water source, industrial water source, and meat complex area, respectively. The drilling of 20 more wells in the lower Nalaih area is planned. The main constraint in using surface water from the Tuul River is freezing of the river from December to March and reduced flow during September to December and March to May.

Tariff Structure

Category	Rate	
	(MNT/m^3)	(US$/$m^3$)
Water Supply		
Institutions/Industries	200	0.18
Residents	130	0.12
Apartments	105	0.10
Wastewater Services		
Institutions/Industries	115	0.10
Residents	85	0.08
Apartments	70	0.06

Notes:
1. This tariff structure has been in effect since July 2000.
2. Domestic connections referred to are bulk connections to apartments managed by OSNAAKs. Water is also sold in water kiosks supplied by USAG through a subsidiary tank company, especially in the *ger* areas. OSNAAKs are government units managing services in residential apartments.
3. Consumers are billed monthly and pay through bill collectors or banks.
4. Contractors bear all costs of new connections. The connection fee is about MNT500,000 (US$426).

Policy and Regulation

USAG has several strategies to maintain its financial capacity and the sustainable development of the utility: the installation of meters, billing based on metered consumption to reduce water wastage, and an improved tariff structure to cover operating expenses with provisions for long-term capital investment.

Wastewater and Sanitation

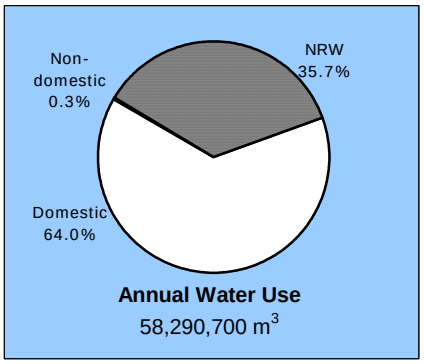
About 48% of the city population are connected to the sewerage system; the rest have latrines and septic tanks. People living in the *ger* areas have latrines within their fenced lots while small industries have septic tanks. Each of the six districts of the city has a special truck for desludging industrial septic tanks. The trucks bring wastewater to the Central Wastewater Treatment Plant. USAG and the Environmental Control Office monitor industrial effluent discharges against limits set by the ministries of health, environment, industry, and trade.

ULAANBAATAR WATER SUPPLY

Production & Distribution

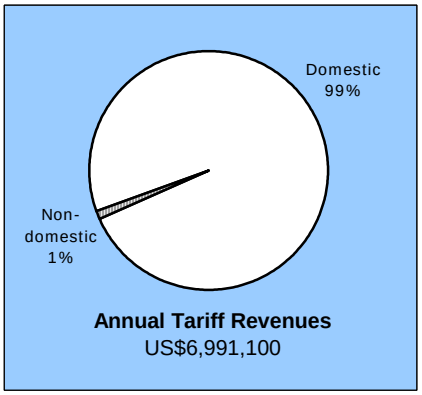
Population: 743,054 (2001)

Annual Production	58,290,700 m^3
Groundwater	100%
Surface Water	Nil
Annual Consumption	
Domestic	37,290,700 m^3
Nondomestic	190,700 m^3
Total	37,481,400 m^3



Service Connections

Domestic[1]	1,411
Nondomestic	15
Total	1,426



Service Indicators

Service Coverage	49%
24-hour Water Availability	48%
Per Capita Consumption	278 l/c/d
Average Tariff	US$0.187/$m^3$

Efficiency Indicators

Nonrevenue Water	36%
Unit Production Cost	US$0.099/$m^3$
Working Ratio	0.83
Staff/1,000 Connections[2]	823.3
Revenue Collection Efficiency	90%

Small-scale Water Providers

In areas not served by USAG, especially in the *ger* areas where 43% of the population live, about 66 private providers draw water from wells and springs and distribute it through kiosks. Other residents are served with water delivered by tankers to the kiosks. Ten companies produce bottled water in 0.33–1.50 liter bottles at an average cost of MNT500 (US$0.45)/liter. Small-scale water providers serve only about 5% of the city population.

Private Sector Participation

Apart from small-scale water providers, the only PSP in the city's water supply is in construction related to rehabilitation and maintenance of pipelines. Because of the increasing population in the *ger* areas and USAG's inability to supply water to these areas, there is a pending proposal to let the private sector manage water distribution there.

Flood Management

Flooding in the city is caused by strong flows in 5 major rivers in the vicinity of Ulaanbaatar during heavy or continuous rains. Existing drainage channels are inadequate to protect the city from flooding except for a few areas including the central district. Residents of *ger* areas on the slopes of mountains and hills, along ravines, and in low-lying areas face the greatest risk of floods. In 2001, the municipality established a state-owned company to be responsible for the repair, operation, and maintenance of flood control facilities in the city as part of the development master plan for 2000–2020.

Notes

[1]Bulk connections to apartments serve on the average 260 persons per connection. There were 360 new connections in 2001.
[2]This unusually high ratio is explained by the nature of mostly bulk connections to apartments by OSNAAKs.

Data as of 2001.

Water Utility

VIENTIANE WATER SUPPLY COMPANY (Nam Papa Vientiane)

Address : Box 2571, Phonekheng Road, Vientiane, Lao PDR
Telephone : (856-21) 412 880
Fax : (856-21) 414 378
E-mail : daophet@laotel.com
Head : Daophet Bouapha, General Manager

Vientiane Water Supply Company (Nam Papa Vientiane) is the water utility operator for Vientiane Prefecture including the city of about 616,000 people. Prior to 1999, the Lao Water Supply Company (Nam Papa Lao), a national government enterprise established in 1962, was responsible for the water supply of the entire country including Vientiane. In line with the decentralization policy of the Government, each province is now responsible for water supply within its own boundaries. State-owned enterprises (known as Nam Papas) are currently managing all urban water systems in provinces that own such facilities.

General Data About Water Utility

Connections	: 42,052
Staff	: 440
Annual O&M Costs	: US$1,281,540
Annual Revenue	: US$1,170,330
Annual Capital Expenditure	: US$1,957,010
Source of Investment Funds	: 60% tariff; 33% connection fees; 7% government grant

Water Resources Management

Water availability is high because of low population density. The main use is in agriculture for irrigation (82%); industry uses 10% and households the remaining 8%. The water sources for Vientiane Prefecture and four other large urban centers are the Mekong River and groundwater. The water in the river and its tributaries within the prefecture is not significantly polluted, although there is high turbidity during the rainy season. Presidential Decree No. 126, promulgated in November 1966, governs the administration, use, and development of water and water resources in the Lao People's Democratic Republic so as to preserve and sustain the resources, ensure water quality and quantity, and protect the environment.

Tariff Structure

Monthly Consumption (m^3)	Rate (KN / m^3)	Rate (US$ / m^3)	Monthly Consumption (m^3)	Rate (KN / m^3)	Rate (US$ / m^3)
I. Domestic and Government Offices			**III. Enterprises & Business** (using water as raw material)		
0–5 m^3	219	0.023	0–50 m^3	855	0.090
6–20 m^3	263	0.028	51–100 m^3	1,216	0.128
21–50 m^3	329	0.035	Over 100 m^3	1,360	0.143
Over 50 m^3	383	0.040			
II. Enterprises & Business (not using water as raw material)			**IV. Diplomatic Personnel / Foreigners**		
			0–10 m^3	6,184	0.652
0–5 m^3	549	0.058	Over 10 m^3	7,668	0.808
6–20 m^3	602	0.063			
21–50 m^3	636	0.067			
Over 50 m^3	670	0.071			

Notes:
1. This tariff structure has been in effect since 1 September 2001.
2. All consumers pay on metered use. Payment is through bill collectors or at the water utility office.
3. Tariff setting objectives are to recover costs including O&M and to generate enough surplus to meet a portion of debt service.
4. The connection fee for a 15 mm domestic connection is KN700,000 (US$74).

Policy and Regulation

Prime Ministerial Decision No 37 defines the government policy on management and development of the water supply and sanitation sector. It includes strategies, targets, and operational framework for effective and sustainable financing, development, and management of the water supply and wastewater systems in urban and rural areas throughout the country. The Government established the Water Supply Authority to oversee developments in the water supply sector, the planning of projects in urban and rural areas, and to regulate the water supply and wastewater sector. Nam Papas are regulated within the provinces through Business Law 42/PR and each is responsible to a Water Administration Board.

Wastewater and Sanitation

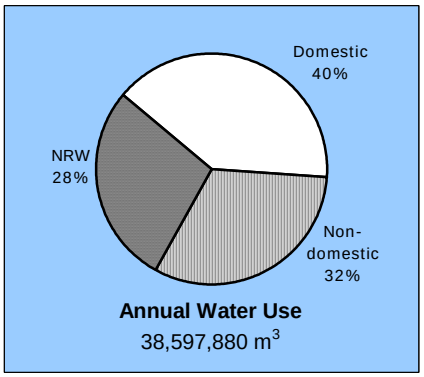
No urban center has a comprehensive piped sewerage system. A small-bore sewer system installed in a limited area in Vientiane municipality is not working due to blockages. In areas with onsite sanitation, septic tank effluents discharge into storm drains to watercourses. Pit latrines are desludged irregularly. There is no national agency responsible for sanitation in the urban centers, although Nam Saat is responsible for sanitation in the rural areas.

VIENTIANE WATER SUPPLY

Production & Distribution

Population: 616,221 (2001)

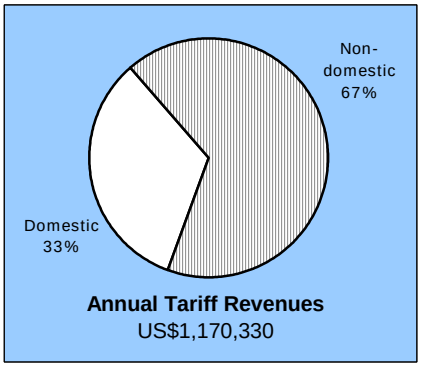
Annual Production	38,597,880 m^3
Groundwater	2%
Surface Water	98%
Annual Consumption	
Domestic	15,592,595 m^3
Nondomestic	12,241,672 m^3
Total	27,834,267 m^3



Annual Water Use
38,597,880 m^3

Service Connections

Domestic[1]	36,121
Nondomestic	5,931
Total	42,052



Annual Tariff Revenues
US$1,170,330

Service Indicators

Service Coverage	63%
24-hour Water Availability	50%
Per Capita Consumption	110 l/c/d
Average Tariff	US$0.042/$m^3$

Efficiency Indicators

Nonrevenue Water	28%
Unit Production Cost	US$0.033/$m^3$
Working Ratio	1.10
Staff/1,000 Connections	10.5
Revenue Collection Efficiency	52%

Small-scale Water Providers

There are no small-scale service water providers in the city, except for water vendors in the rural areas of Vientiane Prefecture and private companies selling bottled drinking water. Water vendors sell water in 200 liter drums at KN3,000 (US$0.32)/drum. Drinking water is sold in 20 liter bottles at KN2,000 (US$0.21) per bottle and in 0.75 liter bottles at KN1,000 (US$0.11) per bottle.

Private Sector Participation

There are no private operators of water supply utilities in provincial and district centers in Lao PDR. In Luang Phrabang, Nam Papa has joined with a hotel company to extend the water network to three villages in the south of the municipality. While the Government recognizes the crucial role that the private sector plays in the country's development, the public sector remains determined to regulate private investment and business growth rather than to provide a consistent framework for the expansion of private sector activities.

Flood Management

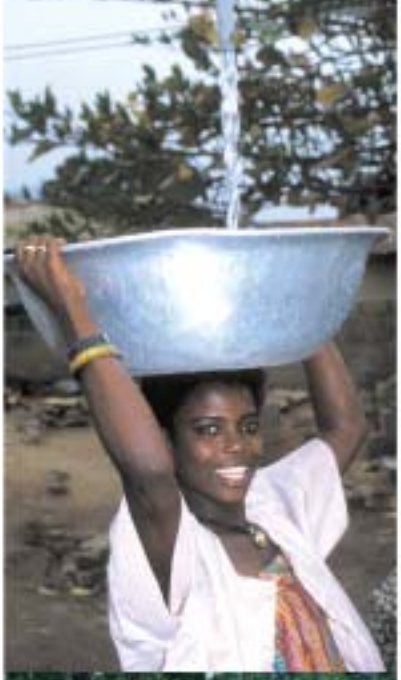
Vientiane Prefecture has a long history of inundation problems caused by overflowing of the Mekong River adjacent to the city. The drainage is inadequate to carry storm run-off and the situation is getting worse. Vulnerable areas, such as the districts of Sikhottabong, Sisattanak, and Hatxaiphong, are flooded at least once a year. Flood mitigation measures undertaken include early warning and better land-use planning.

Notes

[1] The number of persons per connection in 2001 was 6.0. There were 2,545 new connections in 2001.

Data as of 2001.

IMPROVED
November 2004



Rural Water Supply and Sanitation Toolkit for Multisector Projects

Developed by:
Rural Water Supply and Sanitation
and
Social Funds Thematic Groups

THE WORLD BANK

BNWP

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F O R E W O R D

In fiscal year 2003, the Rural Water Supply and Sanitation and Social Funds Thematic Groups jointly coordinated the design and launch of a web-based toolkit on rural water supply and sanitation (RWSS) for multisector projects. This was complemented by a mini-CD/brochure and a publication with some of the key guidelines and tools in English, Spanish, and French. The toolkit aimed at providing practical and user-friendly advice to task teams of social fund and community-driven development programs and clients in improving the quality and sustainability of RWSS investments.

In order to test for applicability and to confirm whether the toolkit was serving its desired objective, the two thematic groups decided to pilot the toolkit and apply it in the field. In the first phase, based on demand from multisector task teams, an RWSS specialist was sent to Benin to verify its operational relevance and identify areas for revision. In the second phase, three task team leaders of multisector projects (Indonesia KDP3, Comoros Services Support Project, and Egypt Social Fund) were requested to peer review the toolkit and provide advice on how to make it even more effective.

Based on the consolidated feedback from the four task team leaders, three broad areas were identified for further improvement: (a) sanitation and hygiene; (b) monitoring and evaluation (including impact evaluation); and (c) institutional issues. A Key Issues section was created to address these issues with more tools structured around the following areas: (a) policy and institutional framework; (b) sanitation and hygiene promotion; (c) project monitoring and evaluation; (d) impact evaluation; and other sections thought to be important and upcoming, such as (e) financing arrangements; and (f) scaling up. Although the web-based version is more comprehensive, **this publication contains additional tools for these topics in the annex section.**

Since its launch in December 2002, the web-based toolkit has received over 33,000 hits (of pages viewed) and demand has been expressed through the Water Help Desk for copies of the CD-ROM and publications in various languages. This initiative spurred interest in other sectors to produce similarly structured toolkits. The revisions to the toolkit in 2004 were coordinated by Parameswaran Iyer and David Warren and the content was provided by consultant Mariana Felicio.

Parameswaran Iyer
Co-chair, Rural Water Supply and Sanitation Thematic Group

David S. Warren
Chair, Social Funds Thematic Group

Mariana Felicio
E.T. consultant, Human Development Network

FOREWORD (FROM 2002 PUBLICATION)

Multisector projects, including social funds, are increasingly being used as a mechanism for channeling funds to communities to help them undertake their own development activities. These new approaches often provide more efficient ways of delivering community-based investments, and can empower communities by allowing them to define their own priorities and to manage subproject implementation, including, in many cases, procurement, contracting, and funds administration. However, results also show that rural water supply and sanitation (RWSS) has consistently been one of the key challenges for many multisector projects in terms of achieving long-term sustainability, and ensuring the effective use of the improved services. With an estimated two-thirds of the World Bank's financing for RWSS investments taking place in the context of multisector investment programs, the stakes are high for making sure that the RWSS components of such programs are well designed.

The purpose of this document is to improve the quality and sustainability of RWSS investments financed under multisector community-based projects by providing task teams with guidelines and tools for designing, implementing, and monitoring and evaluating the RWSS components of these projects. The target audience includes Bank staff, government officials, consultants, and other practitioners who are involved in the preparation and implementation of community-driven development programs.

Under the umbrella of the Rural Water Supply and Sanitation and Social Funds Thematic Groups, this project was coordinated [in 2002] by Jennifer J. Sara (lead infrastructure specialist), Parameswaran Iyer (senior water and sanitation specialist, Water and Sanitation Program) and David S. Warren (senior social protection specialist). The content side was provided by consultants Robert Fishbein and Mariana Felicio, and the technical side was executed by Hywon Cha Kim and Zoe Elena Trohanis. Other members of the task team were François Munger and Christophe Prevost, while valuable comments were received from Alexander Bakalian, Samantha de Silva, Talib Esmail, Caroline van den Berg, Andrea Vermehren, Meike van Ginneken, Peter Roberts, and Cristina Malmberg Calvo.

This report was funded by the Bank-Netherlands Water Partnership, a facility that supports World Bank operations to increase delivery of water supply and sanitation services to the poor (for more information see http://www.worldbank.org/watsan/bnwp).

Jamal Saghir, Director
Water and Energy

Robert Holzmann
Director, Social Protection

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RWSS TOOLKIT FOR
MULTISECTOR PROJECTS GUIDE

"If anything has been learnt in the almost 50 years of installing village water supply systems, it is that where there is no local participation in planning and decision making and no local commitment to operation and maintenance, including local financing, the system has a short life."

Arthur Okun

INTRODUCTION

Multisector projects, including social funds and community-driven development, are increasingly being used as a mechanism for channeling funds to communities to undertake development activities. These new approaches often provide efficient ways to deliver community-based investments, and can empower communities by allowing them to define their own priorities and to manage subproject implementation.

Rural water supply and sanitation (RWSS) is often a high development priority in communities and there are good examples of communities actively participating in the planning and implementation of RWSS subprojects. However, a persistent challenge is how to ensure the quality and sustainability of the services that these water and sanitation subprojects are designed to provide.

Decades of experience have produced a body of knowledge which can be useful and instructive in addressing these issues. This toolkit has been devised to help multisector task managers tap into this body of knowledge. The toolkit is divided into the following main sections:

1. **Basic Principles in RWSS.** This section heightens awareness of sector-specific issues and highlights the basic principles of good RWSS practice.

2. **Rapid Sector Assessment.** The first step in determining how to include RWSS components in a multisector project is a sector assessment. This provides a broad overview of the critical constraints and opportunities of RWSS service provision in the country, and is used to design the strategy for incorporating RWSS into the multisector project.

3. **Sanitation and Hygiene Promotion.** This new section describes how sanitation and hygiene behavior changes can be achieved through promotion, and presents guidelines for designing sanitation and hygiene promotion components for rural communities.

4. **RWSS in the Project Cycle.** An organizing framework is provided for implementing each stage of the subproject cycle as it relates to RWSS investments.

5. **Resources.** This section provides terms of reference (TORs), checklists, and other tools in carrying out the rapid sector assessment and implementing RWSS through the project cycle, as well as bibliographic references of online documentation, useful links, and contact information.

The series of steps needed to incorporate an RWSS component into a multisector project are summarized on the next page.

STEP 1

What: Assess the country situation and define an RWSS strategy for the project.
Undertake a rapid sector assessment of the policy and institutional environment, review proposed project objectives, and determine how RWSS can best be incorporated into the project.

Who: Internationally qualified consultant(s) in RWSS or a Bank technical staff member. Preference would be a team of consultants with a technical, social, and financial staff.

Result: Country sector snapshot, agreement on the basic approach to RWSS in the project, and input to project concept document, including input to logical framework.

STEP 2

What: Design RWSS project interventions, set up project rules, and elaborate operational manual.
Develop an implementation strategy, define project activities, and spell out the rules under which RWSS subprojects will be funded.

Who: Government project office in coordination with sectoral agencies, with or without assistance of local consultant(s), with expertise in RWSS hardware and software issues.

Result: Definition of RWSS component and final draft of operational manual.

STEP 3

What: Review RWSS component during project appraisal. Review and agree with government on the implementation strategy, component definition, and operations manual; finalize RWSS input to project appraisal document logical framework and project appraisal analyses (if applicable).

Who: Internationally qualified consultant in RWSS or a Bank technical staff as member of appraisal team.

Result: Project appraisal document.

STEP 4

What: Implement project and carry out regular monitoring and reporting.
Oversee community-based evaluation; assess performance of completed subprojects and take corrective actions.

Who: Government project office and communities, with or without assistance of local consultant.

Result: Progress reports and evaluation reports.

STEP 5

What: Carry out implementation support and evaluation.
Organize regular supervision missions and evaluate outcomes.

Who: Internationally qualified consultant in RWSS or a Bank technical staff member as part of Bank implementation support team.

Result: Aides-mémoires, evaluation reports.

1. BASIC PRINCIPLES IN RWSS

1.1 Key Characteristics of RWSS

What is RWSS? RWSS *provides potable water to rural communities for domestic uses* (for example, drinking, eating, cooking, bathing, and hygiene), and *requires the supply of high-quality water on a continuous basis*. In the developing world, families – especially women – spend a considerable amount of time trying to provide sufficient water for these uses. The potable water systems usually replace traditional sources of water, such as rivers and open wells, which are often contaminated and distant from the household. Improved rural water solutions include a *range of technologies* from protected wells equipped with manually operated handpumps to more complex gravity-flow or pumped piped water systems connected to houses or public standposts. The technical solution is very *location specific* and will depend on a range of characteristics such as community demand, affordability and willingness to pay, community size and household density, water resources and electricity availability, and topographical issues.

The **health benefits** of improved water and sanitation services derive mainly from the safe disposal of human excreta and the adoption of sustained and effective use of water for hygienic purposes. These objectives often need to be achieved through intensive community sensitization campaigns, based on the existing practices and beliefs of the population. Technical solutions for sanitation will depend very much on household preferences and will consider many factors, such as cultural and gender issues, traditional building materials, costs, water supply availability, environmental concerns, and the legal and policy environment.

RWSS services need to be managed and paid for. Experience shows that community-based management solutions are the most appropriate, as long as the community organization is representative, accountable, and has the capacity to implement its tasks, and there is an adequate tariff and cost recovery mechanism in place to pay for the costs of supplying the service. It is essential for communities to make informed choices about the costs to be incurred, as the estimated tariff must take into account maintenance costs as well. Years of experience also show that community-based management committees need access to technical assistance on a *continuous basis*. This assistance can be provided by local government, a national sectoral agency, or the private sector.

The **institutional and policy framework** in which the multisector project operates, and the rules and procedures adopted during project implementation, are critical to the success and sustainability of community RWSS subprojects. It is important that the roles and responsibilities of stakeholders (primarily *communities*, the *private sector*, and the *government*) are clearly defined, within an appropriate legal framework of ownership and management. This should include, but not be limited to, an autonomous, community-elected water users association to operate the service, set tariffs and manage funds, and ensure continuity in the provision of service.

Capacity building and training at a local level are also highly linked to the project's success. Experience tells that for operations and maintenance to be long lasting, communities need to be trained before, during, and after facility construction, make choices based on all available options, and be given the opportunity to develop their capacity.

Two fundamental characteristics of RWSS can be summarized as follows:

≈ **First key characteristic: RWSS involves the provision of a continuous service, and this service requires management and generates costs.** Understanding this basic concept is fundamental to improving performance of RWSS subprojects. A reliable level of service that the communities can afford and for which they are willing to pay must be ensured.

≈ **Second key characteristic: Water is increasingly viewed as an economic as well as a social good.** This is reflected in the users' willingness to pay for the cost of the service. RWSS practitioners around the globe agree that this concept – referred to as the demand-responsive approach – is essential to successful water supply projects, because it establishes the basis for sustainable operations and maintenance and provides a framework for communities to make informed choices as to the level of service they desire and can afford.

Other related characteristics include:

≈ **RWSS components have immediate and direct welfare consequences.** The failure or malfunction of RWSS systems has direct welfare consequences on the beneficiaries – they no longer have water for essential daily life. Thus, the social cost of poor operations and maintenance is high.

≈ **RWSS components are essentially interdisciplinary in nature.** Investments in water supply cannot achieve their full potential benefit, and ultimately their poverty reduction goals, without complementary efforts in hygiene and sanitation, environmental protection, and sustainable water consumption.

≈ **RWSS investments involve multiple alternatives for design and level of service.** Communities need to be aware of, and participate in, the choice of these alternatives, because it will have implications for the size of the investment and the cost of future operations and maintenance.

≈ **Adherence to quality standards is an essential ingredient for sustainable service delivery.** Quality work is necessary for ensuring long-lasting investments. Construction and equipment installation must therefore be carried out by trained professionals from the beginning.

≈ **Sanitation and hygiene aspects should be seen as distinct activities within RWSS.** In contrast to water supply, rural sanitation systems – entailing household latrines and drainage – do not generally lend themselves to a fee-for-service framework. They involve a strong *software aspect*, which focuses on *awareness and behavioral changes* that extend to the household level and recognize women as key actors, as well as on synergies with education and health projects.

≈ **RWSS includes hardware and software aspects.** Successful and sustainable RWSS projects include not only the infrastructure investment (for example, wells, pipes, pumps, and latrines), but also the software aspects of service management and promoting health and hygiene practices.

1.2 Definitions in RWSS: Demand-Responsive Approach and Willingness to Pay

Fundamental to RWSS jargon are two concepts, the demand-responsive approach and willingness to pay, both of which are interlinked.

Four overarching principles encompass the notion of the *demand-responsive approach:* (a) water should increasingly be managed as an economic as well as a social good; (b) management should be focused at the lowest appropriate level; (c) a holistic approach to the use of water resources should be employed; and (d) women should play a key role in the management of water.

The fundamental characteristics of the demand-responsive approach are:

1. Community members make informed choices about:

≈ Whether to participate in the project

≈ Technology and service-level options based on their willingness to pay for various levels of service (higher levels of service are more expensive)

≈ When and how their services are delivered

≈ How funds are managed and accounted for

≈ How their services are operated and maintained.

2. Government plays a facilitative role, setting clear national policies and strategies, encouraging broad stakeholder consultation, and facilitating capacity building and learning.

3. An enabling environment is created for the participation of a wide range of providers of goods, services, and technical assistance to communities, including the private sector and nongovernmental organizations (NGOs).

4. An adequate flow of information is provided to the community, and procedures are adopted for facilitating collective action decisions within the community and between the community and other actors.

If we understand that water is an *economic good*, it is also true that the poor are no different from anyone else in their *willingness to pay* for reliable water supply and sanitation services. In most countries people are already paying for water and sanitation services, either in time, labor, or money. Experience is also showing that, if asked, households are often willing to pay more for water and sanitation than the established rate.

Several methods are currently in use to quantify the willingness to pay at the subproject level:

≈ Determine what people are currently paying under similar and existing schemes (revealed preference surveys)

≈ Carry out household surveys, using such methods as the contingent valuation method

≈ Carry out focus group discussions on various service and payment options.

In assessing these alternatives, the multisector project should keep in mind that the whole point of the exercise is to facilitate informed choice on investment options and determine a fair basis for setting tariffs that will ensure sustainable operations. In this context, the key question is: *Does the established rate cover the real costs of offering the desired level of RWSS service, and are consumers willing to pay that amount?*

1.3 The Policy and Institutional Environment Matters!

Reliability and sustainability of community-based RWSS services depend on a series of technical, financial, and management support networks, all of which operate within a policy and legal framework.

Understanding the nature, strengths, and weaknesses of this environment will help the task manager to design RWSS interventions that have the greatest chance of sustainable service delivery.

Good practice in RWSS has tended towards decentralized ownership and management of assets and service delivery. This approach dovetails well with the trend towards decentralization and community-driven development. The following summarizes the general distribution of roles among stakeholders at various levels:

National agencies (usually ministries or parastatal agencies) are increasingly acting as *adviser, facilitator, and trainer* to local governments and communities, who themselves are organizing procurement of RWSS equipment and services. In this revised role, national agencies also define and certify quality norms, procurement standards, and training programs for RWSS equipment and service suppliers.

Local governments (usually provincial, district, or similar administrative units) usually provide *support to communities* (such as villages or neighborhoods) in planning, procurement of equipment and services, and training. In some cases, local governments themselves may organize the procurement of equipment and services on behalf of multiple communities.

Communities (usually villages, small towns, or neighborhoods) should be the *owners* of the RWSS assets, with the responsibility for ensuring service provision and operations and maintenance. This includes procurement of the equipment and services, as well as setting and collection of user fees to ensure continuous financial self-sufficiency of service delivery and operations and maintenance.

The private sector (including equipment and spare parts suppliers, operations and maintenance providers, and NGOs) are contracted by the communities to provide a range of RWSS *support services*, which could include equipment and spare parts supply, operations and maintenance, organizational support, and training. These are done under accountable and transparent procurement procedures, and according to national standards and regulations.

1.4 Basic Principles

Below are 13 best practice design principles in RWSS to be used when assessing the country situation and designing the project interventions. Table 1 highlights these principles in relation to major thematic areas.

1. Promote a demand-responsive approach whereby communities make informed choices regarding their participation, service level, and service delivery mechanisms.

2. Promote institutional reform based on clear roles for key stakeholders whereby communities own their facilities, the private sector provides goods and services, and government facilitates the process.

3. Ensure an appropriate legal framework for ownership and management.

4. Implement RWSS projects within the context of broader community and local government development.

5. Establish financial policies underpinning a demand-responsive approach whereby communities pay part of the capital cost in proportion to the cost of the facilities, and all operations and maintenance costs.

6. Support formation of representative water users associations for planning, implementation, and management of community water supply facilities.

7. Create a competitive environment for allowing communities to access a range of providers of goods and services for all aspects of the project cycle.

8. Integrate water, sanitation, and hygiene education in RWSS projects.

9. Promote user investment in sanitation through public awareness and hygiene education, and strengthen the private sector's ability to construct facilities.

10. Ensure representative and informed participation of all stakeholders.

11. Include clearly defined capacity building components that enable all stakeholders to play their roles and build partnerships.

12. Set rules to target poor, unserved communities and vulnerable groups in these communities.

13. Support community-based environmental management to improve living conditions and protect water resources.

TABLE 1

KEY DESIGN PRINCIPLES FOR COMMUNITY WATER AND SANITATION SERVICES

Thematic Area	Problem Definition and Key Responses	Community Water and Sanitation (CWS) Strategy for Rural Areas and Small Towns
Policy Environment	Limited political commitment, weak legal framework, and poor governance lead to unstable policy environment for sector. This results in underinvestment, undefined ownership, poor participation, weak regulation, and conflicting priorities. *Response:* • Bank works only where policy reform is in place, or where there is a demonstrated commitment to it. • Government should clearly articulate and disseminate policies, regulations, and programs. • Role of stakeholders should be clearly defined. • Broad consultation in policy review should be promoted.	**Promote a demand-responsive approach whereby communities make informed choices regarding their participation, service level, and service delivery mechanisms.** Communities decide: • Whether to participate in project. • Preferred level of service based on willingness to pay. • How services are planned, implemented, operated, and maintained. • How funds are managed and accounted for. **Promote institutional reform based on clear roles for key stakeholders whereby communities own their facilities, the private sector provides goods and services, and government facilitates the process.** • Community owns, manages, and helps finance services. • Government at all levels facilitates the process by encouraging stakeholder participation, setting policies and standards, and financing facilities. • Private sector and NGOs provide goods, services, and financing. • External support agencies: financing, technical assistance, policy coordination. • Civil society provides policy and implementation support. **Ensure appropriate legal framework for ownership and management.** • Ownership (water resources + assets). • Recognition and autonomy of community-elected water users associations to operate, set tariffs, manage funds, especially local government. **Implement CWS projects within context of broader community and local government development.** • Support decentralization reforms. • Recognize and promote cross-sectoral linkages (education, health, rural development, energy, etc.).
Financing Options	Demand for services is increasing but service expansion has been constrained by insufficient resource allocation from the public sector, inefficient investments in costly schemes, and a lack of capacity to mobilize resources from users, local government, private sector, and others. *Response:* • Financial policy should link prices charged to costs of services. Users should pay more for higher levels of service. • Tariff policy is important and should be designed to ensure financial viability of each system. • Subsidies should only be transitional and targeted to communities on a one-time basis. • Balance capital investments with long-term operations and maintenance.	**Establish financial policies that underpin a demand-responsive approach whereby communities pay part of the capital cost in proportion to the cost of the facilities, and all operations and maintenance costs.** Promote increased capital cost recovery from users: • An up-front cash contribution based on their willingness to pay is required from users to demonstrate demand and develop community capacity to administer funds and tariffs. • Ensure 100% recovery of operations and maintenance costs. • Improve community-level financial management and resource mobilization, especially for major repairs/replacements and service expansion. • Set up robust financing mechanisms (public and private sector) and explore financial intermediation options (such as household credit for on-site sanitation) to increase internal resource mobilization. • Small towns may need specific assistance for tariff setting and financial management plan for service expansion and upgrading. • Provide detailed information on costs to allow informed choice, and seek to reduce investment costs through lower-cost options and more efficient delivery mechanisms

Thematic Area	Problem Definition and Key Responses	Community Water and Sanitation (CWS) Strategy for Rural Areas and Small Towns
Service Delivery Options	Government monopoly of service provision has resulted in lack of accountability and community ownership, poor management and sustainability, low-quality services, and weak development of private sector and alternative delivery options. *Response:* • Promote community ownership and management and support a range of delivery and management options based on service levels, population size, etc. • Promote policies and institutional reforms that remove barriers to private sector participation and other support and management arrangements. • Develop mechanisms for allowing users to make informed choices (social intermediation). • Promote flexible standards that open up choice and support appropriate technologies and equipment standardization (where required for spare part network). • Consider management and operation and maintenance issues as an integral element of the community planning and decision process.	**Support formation of representative water users associations for planning, implementation, and management of community water supply facilities.** Promote community contracting and transparency in all procurement: • Recognize range of management options based on community size and technical and financial complexity, and consider the special needs of multicommunity regional systems and neighborhood options in small towns. The larger and more complex the system, the greater the need for professional operators. • Ensure long-term support and technical assistance to community management (private and public sector support, associations of water users associations, etc.), appropriate technology, availability of spare parts in the local market, etc. **Create competitive environment for allowing communities to access range of providers of goods and services for all aspects of the project cycle.** • Community organization and formation of representative water users associations, resource mobilization. • Service planning: estimating costs, engineering designs, financing plans. • Training of water users associations in financial management, contract administration, operations and maintenance. • Community awareness raising, hygiene education, sanitation promotion. • Contracting, procurement, and construction supervision. • Long-term support to management, operation, maintenance. • Small towns are institutionally, technically, and financially more complex than rural areas and require additional support and training.
Hygiene and Sanitation	Full economic and health impacts of improved CWS are often not achieved due to lack of attention to hygiene education and sanitation. Approaches to sanitation have focused mainly on technology aspects, rather than on behavior changes and creating a market (supply and demand) for sanitation facilities. *Response:* • Ensure that hygiene education and sanitation components are included in national policy dialogue and resources provided in CWS programs.	**Integrate water, sanitation, and hygiene education in CWS projects.** • Hygiene education and sanitation need clear objectives, performance indicators, and monitoring and evaluation processes. • Hygiene education should build on existing beliefs and community priorities, and seek to achieve effective and sustained use of improved water and sanitation services and hygiene practices. • Schools and family units are both important in hygiene education and sanitation programs. **Promote user investment in sanitation through public awareness and hygiene and sanitation education and strengthen the private sector's ability to construct facilities.** • Subsidy programs for sanitation are not sustainable; however, targeted subsidies may be appropriate to demonstrate approaches and stimulate demand. • Include a wide range of technology options for waste water and excreta disposal and treatment. • Interventions should supplement and be coordinated with national health programs.
Participation and Gender	Lack of community involvement, especially the involvement of women, has been the main reason for poor service sustainability. Traditional project design did not consider the required project rules and incentives to achieve full participation. *Response:* • Demand-responsive approach requires ample information flow, and processes for the community to make all investment decisions.	**Ensure representative and informed participation of all stakeholders.** • Place the community at the forefront of decision making and management through appropriate project rules, incentives, and social intermediation. • Ensure participation of women and minority groups. • Promote exchanges (meetings, newsletters, e-mail, associations of water users associations). • Facilitate stakeholder participation in policy formulation and program design/evaluation. • Monitoring and evaluation should include participation of all stakeholder groups.

Thematic Area	Problem Definition and Key Responses	Community Water and Sanitation (CWS) Strategy for Rural Areas and Small Towns
	• CWS programs should recognize women as primary users of water, hygiene educators, and managers, and involve women in sector development, treating men and women as equal partners.	
Capacity-building	Insufficient attention is paid to the appropriately targeted capacity building required to implement a demand-responsive approach, and there are also few incentives for local private sector and NGOs to participate in programs. *Response:* • Capacity building is central to Bank support in sector. • Capacity building requires a commitment to long-term support. • Projects must have realistic objectives consistent with local capacity and build in local knowledge. • Demand-responsive approach recognizes the need to support community outreach, social intermediation, and training.	**Include clearly defined capacity building components that enable all stakeholders to play their roles and build partnerships.** • Target training to communities, private sector, NGOs, local/regional/national government. • Innovative tools and methodologies are required as well as a learning-by-doing approach. • Community outreach, intermediation, and training are required before, during, and after facility construction. • Selection of trainers and community development workers should be done in a cost-effective and competitive manner, with the community involved in the contracting process as appropriate. • Capacity is most required in social intermediation skills and informing communities about choices. • Training should be time-bound and output and impact oriented, with performance monitoring and targets to measure capacity and achieve goals. • Develop opportunities for local stakeholders (private sector, local government, NGOs) to participate and build their capacity.
Poverty and Access	Majority of clients are the poor, and the poorest are outside the cash economy and politically weak; it is easier to provide services to the rich. Population is increasing, and there are decreased services and resources as well as lack of political commitment towards the poor. *Response:* • Design CWS programs to reach the poorer segments of the population. • Expand range of technology and management options that are affordable to the poor.	**Set rules to target poor, unserved communities and vulnerable groups in these communities.** • Develop baseline information, identify vulnerable groups, and monitor access of the poorer communities to project services. • Expand range of technology options, building on existing resources in community. • Ensure adequate flow of information to all eligible communities and ensure adequate social intermediation and participation by all groups, including women, the poor, and minorities. • Recognize and build on informal safety nets within communities. • Involve women and minority groups in community decisions and management.
Environmental Management	Improper excreta and solid waste disposal are increasingly a source of pollution and related disease. Growing demand for water coupled with high variability of supply contributes to increased competition for scarce water resources and degradation of resource. *Response:* • Consider environmental aspects of CWS: water resources and waste management. • Promote holistic view of integrated water resource management (IWRM) in designing CWS policies and programs.	**Support community-based environmental management to improve living conditions and protect water resources.** • Consider source protection, conservation, education of water users as stewards of water resources, watershed management, and appropriate water resource allocation among competing sectors, etc. • Promote waste management as an integral part of integrated water resource management. • Support public awareness and community education programs on environmental protection and integrated water resource management. • Rely on groundwater rather than surface water, which must be treated to protect water quality.

2. RAPID SECTOR ASSESSMENT

2.1 Why Is a Rapid Sector Assessment Important? Carrying out a rapid sector assessment is important because it provides the project's task manager and team with crucial information about the country's commitment regarding the provision of water and sanitation services and the general strengths or weaknesses of the policy and institutional environment. This allows the team to evaluate, prior to intervention, whether the panorama is ripe for involvement, or if there is *first* a need for policy reform. Accomplishing a good rapid sector assessment can save many future headaches and help the team be better prepared for potential obstacles.

The first step in the rapid sector assessment is to get a *quick overview* of the country context by clarifying the nation's policy and strategy for providing RWSS services and understanding its ongoing programs and capacities. This will involve discussions with the responsible sector agency and stakeholders and review of existing strategy documents, master plans, implementation manuals, and reports.

Secondly, a determination is made of the extent to which sector reform is needed and (a) whether and how this reform should be addressed by the project; and (b) how other RWSS interventions should be addressed in the project.

The rapid sector assessment can be accomplished by examining the following subthemes: (a) national goals and strategy; (b) roles and responsibilities; (c) technology options; (d) finance and cost recovery; (e) legal issues; (f) ongoing programs; and (g) formulating a strategy.

KEY TOOLS
The key tools for carrying out a *rapid sector assessment* are: TOR for Country Assessment for RWSS Component (Annex I); and Checklist for Rapid Sector Assessment, addressing the subthemes mentioned above (Annex II)

TABLE 2
SUMMARY: RAPID SECTOR ASSESSMENT – AVAILABLE DOCUMENTS

Rapid Sector Assessment Phase	Key Document(s) Provided & Additional Online Resources
General	**Annex I:** TOR for Country Assessment for RWSS Component **Annex II:** Checklist for Rapid Sector Assessment **Online:** Sample reports
National Goals & Strategy	Use general documents
Roles & Responsibilities	Use general documents; see Annex X, Sample Bylaw
Technology Options	**Online:** Manuals – The Ethiopia Social Rehabilitation and Technical Design Manual, DFID Guidance Manual on Water and Sanitation Programmes, Lao PDR water supply and sanitation technology options documents, Peru technical manuals, and technology-related websites
Finance & Cost Recovery	**Online:** Guidelines on calculating tariffs, fiduciary management for community-driven development projects
Legal Issues	Use general documents
Ongoing Programs	Use general documents
Formulating a Strategy	**Online:** Sample reports

Below, information complementary to the TORs and checklist is provided for some of the subcategories.

2.2 Roles and Responsibilities

The definition of roles and responsibilities in the sector should be seen within the context of ongoing programs for decentralization and reforms in the urban water sector (for example, management of small town systems may be transferred from national utility to local governments). The sector assessment should summarize the strengths and weaknesses of the actors to assess their ability to play their respective roles in RWSS service provision, with a view towards compiling lessons learned for the project. In particular, the following stakeholders and the fulfillment of their roles should be examined:

≈ **National agency** and its ability to pursue a demand-responsive approach, and to regulate and promote quality standards

≈ **Local governments** and their capacity to support communities

≈ **Communities** and their ability to manage the procurement and oversight of equipment supply and operations and maintenance services

≈ **Local market of suppliers** of goods and services for design, construction, procurement, and spare parts

≈ **Local organizations** to provide support to communities in mobilization, subproject identification and preparation, engineering design, training of water committee members.

2.3 Technology Options

The relevant key issues to examine here include: (a) the extent to which communities have choices for RWSS service delivery; (b) how these options are framed and discussed with the communities (for example, are they fully understood? Do they cover operations and maintenance? Are gender aspects considered?); and (c) the extent to which technical norms and standards exist and are enforced within the country. Other important issues are:

≈ **Are there national RWSS standards? Are they appropriate? Are they sufficiently flexible and affordable to meet various community needs?** Examples of national standards include:

≈ Types of technology or service level for given populations within a given radius

≈ Technical specifications for various technology or service levels

≈ Minimum water quality standards for household use

≈ Environmental standards for siting of RWSS facilities.

The assessment should ascertain the extent to which these standards exist and who is responsible for enforcing them. Also, is there a cadre of sector professionals who are familiar with these standards and can provide quality services to the communities? If not, how can this be developed?

Are communities provided with a list of standard technology options, with their advantages and disadvantages? An example of the range of technical options might include:

≈ Improved shallow wells

≈ Boreholes equipped with handpumps

≈ Spring protection

≈ Mechanized boreholes connected to standpipes or household connections

≈ Surface water catchments linked to piped system

≈ Latrine improvements

≈ Small sewer networks.

KEY TOOLS
The key tools for defining *roles and responsibilities* at a project level are: Sample Bylaw (Annex X); and online page on institutional issues under Key Issues section

Do these options provide information on the investment costs and management implications for operations and maintenance, including annual costs and tariffs required to cover those costs? Communication of these options to communities highlights the need to think through the cost and management implications of their investment choices.

Is water resource availability an issue in the country? The project should be aware of any concerns related to water scarcity and its effect on the cost and sustainability of project investments.

2.4 Finance and Cost Recovery

RWSS subprojects often fail because inadequate attention is paid to finance and cost recovery issues. Therefore the following questions must be addressed:

Is there a standard policy for subsidy across the country? Is the subsidy level fiscally sound and affordable? Is there a standard policy for local sharing of the investment cost that follows the principles of the demand-responsive approach (that is, cost-share level related to cost of service)? The project should strive to promote a consistent approach and financial policy within the country, at least at the regional level. It is also important to determine the extent to which the level of cost share relates to various levels of service. For example, does the percentage contribution and level of subsidy vary for hand-dug wells, deep wells, communal standpipes, or household connections?

Is there a standard policy for recovery of operations and maintenance costs through tariffs? How are these tariffs arrived at? As with investment subsidies, the project should avoid conflicting with established tariff policies and practices, and should promote standard approaches. The key issues to examine are whether the tariffs:

- ≈ Are based on actual costs for rendering differing levels of service
- ≈ Include provision for equipment renewal
- ≈ Include a provision for annual tariff adjustments
- ≈ Allow for financing potential network expansion and upgrading.

What are the software costs and how are they financed? Does the government have a policy on the provision of software items, such as capacity building for the community, local governments, and the network of service providers, and promoting behavioral change for improved hygiene and sanitation? Often referred to as social intermediation, these crucial activities, which generally amount to about 25 percent of project costs, are often either not considered in the project costs or are add-ons.

Is there any reliable information on RWSS costs? The initial assessment should determine the extent to which data exist on unit costs of RWSS service investments, operations and maintenance costs, and other software project costs. These will provide a foundation for estimating project costs and developing the operational manual, as well as a baseline to be used for monitoring and evaluation.

KEY TOOLS
The key tools for analyzing *technology options* are located online, and include: technical design manuals and papers from Ethiopia, Lao PDR, and Peru; and several links to websites with information specific to water supply and sanitation technology

Words of Advice...

Quantify all project costs. Although all subprojects quantify hardware investment costs, they often do not fully account for the software costs necessary for ensuing sustainable service delivery. This includes such expenses as:

- ≈ Training and institution building for the community, local government, and other stakeholders
- ≈ Educational programs for environmental management, hygiene, and sanitation
- ≈ Project supervision, follow-up, and support.

Resources for such expenses should be reserved in the project, or generated through user fees at the subproject level.

Ensure that local contributions to investment cost rise in proportion to the cost of the facilities. This is an essential element of the community's making a meaningful choice between service-level options.

Experience has shown that the arbitrary use of subsidies for all service levels leads to the use of inappropriately expensive facilities and creates expectations that cannot be replicated or effectively scaled up.

For water supply, calibrate tariffs to cover all operations and maintenance, including equipment replacement and depreciation. In the absence of good operations and maintenance cost information, most projects set an amount that reflects common practice, willingness to pay, and ability to pay for water. However, in the interest of providing sustainable service, the project should require that improved cost of service information be generated and used to establish cost-based tariffs in a transparent way. This information can then be used to establish a tariff policy that can be revised regularly by the service providers with the community.

When it comes to sanitation infrastructure, such as latrines, focus on creating demand and minimizing subsidies. Unless the subproject funds can provide for everyone in the community, requesting up-front contributions may mean that the better off gain a higher subsidy or that the poorest are excluded. However, if these investments are part of a multisector project menu, then the following lessons ought to be considered:

≈ Subsidize only the most basic level of facility, leaving people to make improvements as they can afford them

≈ Ensure that the economic ranking of various choices remains the same based on the real costs (such that a more expensive option does not become more attractive than a less expensive option because of the subsidy)

≈ If funds are limited, consider subsidizing only the interventions that have the greatest health impact

≈ Find out what people are willing to pay

≈ Calculate the real cost of assisting the entire target population; is it affordable?

Establish a common financing and cost recovery strategy. The lack of such an agreement could lead to projects and programs undermining each other. The potential payoffs are great, in terms of generating and improving information available for future investments and service providers.

2.5 Legal Issues

The rapid assessment should review existing water legislation with a view towards identifying any potential constraints and facilitating legislation for the development of rural water supply systems. Of particular interest to multisector projects is the legal basis for water use rights, customary entitlements, standards for water quality, and the conditions which govern watersheds, groundwater, and protected areas. Without a clear definition of asset ownership, the responsibility for operations and maintenance can be ambiguous with respect to who does what. This state of affairs results in a steady deterioration of the physical assets and an erosion of the basic service the assets were designed to provide. The following questions therefore need to be addressed:

≈ What is the current law governing water resource ownership and use, and how is it applied?

≈ What is the current law concerning RWSS asset ownership?

≈ Is there a legal recognition of water boards, water user committees, or other entities promoted by the project?

2.6 Ongoing Programs

Once the basic policy, strategy, and institutional framework is clarified, a critical look should be taken at how all this is working. This can be done by means of a rapid analysis of the performance of ongoing RWSS programs and the capacity of the various stakeholders and actors to play their roles.

2.7 Formulating a Strategy

Depending on the results of the analysis of the country context, the rapid assessment would formulate a strategy for incorporating RWSS components into the multisector project.

This task should conclude with a clear definition of the next critical steps and responsibilities of the government's team in the preparation of the component. This would include, but not be limited to:

KEY TOOLS

The key tools for *finance and cost recovery* are located online: guidelines on how to calculate tariffs specific to RWSS; fiduciary management for community-driven development project guidelines; community financing agreement; and extensive literature on the subject

≈ Contribution to project logical framework, and to technical, economic, environmental, and social analyses

≈ Preparation of project rules and covenants

≈ Preparation of operational manual and guidelines

≈ Development of project monitoring and supervision arrangements.

2.7.1 Sector Policy Reform

Are the sector policy and institutional conditions favorable? The assessment should gauge the nature and severity of policy and institutional constraints on, and opportunities for, providing and improving sustainable RWSS services. The situation may fall into one of three broad categories:

≈ **Unfavorable,** due, for example, to highly centralized, rigid, and supply-driven policies, with little attention to sustainable maintenance

≈ **Functional, but with a need for capacity building and reform** to ensure sustainability and improve current institutional frameworks and capacities

≈ **Fully functional,** such that the multisector project can readily link into ongoing programs and institutional frameworks.

Is there a need for sector reform? Clarification of the policy and institutional constraints and opportunities should indicate the extent to which additional policy reform and institutional strengthening should take place, either within the project, or in a separate sector-based project.

If the country's policy is considered 'unfavorable', that is, focused totally on centrally controlled, supply oriented provision of infrastructure, the project should seriously consider whether RWSS investments should be made at all. In such cases a sector-based reform package may be proposed and RWSS investments put on hold, pending these reforms. More commonly, however, RWSS policies will be moving in the right direction, but the support networks and institutional capacities are weak. In these cases, the strategy should be to concentrate on the most important weak points and propose ways in which such weaknesses can be addressed either with project funds, or as part of subproject costs.

The strategy should also include explicit monitoring and adjustment of the various measures such that, over time, capacity building and support mechanisms are continuously improved, even beyond the life of the subproject intervention.

What is the approach to community development, training, and gender? Depending on stakeholder capacities and progress towards decentralization, the strategy should propose an explicit approach for promoting community ownership and management of the RWSS assets, as well as ensuring that gender-related issues are addressed in the project. A simplified decision making framework, which capitalizes on the basic knowledge generated during the sector assessment, can assist the project team in addressing the above issues and narrowing down the options for defining the RWSS component (diagram 1).

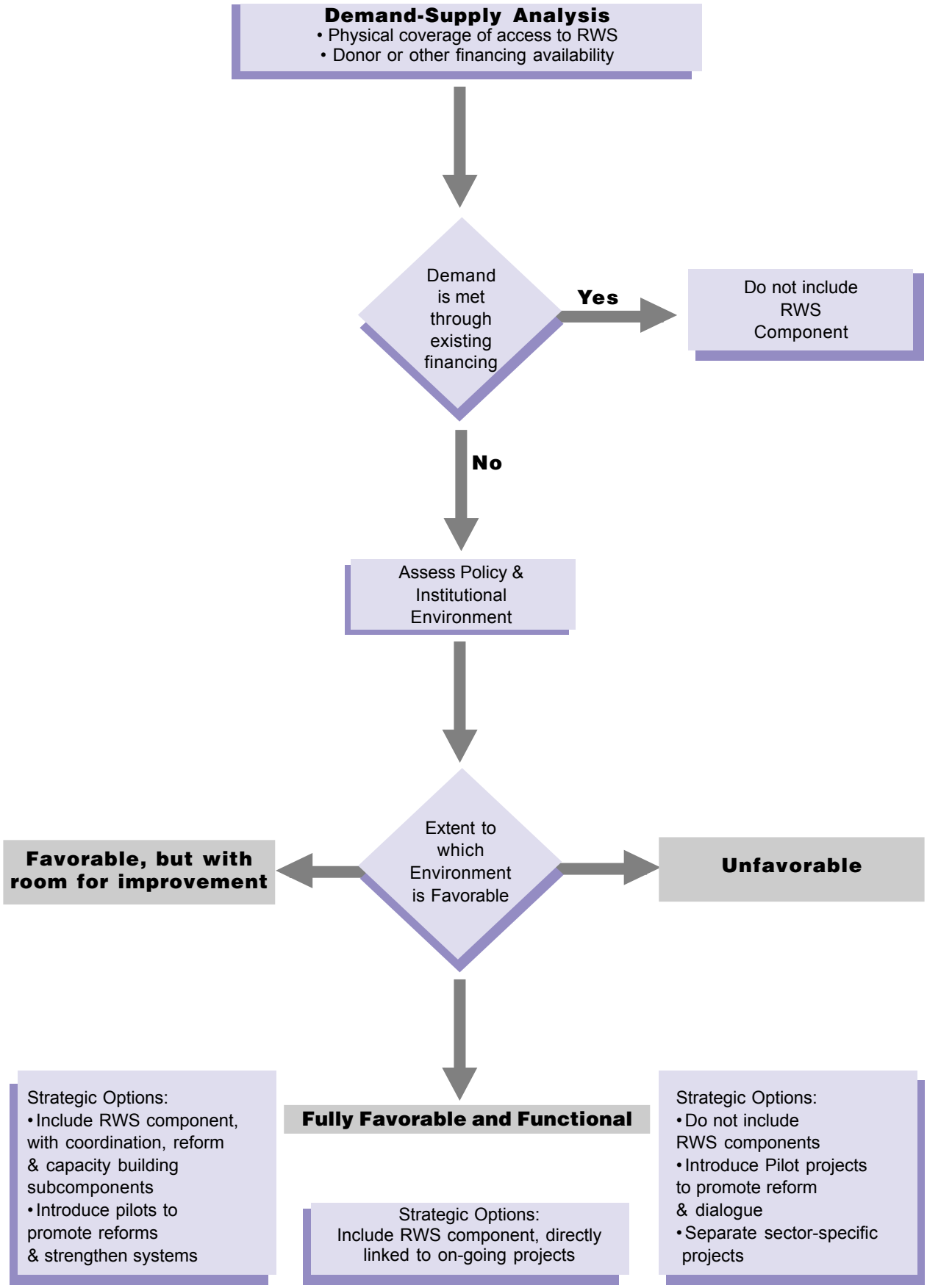
2.8 Expected Outputs

After reviewing this section and considering the questions posed, the expected output of the rapid sector assessment should be to (a) assess the demand for, and supply of, RWSS in the country; (b) assess the policy and institutional capacity to meet RWSS demand; (c) recommend a role for the project; and (d) formulate a strategy as to the next steps to take.

Once a rapid sector assessment is accomplished, you are ready to begin project preparation for designing the RWSS component in the project cycle.

DIAGRAM 1

DECISION FRAMEWORK FOR DETERMINING ROLE OF RWSS IN MULTISECTOR PROJECTS



3. SANITATION AND HYGIENE PROMOTION

3.1 The Urgent Need for Promotion

The international community set the Millennium Development Goal to halve the number of people without access to adequate sanitation facilities by 2015, meaning that an additional 350,000 people will have to gain access to improved sanitation facilities every day between now and 2015.

Numerous studies have shown that, taken alone, physical improvements to quantity and quality of drinking water supply have only limited effects on public health. The most significant improvements result from *behavioral changes* that prevent pathogens reaching the immediate human environment, such as sanitary disposal of faeces, handwashing after defecation and before touching food, and keeping drinking water free from faecal contamination.[1]

In light of this knowledge, RWSS components should include an explicit framework for *community-level facilitation and adult learning* focused on (a) clarifying hygiene- and sanitation-related problems; (b) providing input into technical investment options; and (c) setting measurable objectives and indicators for hygiene behaviors.

3.2 Some Definitions

Sanitation. "Interventions to reduce people's exposure to diseases by providing a clean environment in which to live; with measures to break the cycle of disease. This usually includes disposing of or hygienic management of human and animal excreta, refuse and wastewater, the control of disease vectors and the provision of washing facilities for personal and domestic hygiene. Sanitation involves both behaviours and facilities which work together to form a hygienic environment."

Promotion. "To raise or advance a cause, raise the profile and status of the cause, further the growth and expansion of the cause and to further its popularity. In the public health sense of the word, it also involves providing the enabling mechanisms to others so that they may take up the cause armed with effective tools." [2]

While *hygiene promotion* is about the communication of behavioral practices that are directly related to health, such messages are not usually the ones that lead people to the decision to have and use (or not have or use) a latrine. Other factors are more likely to sell the concept of sanitation, such as privacy, convenience, and status, even aesthetics. This demands a holistic approach to promotional activity.

3.3 Promotion Guidelines

Some guidelines for designing hygiene promotion and sanitation components in rural communities include:[3]

Prepare the Ground

≈ Carry out high-quality baseline surveys at start-up.

≈ Recognize that in very poor rural communities latrine programs may not be demand-driven, though water programs are. Demand may have to be created.

≈ Base program design, and speed of implementation, on in-depth knowledge of reasons for low demand (beliefs, practices, economic constraints, priorities, and other reservations).

[1] Van Wijk, C. and Tineke, M. 1995. *Motivating Better Hygiene Behavior: Importance for Public Health and Mechanisms for Change*. UNICEF, New York.

[2] Simpson-Hebert, M. and Wood, S. 1998. *Sanitation Promotion: WSSCC Working Group on Promotion of Sanitation*. WHO, Geneva.

[3] Adapted from: World Bank. 2002. *State-of-the-Art Hygiene and Sanitation Promotion Component Design of Large-Scale Rural Water Supply and Sanitation Programs: Inception Report.*

Mobilize Available Human Resources

≈ Identify the constraints on national, provincial, and local government in terms of availability of personnel and costs. Draw local leaders and residents interested in promoting sanitation and hygiene into the community education process, while supporting the roles of local-level personnel in program activities.

≈ Make every effort to include all village-level stakeholders and sector officials, with particular emphasis on women, in program operation.

≈ Build capacity within local communities to support ongoing outreach to households.

≈ Engage interested residents, particularly younger female residents, as hygiene promoters in their own villages, beginning with qualitative, baseline, and monitoring studies and continuing through implementation. Wherever possible, hire these promoters to work with similar residents in expansion areas.

Create Linkages to Build Initial Capacity

≈ Ensure that sanitation promotion and hygiene education begin in community and schools at the same time.

≈ Establish capacity before asking for change, for example, by ensuring that appropriate latrines are available in schools at the same time as hygiene education is initiated. Where improvements in water supply are required to implement appropriate hygiene, make sure that these improvements are made at the same time as latrines are installed.

Establish Practicable Cost and Payment Options

≈ Recognize that insistence on household payment covering all costs for latrines may mean, in very poor communities, that few latrines are actually built. Undertake careful calibration of household contribution such that enough is charged to give a sense of ownership, while ensuring that latrines remain affordable to the population.

≈ Time intervention carefully, for example, by scheduling campaigns to begin just before the agricultural season ends and families have some money which could be invested in sanitation.

Scale Up Realistically and Flexibly

≈ Create demonstration programs in small areas and make every effort to ensure the success of these programs before attempting to expand to adjacent areas.

≈ View demonstration programs as a form of action research, adapting the approach and technology as information and experience increase.

≈ As demonstration projects achieve targets, disseminate descriptions of the process which is under way, and support sector officials at national level to visit project areas.

≈ Take into account cultural differences between regions of the country when expanding sanitation promotion and hygiene education into new areas.

3.4 Resources Available on the Web-Based Toolkit

≈ Terms of Reference for Hygiene Specialist (see Annex IX)

≈ A Manual on Communication for Water Supply and Environmental Sanitation Programmes: http://www.unicef.org/wes/com_e.pdf

≈ A Manual on Hygiene Promotion: http://www.unicef.org/wes/hman.pdf

≈ A Manual on School Sanitation and Hygiene: http://www.unicef.org/wes/sch_e.pdf

≈ A Sanitation Handbook: http://www.unicef.org/wes/san“e.pdf

≈ Unit 4: Linking Water, Health, Sanitation and Environmental Protection, Operation and Maintenance of Rural Water Supply and Sanitation Systems – A Training Package for Managers and Planners: http://www.who.int/water_sanitation_health/hygiene/om/omruralsystems/en/

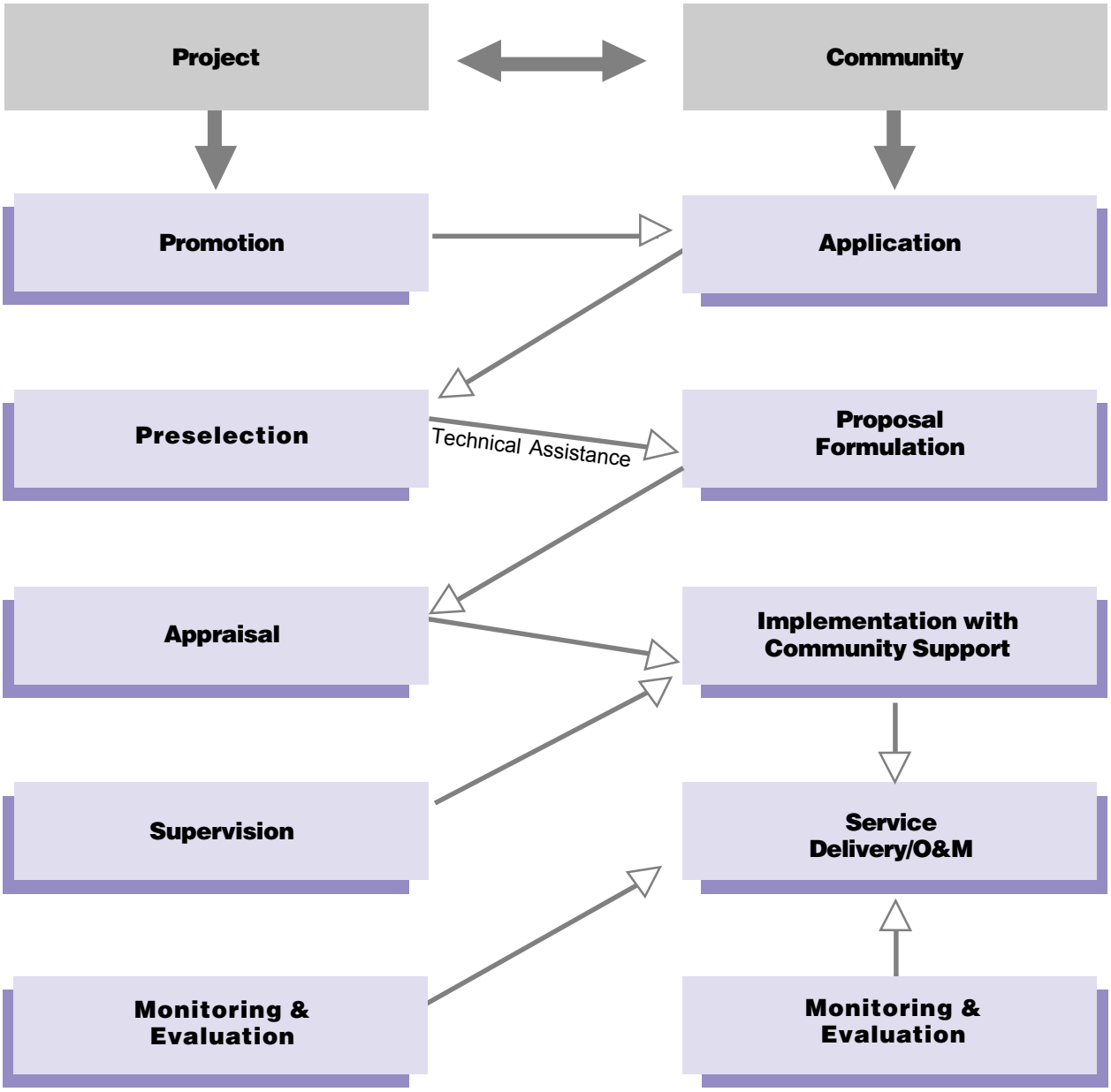
4. RWSS IN THE PROJECT CYCLE

4.1 The Project Cycle

The project cycle may be viewed as an interactive process between the project and the community, with supporting roles being played by the private sector, NGOs, and other stakeholders (diagram 2). Depending on the country, the project may be understood to be an implementing agency such as a social fund or local government.

DIAGRAM 2

PROJECT/COMMUNITY INTERACTIVE ROLES DURING THE PROJECT CYCLE



KEY TOOLS
The key tools for implementing the *project cycle around RWSS* are: Terms of Reference for RWSS Intervention Design (Annex III); checklist addressing the project cycle phases mentioned above (Annex IV)

Using the subproject cycle as a framework, this section provides (a) guidance on why each stage is important to RWSS; (b) guidance on what can be expected from each partner throughout the project cycle; and (c) references to the resource section and the web-based toolkit for tools for achieving these tasks.

TABLE 3

SUMMARY: RWSS IN THE PROJECT CYCLE – AVAILABLE DOCUMENTS

Subproject Cycle Phase	Key Document(s) Provided	Additional Resources Online
General	**Annex III:** Sample TOR for RWSS Intervention Design **Annex IV:** Checklist for RWSS Subproject Component Design	Surf through Resources section online to find: TORs, checklists, project appraisal documents, manuals, procurement guidelines, sample contracts, audits, and monitoring, and more
Promotion		• Community promotion guidelines • UNICEF Manual on Communication for Water Supply and Environmental Sanitation
Application	**Annex V:** List of Documents Required during Project Preparation	• Community project request form • Project sample forms • Application/action by community guidelines • Guidelines for designing a water and sanitation committee
Preselection		• Standard score sheets • Preselection criteria
Proposal Formulation	**Annex V:** List of Documents Required during Project Preparation	• Community project request form • Guidelines on calculating tariffs • Procurement and financial procedures manual for use of community-based organizations • Hygiene and sanitation literature • Sample TOR for programmatic environmental assessments • Community mobilization and planning guidelines
Appraisal	**Annex V:** List of Documents Required during Project Preparation	• Subproject appraisal checklist • Ex-ante evaluation tool (based on FHIS – Honduras Project) • Community Subproject agreement between the implementing agency and communities (example from Ethiopia)
Implementation Support	**Annex VI:** Project Operational Manual Index **Annex VII:** Service-Based Performance Indicators of RWSS	• Training resources (manuals on water, sanitation, and hygiene promotion) • Community-based contracting sample projects • Community-based contracting literature • Flow of funds scheme • Procurement section contains: memoranda of understanding (MOUs), agreements, applications, contracts, and useful links
Operations and Maintenance	**Annex VII:** Service-Based Performance Indicators of RWSS	• User cost sharing rules • Operations and maintenance task schedule sample (from India) • Guidelines on tariff determination • Operations and maintenance training package for managers and planners (from WHO)
Monitoring and Evaluation	**Annex XI:** Checklist for RWSS Project Monitoring and Evaluation Indicators	• Sample TORs for monitoring and evaluation • Participatory evaluation guidance • Ex-post evaluation tool, sample impact studies

KEY TOOLS
The key tools for *promotion* located online: community promotion guidelines; and UNICEF Manual on Communication for Water Supply and Environmental Sanitation

4.2 Promotion

Why: The promotion phase is the first critical opportunity for the subproject to engage communities in (a) deciding whether or not they want a project; and (b) defining their development priorities, one of which may include RWSS. If RWSS is chosen, this is an occasion for communicating the demand-responsive approach and explaining the project rules.

What: Options for RWSS investments should link into the multisector project's initial information campaign, which will allow the community to evaluate and decide what type of project best meets its needs. Approaches such as integrated rural accessibility planning may be useful in assisting communities to identify their priorities. If a water project is chosen, the message should be that RWSS is a separate service that must abide by certain basic principles (look at Basic Principles in RWSS section). These principles may be transmitted in an RWSS brochure or flier, which would spell out the basic approach, rules, and procedures under which RWSS investments may be made. Key themes would include:

≈ The concept of water as an economic good that requires management and comes at a cost

≈ Informed choices on the technical options and implications for management and cost

≈ The community's responsibility for continuous management and finance of operations and maintenance

≈ Cost recovery rules and tariffs to ensure sustainable service delivery

≈ Community organization, management, and contracting arrangements

≈ Minimum technical standards and quality

≈ Asset ownership, roles, and responsibilities

≈ Environmental, hygiene, and sanitation aspects

≈ Application and proposal formulation requirements.

Who: Projects often engage promoters familiar with community facilitation, who can be trained to discuss these issues with prospective communities, perhaps supported by radio and other media campaigns.

KEY TOOLS
The key tools include List of Documents Required during Project Preparation (Annex V), and online resources: community project request form; project sample forms; application/action by community guidelines; and guidelines for designing a water and sanitation committee

4.3 Application

Why: The completion of an application form is the first expression of demand. Successful RWSS projects have found it useful to allocate within the subproject cycle a time period during which communities:

≈ Confirm RWSS as a development priority

≈ Assimilate the basic principles and requirements for RWSS investment, transmitted during the promotion phase

≈ Establish an appropriate organizational structure to oversee the maintenance of the systems and service provision

≈ Start revenue mobilization

≈ Apply for assistance under the project.

What: Communities would meet to confirm their interest in the project in general and in RWSS investments in particular. If RWSS is selected, the meeting will discuss the information received and identify the assistance required to enable the communities to acquire their own water supply and sanitation facilities. Topics of discussion would include:

≈ Selection of spokespersons

≈ Participation of all community members

≈ Analysis of information contained in the flier and application form

≈ Community interest and form of involvement in the project

≈ How the community will raise funds for investment and operations and maintenance

≈ Who could assist the community to understand and prepare to receive project assistance

≈ Technological options.

Based on these meetings, the interested communities would fill in application forms for:

≈ The whole project in general

≈ An application specific to RWSS.

The community would also open a bank account, with a specified minimum deposit.

Who: The community may organize these meetings itself, or recruit technical and facilitation assistance to complete these initial steps. The project, through district-level technical staff, may participate in, or observe, the community-level meetings.

KEY TOOLS
The key tools include List of Documents Required during Project Preparation (Annex V) and online resources: community project request form; project sample forms; application/action by community guidelines; and guidelines for designing a water and sanitation committee

4.4 Preselection

Why: The preselection process enables the project to (a) screen communities for RWSS investments based on need, commitment, and capability; (b) get an initial assessment of investment and annual budget requirements; and (c) avoid disappointing communities by reducing the number of full-blown proposals that are prepared.

What: The project will organize a subcommittee responsible for reviewing applications. The applications will be ranked on standard score sheets according to preselection criteria. The project will preselect a limited number of communities, based on financial and staffing capacity.

Who: The project, in collaboration with technical agency and local government.

4.5 Proposal Formulation

Why: Experience has shown that successful RWSS projects require a committed up-front investment in order to establish durable community organizational arrangements. This is because an RWSS subproject has distinct requirements, insomuch as it:

≈ Depends on a limited natural resource, water, which is also an economic good, and therefore requires consumers to pay for the service

≈ Requires consultation and coordination among community members, local governments, investors, development workers, engineers, and other stakeholders

≈ Lends itself to alternative technical design and levels of service with varying cost and management implications

≈ Requires an inter-sectoral and integrated approach, including engineering, the environment, health, and education

≈ Needs a maintenance system that is (a) intensive; (b) managed by the community; (c) supported by additional technical assistance; (d) able to provide spare parts; and (e) backed by a reliable system of financial and administrative management.

KEY TOOLS
Include online resources: standard score sheets; and preselection criteria

KEY TOOLS
The key tools include List of Documents Required during Project Preparation *(Annex V)* and additional online resources such as: community project request form; guidelines on calculating tariffs; procurement and financial procedures manual for use of community-based organizations; hygiene and sanitation literature and training methodology; sample environmental TORs; community mobilization and planning guidelines

Technical assistance can help the community address these sector-specific requirements in their proposals, through:

≈ Analyzing the existing situation as regards hygiene, water and sanitation, environmental issues, and baseline information; and determining effective demand for sanitation facilities

≈ Choosing service-level options for water and sanitation services

≈ Determining the capital cost and the level and mobilization of community contributions

≈ Formulating a facilities management plan for operations and maintenance and method of organization

≈ Establishing a financial management plan and a tariff plan to finance the facilities management plan

≈ Preparing a hygiene and sanitation promotion campaign and linking to sanitation investments

≈ Identifying and addressing potential environmental and social safeguard concerns

≈ Identifying responsibilities and ongoing training requirements, including organization and training of the water and sanitation committee.

What: Pre-selected communities will prepare subproject proposals, according to standard guidelines and templates laid out in the operational manual.

Who: Prior to preparation, the communities would receive technical assistance to help them make decisions and complete their proposal request. Technical assistance would be recruited and paid for by the project from among consultants or NGOs, or by hiring a qualified individual in the community. Such personnel would act as facilitators for the community and the water and sanitation committee.

4.6 Appraisal

Why: A sector-specific appraisal format is necessary to assess effective RWSS demand and verify technical, social, and economic feasibility and sustainability

What: Subproject appraisal is undertaken with a standard appraisal checklist designed to verify and confirm community commitment and capacity to ensure sustainable service delivery. Once projects are selected, a community subproject agreement or MOU is signed by the community and the project. This is also signed, if appropriate, by local government and by sector-based or other implementing agencies.

Who: The project would identify an appraisal team for RWSS applications, in conjunction with technical implementing agencies and local government authorities as appropriate.

4.7 Implementation with Community Support

Why: Intensive community-level assistance and training is required at this stage to reinforce ownership, promote health and hygiene benefits, and establish a sound foundation for sustainable service delivery and operations and maintenance. Many lessons have been learned regarding community-based contracting of RWSS services. Two major issues stand out:

≈ **Adapt contracting mode to fit service-level option.** This can range from simple, witnessed agreements to formal performance-based service and supplier contracts

≈ **Ensure adequate skills and tools to administer contracts.** 'Short and sharp' training modules can explain to water and sanitation committee members what is required in terms of expertise and skills.

What: All civil works should be accompanied by community development activities. The operations manual should lay out:

≈ The types of investments eligible under the project

≈ Procurement of goods, services, and works, including rules, procedures, and responsibilities for bidding, selection, and supervision

≈ Flow of funds during the investment period

≈ Construction, which involves supervision of contractors and certification of works.

Three types of arrangements may be envisioned:

≈ The community manages the funds by themselves

≈ The community hires a qualified individual or firm and is responsible for supervising them

≈ The project or local government does the hiring on behalf of the community.

At the same time, each subproject budget should include the provision of technical assistance for training in such vital areas as community organization, health and hygiene education, service delivery management, and operations and maintenance.

Who: The communities should be involved at all stages of subproject implementation, construction, and community development activities. Technical assistance would be recruited to ensure the community development aspects.

KEY TOOLS
The key tools include Project Operational Manual Index Sample (Annex VI), Service-Based Performance Indicators for RWSS (Annex VII), and online tools: training resources and manuals; community-based contracting sample projects; community-based contracting literature; flow of funds scheme; various agreements, applications, MOUs, contracts, and useful links

4.8 Operations and Maintenance

Why: Lack of effective operations and maintenance is the most common problem of RWSS components. To address this problem, operations and maintenance training should begin during the implementation phase, and focus on the community's capacity to ensure reliable and sustainable service delivery.

What: Four major elements are emerging in good practice RWSS projects:

1. **Operations and maintenance and facilities management plans.** Operations and maintenance plans should not only list maintenance tasks, but also provide a detailed task schedule focused on preventative maintenance and specifying responsibilities. The project operations manual can provide guidance or models for such schedules, relying on, for example, color-coded cards and other management techniques for regular maintenance and monitoring.

2. **Cost recovery and tariff structures.** The key to achieving sustainable service delivery is an effective system for user payments. Methods for RWSS tariff calculation have been developed that can be adapted to operations and maintenance budgets on an annual and multiyear basis, as well as covering financial needs for future system expansion or equipment replacement.

3. **Community-level training for operations and maintenance.** Numerous methodologies have been developed for community-level training in RWSS services. An excellent source can be found in *Operation and Maintenance of Rural Water and Sanitation Systems – A Training Package for Managers and Planners* (WHO).

4. **Performance-based service contracts.** This relatively new approach aims to remunerate a contractor for providing a service at a predefined quality standard, rather than pay the contractor based on time, works, or materials. In its simplest form it could involve paying a village operator a flat monthly fee to cover scheduled routine and periodic maintenance, with incentives for improved service and penalties for a reduction in the service standard. As systems increase in complexity, the use of service contracts, leases, management contracts, or concessions may be appropriate.

Who: Operations and maintenance responsibility starts with the management committees chosen by, and accountable to, the community. Backstopping services, however, need to be planned for, by some mix of the private sector and technical government services.

KEY TOOLS
The key tools include Service-Based Performance Indicators for RWSS (Annex VII), and online: user cost-sharing rules; operations and maintenance task schedule sample; tariff determination guidelines; and operations and maintenance training package for managers and planners

4.9 Monitoring and Evaluation

Monitoring focuses on whether a project is being implemented as designed, providing timely information for ensuring that progress, quality, and effect of processes and procedures is maintained. Process **evaluation** examines how the project operates and addresses problems in service delivery.

Measuring and monitoring *sanitation and hygiene interventions* is distinct from that of water supply. Under the Global Public-Private Partnership for Handwashing with Soap, a global monitoring and evaluation framework is being developed to measure sanitation and hygiene impacts. The model contains two components to measure impacts: (a) behavior change; and (b) health impact.

KEY TOOLS
The key tools include Outline Terms of Reference for Project Supervision Missions (Annex VIII); Checklist for RWSS Project Monitoring and Evaluation Indicators (Annex XI); Water Supply, Sanitation, and Health Impact Evaluation Indicators (Annex XII); and online: sample TORs for monitoring and evaluation; participatory evaluation literature; ex-post evaluation tool; and sample impact studies

Why: Effective monitoring and evaluation systems should be viewed as tools for helping stakeholders at various levels focus on achieving sustainable service delivery.

Community-level information systems will encourage ownership, transparency, and accountability in the investment phase, as well as promote a longer-term commitment to the monitoring of operations and maintenance.

At the *government level*, as the multisector project is set up to launch sector-based investments rather than to provide long-term sector support, the government project unit needs to have a monitoring tool to ensure that:

≈ RWSS investments are carried out as planned and of acceptable quality

≈ Sustainability and management issues are addressed after the initial investment (through the community-based systems noted above)

≈ Sector-based support networks are in place and functioning.

At the *project level*, information is needed to assess the project's contribution to poverty reduction goals and the poverty reduction strategy paper (PRSP).

What: As noted in the terms of reference, input, output, and outcome indicators for RWSS would be developed in conjunction with the stakeholders and be linked to the project's logical framework as well as to the PRSP development goals and indicators.

The operations manual would specify approaches, procedures, and responsibilities for two broad types of interlocking activities:

1. Subproject performance monitoring

≈ **Community-level participatory monitoring and assessments.** As part of the software support, the subproject should assist communities to develop their own simple information systems to document and monitor progress and performance of project implementation and post-investment service provision. A wide range of tools and methods that can be adapted to project circumstances has been developed along these lines.

≈ **Government-level subproject performance monitoring.** In addition to the standard investment progress and completion reports, it is recommended that the subproject cycle include *post-investment subproject assessment*, at intervals of, for example, six months or one year following completion of the investment. To this end, post-investment evaluation tools for each subproject can also provide the basic data for aggregating, analyzing, and reporting project results in the government's regular progress reports, as well as providing basic information on the project's contribution to poverty reduction objectives.

2. Project performance and impact evaluation

This encompasses the periodic assessment of overall project performance and its causal links with poverty reduction and other project objectives. Within the context of the multisector project, these would aim to meet the following milestones:

≈ Midterm review

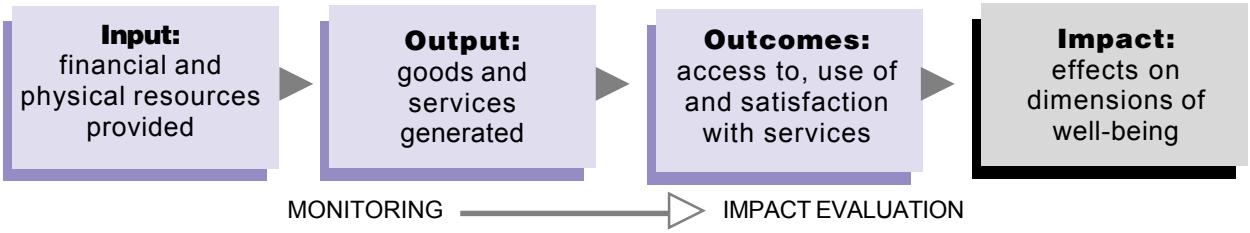
≈ Implementation completion report

≈ Specific reviews and focused impact studies.

Impact evaluations are the result of a process involving input, outputs, and outcomes, and are essential to understanding how effective projects have been in attaining their expected outcomes and whether these have been sustainable or not (diagram 3).

DIAGRAM 3

FROM MONITORING TO IMPACT EVALUATION



Who: As part of the community development activities, technical assistance and training would be provided to the community in the establishment of simple community-based information systems, focused on service-level performance indicators.

The next section only presents a few of the many key tools currently available online by visiting http://www.worldbank.org/rwsstoolkit/index.htm.

In addition to those provided here, you will find:

TORs: Sample TOR templates that can be adapted to a specific project for both a rapid sector assessment and for designing the RWSS component of a multisector project.

Checklists: Practical tools to facilitate the tasks spelled out in the TORs. The checklists address rapid sector assessment and RWSS in the project cycle.

Sample reports: Good practice examples of rapid sector assessment reports (including back-to-the-office reports and aides-mémoires) and project appraisal documents of multisector projects with an RWSS component.

Manuals: Best practice examples of project-specific RWSS operational and technical design manuals, which can be adapted to the multisector project. Also included are generic manuals produced by other agencies such as the Water, Engineering and Development Centre and its WELL resource centre, the UK's Department for International Development, the IRC International Water and Sanitation Centre, and the United Nations.

Procurement: Agreements, applications, contracts for works and services, MOUs between different stakeholders, audits, and monitoring sample templates and examples.

Audits and monitoring: Sample templates for monitoring and reporting on project implementation performance, as well as examples of progress reports and implementation completion reports.

Guidelines: Other useful guidelines for setting up water and sanitation committees, NGO selection criteria, rules for user cost sharing and calculating tariffs.

Selected reading: Case studies, source materials categorized by theme; community contracting, decentralization, finance, gender issues, health, legal, hygiene and sanitation, monitoring and evaluation, supply chain, technology, training resources, willingness to pay, notes on lessons learned, and links to presentations on RWSS.

Useful links: A list of internal World Bank links and external links to organizations committed to water-related issues is provided for additional resources.

5. RESOURCES

ANNEX I
SAMPLE TERMS OF REFERENCE FOR COUNTRY ASSESSMENT FOR RWSS COMPONENT

(Name of Multisector Project)

(Name of Country)

Background *(Provide brief description of the project, including its background, stage of development or implementation, geographic scope, etc.)*

OBJECTIVE

The objective of the country assessment is to establish an operational knowledge base concerning RWSS activities in (*name of country)*. This knowledge base will assist the (*name of project)* team to identify critical constraints and opportunities for RWSS components within the project. The assessment will set the stage for formulating a strategy on how to incorporate RWSS components into the project and lay the foundation for interface between the project and RWSS sector-based institutions. The assessment seeks to address two fundamental questions:

≈ Do existing policies, practices, and the institutional framework favor sustainable RWSS service delivery in the country?

≈ Depending on the above answer, what should be the strategy for incorporating RWSS components into the multisector and/or country Bank program?

TASKS

The country assessment will be divided into the following three major tasks:

Task 1: Review RWSS Policy and Institutional Framework

The objective of this task is to clarify the nation's policy for providing RWSS services and its strategy for achieving that policy. It will involve discussions with the responsible sector agency and review of existing strategy documents, master plans, and implementation manuals. This review should be essentially *descriptive*, while task 2 will provide an analysis of performance. It will include the following subtasks:

Subtask 1.1: Clarify national RWSS goals and objectives. Specify whether this is expressed in terms of national coverage; access to services; or other indicator(s). It may be in the form of a mission statement of the national agency or national master plan.

Subtask 1.2: Assess national RWSS strategy. Assess the government's strategy to achieve its stated goals, focusing on whether, and to what extent, the strategy involves a demand-responsive approach. This may be stated as a set of guiding principles within the context of a master plan or implementation manual for the national agency or ministry. Indicate whether the strategy involves integration of health and hygiene considerations.

Subtask 1.3: Assess roles and responsibilities. Clarify the roles and responsibilities for RWSS service provision in the country, in respect of: (a) national policy development and implementation; (b) social intermediation; and (c) RWSS equipment procurement and service provision. This assessment should take into account ongoing programs for decentralization, and clarify the evolving roles of the national government, local government, communities, the private sector, NGOs, and other stakeholders.

Subtask 1.4: Assess technology options and standards. Summarize the extent to which communities are provided with a choice of service-level options for RWSS. Indicate how these options are presented to the communities and whether the choices are framed in terms of cost of equipment and cost of operations and maintenance. Describe the technical standards and norms existing in the country, as well as if and how they are enforced.

Subtask 1.5: Assess finance and cost recovery policy and methods. Clarify the current policy and practice for local contribution during (a) the equipment and installation phase; and (b) the operations and maintenance phase. Indicate the sources of finance (private, donor, government subsidy) during both phases, and the extent to which user fees are required during the operational phase. Describe mechanisms for collecting user fees and adjusting user fee rates to reflect increases in service levels and covering long-term amortization and equipment replacement cost.

Subtask 1.6: Assess legal framework. Clarify the legal status of RWSS assets, indicating to what extent the communities, local government, and the national agency retain ownership of the assets. Summarize any cases of conflicts that have arisen in the project area or the country regarding RWSS assets and mechanisms available to resolve these conflicts.

Task 2: Analysis of Ongoing Programs and Institutional Capacity

Once the basic policy and institutional framework is clarified, task 2 will assess how the strategy is working. This will involve a rapid analysis of the performance of ongoing programs and the capacity of the various stakeholders and actors to play their roles. It will include two broad subtasks:

Subtask 2.1: Assess program/project performance. Describe the types and number of donor and internally funded programs for RWSS in the country. Evaluate the basic approaches taken in these programs. Critically evaluate the performance of these programs in terms of their stated goals (for example, coverage rates and sustainability).

Subtask 2.2: Assess capacity and performance of actors. Provide a critical overview of the ability of various actors to perform their respective roles as identified in the strategy. This would include, but not be limited to: (a) national agency; (b) local government; (c) community organizations; (d) private sector suppliers of equipment, spare parts, and engineering and operational services; and (e) NGO and social intermediation agencies. Describe the strengths and weaknesses of the above groups of actors in terms of:

≈ Local market of suppliers of goods and services for design, construction, procurement, and spare parts provision at the community or local government level

≈ Existing and potential capacity of local organizations to provide required community-level intervention in mobilization, subproject identification and preparation, engineering design, training of water committees, hygiene education, and outreach to community members

≈ Evolving nature of decentralization and its future role in supporting community-based efforts.

Task 3: Constraints and Opportunities: Evaluate a Role for the Project

The goal of task 3 will be to decide whether or not to include an RWSS component in the *(name of project)* multisector project, and if so, what should be the elements of this intervention. Every effort should be made to link with the ongoing PRSP preparation process and information sources in the country. Depending on the outcome, the next steps in the project preparation process will be identified, including terms of reference for further design activities. It will involve the following subtasks:

Subtask 3.1: Assess demand and supply for RWSS services. Provide a broad overview of the extent to which the demand for RWSS services is being met in the country and project area. This should be expressed in terms of (a) physical coverage by types of service and geographic dispersion; and (b) sources of donor or other financing. Secondary data sources should be used for this assessment, which could include PRSP-related studies, social assessments, or RWSS master plans. The outcome of this analysis should show:

≈ Whether there is a need for additional financing for RWSS services, which could be met through the multisector project

≈ An order of magnitude estimate of the level of RWSS investment requirements, should an unmet demand be identified.

Subtask 3.2: Assess policy and institutional capacity to meet RWSS demand. Evaluate the nature and severity of policy and institutional constraints on, as well as opportunities for, the provision and improvement of

sustainable RWSS services. The outcome of this analysis should determine whether the policy and institutional environment is (a) unfavorable, due, for example, to highly centralized, rigid, and supply-driven policies, with little attention to sustainable maintenance; (b) functional and oriented towards demand-driven approaches, but where institution strengthening and capacity building measures will be required to ensure sustainability; or (c) fully functional, such that the multisector project can readily link into ongoing programs and institutional frameworks.

Subtask 3.3: Recommended role for the project. Based on the above analyses, determine whether there is a role for the multisector project to play in RWSS service provision and recommend an overall strategic approach for this to occur. This may involve one or more of the following strategic options:

STRATEGIC OPTIONS FOR RWSS SERVICE PROVISION

Constraints and Opportunities		Sample Strategic Options
Demand-Supply	**Policy and Institutional Environment**	
Demand is already met through existing finance and projects	N/A	• Do not include RWSS component
Demand is not met through existing finance and projects	Unfavorable	• Do not include RWSS component • Introduce pilot projects through multisector investment funds to promote reform and dialogue • Prepare a separate sector-specific project
	Favorable, but some need for reform and capacity building	• Include RWSS component with coordination, reform, and capacity building elements
	Fully favorable and functional	• Include RWSS component, directly linked to ongoing programs

Subtask 3.4: Contribute to project logical framework. Depending on the outcome of subtask 3.3, provide a concise statement of the RWSS-related development objectives, as well as draft outcome indicators, to be integrated into the project logical framework.

Subtask 3.5: Definition of next steps. Based on the above results, spell out the next critical steps to be taken, in the context of project preparation. This could include, but not be limited to, the Terms of Reference (Annex 1) for consultancy to:

≈ Finalize project strategy

≈ Prepare operational manual and guidelines

≈ Prepare project rules and covenants

≈ Contribute to project logical framework, and technical, economic, environmental, and social analyses

≈ Develop project monitoring and supervision arrangements.

Outputs

The output of this assignment will be a country assessment report summarizing the results of the above tasks. The consultants will present a draft report and verbal briefing of the major findings after three weeks of fieldwork. A final report will be presented one week following comments by the project task team leader.

Level of Effort and Expertise Required

The country assessment will be carried out by a two-person team:

≈ Water supply and sanitation engineer/specialist

≈ Rural development/social scientist.

Both persons will have extensive field experience in the planning and implementation of community-managed water and sanitation projects, preferably both in and outside the country.

ANNEX II
CHECKLIST FOR RAPID SECTOR ASSESSMENT

1. National RWSS Goals, Targets, and Indicators

- Is there a stated national goal for rural water supply and sanitation?
- Is it stated in terms of:

(a) Coverage (for example, 'xx% of communities have RWSS systems')
(b) Access to services (for example, 'xx% of population have access to RWSS services')
(c) Health, hygiene, or sanitation factors (d) Other indicators?

2. National RWSS Strategy

- What is the strategy to achieve the goal?
- Does it also include an element of the demand-responsive approach and effective and sustained service delivery? Is there any link with hygiene and sanitation strategies?
- Are there links with the PRSP and are they consistent with the Millennium Development Goals? Are there clear and realistic indicators?

3. Roles and Responsibilities

- Who is responsible for national policy development and implementation (for example, a central ministry, a parastatal agency, donor projects, service fees)?
- What is the distribution of roles and responsibilities for RWSS services? How does this relate to decentralization programs, central government of parastatal agency, local governments, communities, private sector, and NGOs? What is the capacity and performance of the actors?

4. Technology Options and Standards

- Do communities have a choice in the scale and type of RWSS systems installed?
- Are these choices framed with regard to cost of construction and operations and maintenance?
- Are there standards and norms with regard to RWSS service levels in the country?

5. Finance and Cost Recovery

- What is the policy for local contribution for construction and installation of the system?
- How are operations and maintenance services financed (user fees, community funds)?
- What are the sources of funds for the contributions of various actors?
- Does the policy include arrangements for long-term system amortization and replacement?

6. Legal Framework

- What is the legal framework regarding asset ownership and water resource use?
- Have there been any serious conflicts regarding water resource use and are there any effective mechanisms for resolving these conflicts?

7. Analysis of Ongoing Programs

- Describe the types and number of donor and internally funded programs for RWSS in the country. What is their performance of the strategy in terms of achieving the stated goals (for example, coverage rates)?
- To what extent is the demand for RWSS services being satisfied through ongoing programs?
- What is the capacity and performance of the actors in playing their respective roles? These would include, but not be limited to: national agency, local government, community organizations, private sector suppliers of equipment and spare parts, engineering and operational services, NGOs, and social intermediation agencies
- What is the capacity and performance of the local market of suppliers of goods and services for design, construction, and procurement at the community or local government level?
- What is the existing and potential capacity at local level to mobilize social intermediation and engineering aspects of the ongoing programs?
- In the context of decentralization, in what direction is this evolving?
- How effective are the programs in achieving the national goal and strategy?

8. Strategy for RWSS in the Project

- How can the project contribute to unmet RWSS demand in the project area?
- Is there need to differentiate between types of systems and geographic areas?
- Is there need for sector reform and capacity building that can be addressed in the project, or should this be addressed in a separate stand-alone project?
- What should be the distribution of roles and responsibilities among sector stakeholders?
- What should be the next steps in the detailed preparation of the component, including establishing subproject rules and operational manuals?

ANNEX III
SAMPLE TERMS OF REFERENCE FOR RWSS INTERVENTION DESIGN

(Name of Multisector Project)

(Name of Country)

BACKGROUND

(Provide brief description of the project, including its background, stage of development or implementation, and geographic scope, drawing on country assessment or other preliminary information on the RWSS sector.)

OBJECTIVE

The objectives of the RWSS component design are to establish an implementation strategy, define project activities, and prepare guidelines under which RWSS subprojects will be funded by *(name of multisector project)*.

(Add any additional information or objectives identified in the country assessment.)

TASKS

The assignment will be divided into the following tasks:

Task 1: Summarize Policy and Institutional Issues

Based on the country assessment or other existing information, summarize the main policy and institutional issues for RWSS, with particular reference to sustainable service delivery, to be financed under the project. This would include, but not be limited to:

≈ Policy and institutional environment and extent to which the demand-responsive approach is used

≈ Extent of unmet demand for RWSS services and performance of other projects or programs.

Task 2: Carry Out Sector Dialogue and Participatory Strategy Formulation

In view of the overall policy and institutional issues summarized above, initiate a participatory process with the major stakeholders and arrive at a consensus on the basic strategy for including RWSS components in the project. This would be implemented through a series of consultations and workshops, and would address how, and under what conditions, RWSS investments will be made under the project. It would include, at a minimum, the following strategic themes:

≈ **Policy and institutional framework.** Are fundamental reforms needed of the existing policy and institutional framework before RWSS can be considered part of the project (for example, reform of the central or sector-based agency)? If so, how will they be addressed – within the project, or in a sector-based project?

≈ **Roles and responsibilities.** Clarify areas of responsibility and collaboration for RWSS components of the project. For example, should RWSS subprojects be required to collaborate with existing sector-based institutions and existing norms? Do such norms need to be created?

≈ **Establishing technical norms and making service-level options available to communities.** Recommend a policy and approach to ensure availability of service-level choices to communities and adherence to technical norms during both the investment and operational phases. This should include a policy and implementation framework for communications with the community at all stages of the subproject cycle.

≈ **Hygiene and sanitation issues.** Recommend a policy and approach to ensure that hygiene and sanitation issues become part of the RWSS component.

≈ **Finance and cost recovery.** Recommend a policy and approach for finance and cost recovery for both the investment and the operational phases.

≈ **Community support and institution building.** Define the strategy to ensure local capacity for sustainable service provision. This will include: a) Local government capacity to backstop communities; b) Support to NGOs and private sector to provide sustainable supply chains for software and hardware components; c) Community contracting mechanisms; and d) Ensuring environmental and social safeguards and mitigation during installation and operational phases.

Task 3: Define RWSS Component and Activities

Based on the results of task 2, specify the types and estimated magnitude of RWSS investments that would be financed under the project. If applicable, define sector-specific institutional and capacity building activities to be financed under the project. Describe how and where linkages with other subprojects or programs (such as health-related projects) will be promoted.

Task 4: Elaborate Operations Manual for RWSS Subprojects

Within the framework of the above strategy, and in collaboration with *(specify the main stakeholders)*, spell out the rules and procedures for identifying, preparing, appraising, implementing, and monitoring community RWSS interventions within the context of the project. The implementation manual would specify all the steps in the subproject cycle, and provide a checklist of critical items or issues to be addressed at each stage in the cycle (see Annex 1 for a list of model operations manuals).

Task 5: Elaborate Community-Based RWSS Management Tools

In addition to the project-based guidelines, the consultant will collaborate with sector-based stakeholders to prepare a set of toolkits to be used and continuously improved on by the communities and RWSS service providers. These tools would be developed in local languages and user-friendly formats. They would be at various levels of technical detail and targeted to various stakeholders, according to their roles and responsibilities. Specific areas would include, but not be limited to:

≈ Participatory analysis of existing water and sanitation facilities, as well as hygiene and environmental practices, as part of needs assessment

≈ Simple tools for assessing different technologies and making an informed choice of service-level options

≈ Communications approaches in respect of ensuring long-term operations and maintenance and financing through user fees and tariffs

≈ Communications approaches in respect of promoting hygiene and sanitation benefits

≈ Forming, organizing, and managing water user committees

≈ Community contracting methods, management, and documentation

≈ Standards and norms for private sector-based operations and maintenance services

≈ Standards and norms for spare parts supply and social intermediation services

≈ Standards and norms for community-based performance monitoring and auditing of RWSS services.

Task 6: Finalize Logical Framework and Monitoring and Evaluation Plan

Based on the overall strategy and project subcomponents, a short workshop would be conducted with the project team and major RWSS stakeholders to summarize the sector-based goals, development objectives, and project

inputs and outputs. This will also provide a forum for arriving at a consensus concerning indicators of performance at various levels:

≈ Project performance, which would be part of the operations manual

≈ Community-level and institution-level performance, which would be part of the locally-based RWSS management tools.

Task 7: ***Specify Critical Issues and Risks***

Specify critical policy or institutional issues that have a bearing on the successful achievement of sustainable RWSS services and recommend conditionalities or measures to address these issues or minimize the risks.

OUTPUTS

The consultant will produce the following outputs:

SUMMARY OF CONSULTANT OUTPUTS

Week	Output
0	Commencement of assignment
2	Preliminary report, which would summarize results of tasks 1, 2, and 3, with an outline and work plan for completing tasks 4-7
4	Draft RWSS component operations manual (task 4)
6	Final operations manual (task 4). Draft logical framework and critical issues report (tasks 6-7)
8	Draft community-based RWSS management toolkit (task 5)
10	Final locally-based RWSS management toolkit (task 5)

LEVEL OF EFFORT AND EXPERTISE REQUIRED

The design of the RWSS intervention will be carried out by a three-person team:

≈ Water supply and sanitation engineer/specialist 2.5 months

≈ Rural development/social scientist 1.0 month

≈ Communications/publications specialist 1.0 month

The water supply and rural development specialists will have extensive field experience in the planning and implementation of community-managed water and sanitation projects, preferably both in and outside the country.

The communications/publications specialist would be locally-based. A local graphics and publishing company may also be engaged to produce the locally-based management toolkits.

ANNEX IV

CHECKLIST FOR RWSS SUBPROJECT COMPONENT DESIGN

1. Promotion

- A field-tested communications strategy and program
- Trained promoters or facilitators
- Explanation of policy framework (such as demand-responsive approach) and institutional responsibilities.

2. Application and Preselection

- Application form designed and field tested
- Preselection criteria and procedures established (including score sheets)
- Community facilitation support available.

3. Proposal Formulation/Community Support

- RWSS proposal templates and guidelines
- Guidelines and resources available for community-level technical assistance
- Procedures for recruiting and paying for community-level technical assistance.

4. Appraisal

- Establishment of appraisal criteria and checklist
- Establishment of qualified evaluation team
- Template community subproject agreement.

5. Implementation (Construction and Community Development)

- Eligible project list
- Procurement guidelines and forms
- Flow of funds guidelines and forms
- Community development guidelines and procurement procedures.

6. Operations and Maintenance

- Guidelines for operations and maintenance management, including cost recovery and contracting
- Community-level training for continued service delivery and operations and maintenance management.

7. Monitoring and Evaluation

- Midterm review
- Implementation completion report
- Specific reviews and focused impact studies.

ANNEX V

LIST OF DOCUMENTS REQUIRED DURING PROJECT PREPARATION

(*These documents and guidelines are all available in the resources section online*)

Global Tools

- ≈ Terms of reference for intervention design
- ≈ Checklist for RWSS component design

Applications, Forms, and Contracts

- ≈ Community project request form
- ≈ Memorandum of understanding (MOU) between ministry and local government
- ≈ MOU between local government and community water agency
- ≈ MOU between local government and community
- ≈ MOU between community water agency and community
- ≈ Letter of invitation to bid by a community/farmer group
- ≈ Subproject proposal format
- ≈ Letter of submission of bid
- ≈ Instructions to bidders
- ≈ Contract for works
- ≈ Order and contract for services
- ≈ Order and contract for supply of goods
- ≈ Contract form
- ≈ Subproject appraisal checklist
- ≈ Subproject completion report
- ≈ Environmental impact assessment

Guidelines and Manuals

- ≈ Community promotion guidelines
- ≈ Application/action by community guidelines
- ≈ Guidelines for designing a water supply and sanitation committee
- ≈ Guidelines for calculating tariffs
- ≈ Community mobilization and planning guidelines
- ≈ Manual on hygiene promotion

ANNEX VI

RWSS PROJECT OPERATIONAL MANUAL INDEX SAMPLE

TABLE OF CONTENTS

- Guidelines
- Procedures for approval of procurement
- Procurement of goods and works
- Procurement by communities
- Procurement by consultant services

- Operations and maintenance
- Auditing
- Monitoring and evaluation
  - Monitoring methods
  - Evaluation methods
  - Roles and responsibilities
  - Key monitoring and evaluation indicators
  - Monitoring of gender aspects
  - Water and sanitation committee indicators
  - Supervision by the World Bank
  - External monitoring and evaluation

6. ***Technical Design Aspects***

- Design parameters
- Sanitation
- Water source siting and selection
- Construction procedures and technical specification
- Water-lifting devices
- Water quality
- Other technologies

7. ***Training and Capacity Building***

- Local government
- Private sector
- Water and sanitation agency
- Communities

8. ***Financial Management***

- Project accounts and payments
- Fund flow mechanism for subproject implementation
- Audit

9. ***Environmental Impact Identification***

SAMPLE LIST OF SERVICE-BASED PERFORMANCE INDICATORS FOR RWSS

Coverage

- ≈ Percentage of households/population with access
- ≈ If houses are excluded, what are the reasons?
  - ≈ Point sources: within a certain distance
  - ≈ Connections: based on # of households with connections.

Quality, Sanitary, and Environmental Conditions

- ≈ Water quality parameters (for example, lead, arsenic, cadmium)
  - ≈ Measured: daily, monthly, annually
- ≈ Other quality parameters (for example, taste, color)
- ≈ Sanitary conditions at and around the point sources (for example, protecting potable water sources from animals, proper drainage).

Availability

- ≈ Number of days per month service provided, number of hours per day
- ≈ Average waiting times at point sources
- ≈ Number of days/hours service interrupted.

Operations and Maintenance

- ≈ Accomplishment of routine and periodic maintenance tasks according to schedule
- ≈ Response time to repair breakdowns
- ≈ Types, number, and cost of repairs
- ≈ Types, number, and cost of spare parts replacements.

Financial Issues

- ≈ Does established tariff level cover recurrent administrative and operations and maintenance costs, major repairs, and system rehabilitation and expansion?
- ≈ Cost recovery: amount of tariff arrears, percentage of consumers who have paid
- ≈ Is there a positive cash flow? Account balance? Is this sufficient to cover major repairs?
- ≈ Maintenance of bank account, financial records
- ≈ Is there an audit mechanism? If so, when was the last audit and what were the results?

Consumer Relations

- ≈ Time for collecting user fees
- ≈ Responsiveness to complaints and inquiries
- ≈ Customer satisfaction (from surveys)
- ≈ Does management body provide periodic reports to community?

ANNEX VIII
OUTLINE TERMS OF REFERENCE FOR PROJECT SUPERVISION MISSIONS

Introduction

The following can help task managers assess the progress of the RWSS component at various stages of project implementation. Prior knowledge of these issues by implementing agencies would also help them prepare for supervision missions and make supervision time in the field more effective.

Project Launch

The following items may be verified during a project launch mission or workshop.

Written documentation. Is a field-tested operations manual complete? Is it written in local language and accessible to all stakeholders (it may be useful to have manuals targeted to various levels)? Are procedures, rules, and procurement regulations clear? Do the templates facilitate their implementation? Are they based on a demand-responsive approach? Do they include environmental and water quality standards? Do they reflect the 'dos' of RWSS project design?

Stakeholder analysis. Are all the people who are involved at various levels fully aware of their roles and do they have the capacity to carry them out? How will the project rectify perceived capacity gaps? This analysis may include short visits to potential project sites for first-hand assessment and interviews with stakeholders.

Work plan. Is there an implementation plan for the first six months of the program, with clear delineation of responsibilities? Does this include such key initial activities as promotion and the establishment of project information management systems? Does the management information system include collection of baseline information for monitoring and evaluation, which could be tied to targets in the PRSP? Is there an agreed plan for the types of information required for the supervision and follow-up missions (see below)?

Subproject Supervision and Follow-Up

It will be useful for the supervision mission to structure its regular supervision missions around the following elements to gain a cumulative picture of how the project is proceeding throughout its life. These may be organized as follows:

Overall progress. This will include quantitative information related to the number and types of systems, number of communities and populations served, and overall costs and disbursements. The supervision missions should aim to continuously build an information base on cumulative RWSS outputs and outcomes. This would be rapidly reviewed during each supervision mission to get a feel for progression towards original targets, and assessed in more detail in annual, midterm, and final reviews. This information would emanate from the logical framework and include such indicators as:

≈ Number of communities, populations, and households serviced by improved RWSS (by type of system and region)

≈ Investment costs (total costs, costs per system, cost per household, variations by region)

≈ Completion and quality of works (planned versus actual)

≈ Performance of systems (continuous service and breakdowns)

≈ Impact on health (follow up of baseline surveys and PRSP indicators)

≈ Capacity and performance of the actors (analysis of actors: national and local government, communities, private sector, and NGOs)

≈ Customer satisfaction

≈ Lessons learned.

Subproject field verification. It will be useful for the supervision to carry out a short field trip to verify reported

results and adherence to project rules and procedures, gain a firsthand appreciation of field-level implementation constraints, and discuss potential solutions (see attached checklist).

Stakeholder assessment. The supervision mission should assess the actual performance and capacities of various stakeholders and institutions, with the aim of identifying problems, issues, and potential solutions.

Policy and institutional issues. If the component includes policy and institutional reforms, which may include legislation or capacity building of the national water or sanitation agency, the supervision mission should report on the progress of these reforms.

Work plans. The supervision mission should verify the work plans for the next implementation period, focusing on milestones and responsibilities.

Resources

The supervision mission for the RWSS component should have at a minimum:

≈ A technically-qualified person familiar with RWSS design, installation, and management

≈ A social scientist familiar with the software aspects of RWSS projects.

This expertise may be drawn from other members of the team supervising the multisector project as a whole.

Checklist for Subproject Field Visit and Verification

The following items should be verified during field verification of individual subproject sites:

Promotion and preselection activities. Did the community receive adequate information prior to its application? Was the application and preselection process perceived as transparent?

Subproject development, proposal, and appraisal. Has the community gone through a process of informed choice regarding the technology, level of service, and implications for operations and maintenance? Have they focused on health and sanitation issues? Have they received adequate technical assistance?

Subproject implementation progress. The supervision mission should assess the implementation progress in comparison with the agreed plan. This should include not only civil works and procurement, but also community support and software aspects. Any major deviations from the agreed schedule should be analyzed and addressed. In respect of the works, it is imperative to explicitly focus on performance for three contractual areas:

≈ Timing of works

≈ Cost of works

≈ Quality of works.

Subproject service provision. For those communities where investments are completed, the supervision mission should verify the functionality and sustainability of the RWSS services. These will include responding to the following main questions (with sample indicators):

≈ Is the water flowing reliably? (days of continuous service; number and types of breakdowns)

≈ Is the water and sanitation committee functional? (legal agreements; maintenance records and documents; training and competence of members)

≈ Are tariffs being collected? (collection rates; positive bank account balance)

≈ Is water quality being assured? (monitoring records; environmental management plan)

≈ Is hygiene being promoted and assimilated? (assessment of assimilation of messages for behavioral change)

≈ Are vulnerable groups served? (assessment of actual versus planned coverage rates)

≈ Are customers satisfied? (results of focus group discussions)

ANNEX IX
SAMPLE TERMS OF REFERENCE FOR HYGIENE SPECIALIST

1. Rationale for Improved Hygiene Behavior

The rationale for proposing such an initiative in *(country X)* is:

≈ Diarrheal diseases are one of the most important causes of morbidity and mortality in Indonesia in children under five years old.

≈ Reliable data on handwashing with soap after using a toilet or after cleaning up a child are limited. However, studies in rural areas indicate that handwashing occurs mainly after work but that handwashing with soap is not common.

≈ Informal discussions with community women and men revealed that soap is not used for killing germs but for smelling good.

It is now recognized that handwashing is a much more cost-effective means of lowering diarrheal incidence than the more costly infrastructure building programs. Nevertheless, hygiene promotion initiatives in the country have in the past focused on the provision of water and sanitation facilities, good storage methods, and water treatment, but not on handwashing. Little is therefore known about the availability, affordability, and desirability of soap, especially for use after contact with excreta, in rural and semi-urban areas. There is a need to make a connection between hygiene promotion and provision of water and sanitation facilities on the one hand and the production and distribution of affordable soap on the other hand. Soap manufacturers stand to gain by selling more soap through an expansion of their market into more households and by better market penetration towards poorer households. Public agencies stand to gain by involving soap manufacturers in their programs aimed at improving the quality of life by reducing morbidity related to improper hygiene practices.

2. Objectives and Scope of Work

The World Bank would like to procure the services of a behavior change specialist to assist in developing and improving the programming of health activities through a public-private partnership. The consultant will provide guidance and facilitation during the mission to interested partners to consolidate resources and focus efforts towards an appropriate handwashing campaign through existing programs, projects, and available data.

The specific objectives of the assignment are:

≈ To visit the project sites to understand the context and scope of existing activities, particularly current school and community hygiene promotion activities being implemented in conjunction with village water supply and sanitation infrastructure improvements

≈ To understand, generally, the current status, constraints, and drivers for handwashing in communities

≈ To meet with government, NGO, and private sector stakeholders to introduce the handwashing program concept, and assess interest and possible ways forward

≈ To provide a model for collaboration and action for a public-private partnership for handwashing within the context of the project

≈ Gain buy-in from key stakeholders to adopt the model for collaboration.

3. Responsibilities of the Contracted Specialist

The consultant will be responsible for the following:

≈ Conducting an assessment of the project with a focus on behavioral change objectives

≈ Providing input to the midterm review process specifically relating to component 2

≈ Production of a framework for action within the project for developing a campaign for handwashing with soap in collaboration with identified partners and government agencies

≈ Obtaining support/buy-in from Ministry of Health and Ministry of Education for the proposed framework.

4. Qualifications and Selection of the Consultant

The consultant will be a public health specialist with expertise in developing hygiene education programs and possibly brokering partnership programs for health. S/he will have a track record of at least 10 years' experience in planning and developing social marketing and health behavior campaigns. Commercial/industry sector experience is an asset.

5. Final Products

The final products include:

≈ A final report detailing meetings with stakeholders and recommendations for a framework for action for an improved hygiene/handwashing education program

≈ Recommendations and feedback to the midterm review.

6. Time Schedule

It is expected that the work will last about two weeks from mobilization to final report.

ANNEX X

SAMPLE BYLAW OF VILLAGE WATER AND SANITATION COMMITTEE

(This sample bylaw is drawn from India and governs the formation of a village water and sanitation committee)

Constituted for the

Village ..... Block ..... District .....

The Gram Panchayat of Village ..... Block ..... District .....constituted under clause 29 (6) of the United Provinces Panchayat Raj Act 1947 and Govt. of UP GO NO-2158/33-1-2001/48/99 TC-II dated 18 September 2001 hereby approves the formation of Village Water and Sanitation Committee and authorizes it to perform planning, construction, maintenance and operation of water supply schemes under the Swajaldhara Programme. The Gram Panchayat hereby promulgates the rules and regulations for the formation and operation of activities.

General Rules

1. This set of rules shall be called Village Water Supply and Sanitation Committee Rules.

2. This set of rules shall be applicable within the boundaries of the revenue village .....

3. This set of rules shall become operative from the date of notification.

Definitions

1. 'Gram Sabha' means a body established under clause 3 and formed by individuals registered in the voters' list of the village.

2. 'Gram Panchayat' means a Gram Panchayat (constituted) under clause 12 of the Act.

3. 'Population' means the population as determined in the previous census whose compatible data have been published, and the population at present as ascertained by the actual census carried out under the Swajaldhara Programme.

4. 'Panchayat Area' means the territorial area of a Gram Panchayat, announced as such, under the sub-clause (I) of clause II.

5. 'Public property and public land' means such buildings, parks, gardens or other places, where one can enter either on some payment at the spot or by some other means or where admission is permitted.

6. 'Village' means a public area, entered as village in the revenue documents of the district in which it is situated and wherein such an area is also included which has been declared as a village for the purposes of this law, by the state government through an ordinary or an extra ordinary order.

7. 'Village Water Supply and Sanitation Committee' means the committee formed under the Swajaldhara Programme

8. 'Support organization' shall mean an organization which will help in the operation of the project in the Swajaldhara Programme village. This may mean an NGO, a community-based organization, a firm or a company.

9. 'Quorum' shall mean presence of over 50 percent of the total number of adults in all the households living in the revenue village.

Rule 1

Village Water and Sanitation Committee (VWSC) Formation Procedure:

1. JPS constituted by UP Panchayat Rule Act 1947 Rule 29-6 will be work as VWSC.

2. Chairman of VWSC will be elected member of Panchayat.

3. 7-14 members shall be co-opted from users groups.

4. VWSC treasurer will be nominated by VWSC members.

5. VWSC account will be operated jointly by chairperson and treasurer of VWSC.

6. Among all VWSC members (elected and co-opted) the selected members, the representation of SC/ST shall be 20 percent and that of women shall be 30 percent.

Rule 2

The tenure of Village Water and Sanitation Committee:

1. The normal term of the Village Water and Sanitation Committee shall be five years. After five years the Village Water and Sanitation Committee shall be selected by the proposal of the Gram Panchayat.

2. In case of dissolution of Gram Panchayat the Village Water and Sanitation Committee shall function till the new Gram Panchayat is formed. If the new Gram Panchayat expresses its confidence in the Village Water and Sanitation Committee by passing a specific proposal to that effect, in such cases the pre-constituted Village Water and Sanitation Committee shall complete its term.

3. In the event of the newly elected Gram Panchayat expressing its lack of confidence, the re-election of the Village Water and Sanitation Committee shall take place, otherwise the previously elected Village Water and Sanitation Committee shall complete its term.

4. After the completion of the term, the new Village Water and Sanitation Committee shall be formed according to the rules mentioned above.

Rule 3

Relation of Village Water and Sanitation Committee with the Gram Panchayat:

1. The Village Water and Sanitation Committee is constituted as a sub-committee of the Gram Panchayat. Therefore, it shall, every year, submit its description of activities, accounts of income and expenditure and follow the suggestions as proposed by the Gram Panchayat.

2. The Village Water and Sanitation Committee shall have its accounts audited as that of Gram Panchayat.

Rule 4

Functions of the Village Water and Sanitation Committee:

1. The Village Water and Sanitation Committee shall, according to the process provisioned in the Swajaldhara Programme, survey the assets related to the previously established drinking water supply scheme and prepare a detailed list thereof.

2. The Village Water and Sanitation Committee shall, for the money received from government/other institutions, open and operate an account in any bank or post office.

3. The Village Water and Sanitation Committee shall collect contribution (cash/labor) for construction works and money from beneficiaries/Panchayat for the operation and maintenance of schemes.

4. The members' contributions and statement of income and expenditure of Village Water and Sanitation Committee shall be made open to public.

Rule 5

The Village Water and Sanitation Committee, with the help of community and support organizations, shall depict, at a public spot, the community map of the village depicting public properties, natural resources and households of the village to which it belongs.

Rule 6

The Village Water and Sanitation Committee, along with its support organization, shall discuss all possible options of the drinking water supply scheme and the drainage system for disposing waste water of the households; and shall select the optimum option based on its merits and demerits and on the financial capacity of the villagers.

Rule 7

The committee, with the participation of the village, shall place all the community action plans before the general

meeting of the village, wherein one adult member from each household must be necessarily present. The meeting will be held according to the determined quorum.

Quorum: Presence of adult members of more than half of the households of each cluster in the village.

Rule 8

The committee shall measure, in every season (Winter, Summer, Rainy), the water at the source and shall maintain its record. It also shall prepare a plan of necessary environmental arrangement to conserve the source of water.

Rule 9

The committee shall conduct the capacity development programs and shall get deposited the prescribed contribution for latrine, compost pit, soak pit, garbage pit, rain water tank, hand pump boring, tree plantations, irrigation pool, community centers lane, naula, gadhera, modification, etc., according to the demand and shall make the amount of grant available to the beneficiary in two installments. At the same time, it shall also get deposited the prescribed contribution and maintenance advance for the proposed scheme.

Rule 10

If the source of water lies in the forestland, the committee shall start proceedings with the support organization to acquire the forestland on lease, and shall regularly deposit the annual lease rent and maintenance amount.

Rule 11

Water Tax Assessment and levying:

The Village Water and Sanitation Committee shall be free to determine the water-fee for the operation and maintenance of the constructed drinking water scheme/schemes in the village and the existing ones in whichever condition it may be.

To maintain uninterrupted water supply in the village the Village Water and Sanitation Committee shall prepare the annual income/expenditure budget, by fixing the water tariff to be levied upon the consumers and place it before the general meeting of the village to pass a resolution to pay all the dues regarding the operation, maintenance, wear and tear, electric bill and chemicals, etc., for the water supply scheme/schemes, from the said proposed water-fee.

Rule 12

In case of any conflict on issues like construction of water supply schemes, maintenance, acquisition of land for construction, water pollution, water tariff collection, etc., the committee, with assistance of village level institutions, Van Panchayat, Revenue department, Forest department, is free to settle the issue.

Rule 13

Responsibilities and rights of the committee:

In order to plan, execute, operate and maintain the drinking water and environmental sanitation works in the village, the committee shall be free to determine the technological options in the general meeting and assign the various responsibilities to members; form rules of environmental sanitation, cleanliness of home and village and prescribe token pecuniary punishment in cases of their being ignored; deposit the amount so levied in its accounts and issue valid receipt to the person concerned.

The committee shall be free to enter into any agreement regarding drinking water and environmental sanitation schemes; receive amounts for the works; open joint accounts in the bank/post office and comply with the agreement.

The documents to be maintained:

The committee shall keep up the following documents regarding its income, expenditure, assets, decisions, observations, etc.:

1. Procurement register

2. Membership register

3. Assets/stock register

4. Visitors' register

5. Baseline/general information register

6. Cash/labour contribution register

7. Bank/post office pass book, and check book files

8. Cash book, ledger, and voucher

9. Receipt book

10. Water tariff collection register

11. Electricity bill register

12. Payment and expenses register

13. Other necessary documents

Implementation Phase

Rule 14

It shall be the responsibility of the committee that the procurement of works be of the precise quality, such as of the ISI brand, etc.

Rule 15

It shall be the responsibility of the committee to select, impart training and employ on an honorarium basis the local skilled labor to complete the works.

Rule 16

The committee shall undertake to upkeep all pass books and cashbooks of joint and other accounts, voucher files, related store books; register of labor contributions, scheme proceedings, visitors and suggestions, measurement of source, latrines, baseline, healthy home survey, and other allied registers.

Rule 17

Maintenance of all documents related to accounts shall be the responsibility of the Chairman/Treasurer.

Rule 18

Storing and maintenance of the material and updating the documents shall be the responsibility of the committee and it can select and authorize any person for this work, on a voluntary or honorarium basis.

Rule 19

Completion of scheme according to the agreement with the concerned organization, making demands of payment and completion of all formalities shall be the responsibility of the committee.

Preparing of the financial accounts and accounts of physical progress shall be the responsibility of the committee, which it will put up before the general meeting and obtain its approval after informing the Gram Pradhan.

Post-Implementation Phase

Rule 20

The committee shall be fully responsible to acquire all the constructed works and operate and maintain them. The committee shall have the right to nominate any person/persons (voluntary/selected on honorarium basis) according to the accepted rules for the maintenance of works.

Rule 21

The committee shall have the right to collect the amount determined for the operation and maintenance of works from each family and deposit the same every month in the bank account of the committee.

Rule 22

In order to meet the maintenance expenditure, the committee shall have the right to increase or decrease the actual costs of water.

Rule 23

To ensure benefits of the constructed works of drinking water, sanitation, health, and environmental awareness the committee shall undertake healthy home survey at every six months and discuss the results with village community.

Rule 24

Committee will hold at least one meeting every month. This meeting would review constructions works, community development works and physical and financial progresses made towards operation and maintenance.

Rule 25

The applicant shall have to deposit Rs. 1,500 as lump sum with the committee for every new connection, according to the availability of water. The applicant has to bear all expenses for the connection to bring water from the main pipeline to the home. The connection shall be made by the Village Water and Sanitation Committee, through the person responsible for maintenance.

Rule 26

The connection-holder shall not tamper with the main pipeline and the committee shall have the right to impose Rs. 500 as pecuniary punishment and even disconnection on the booster pump user.

Rule 27

The connection-holder shall have to pay the prescribed water-fee every month. The committee shall have the right of disconnection in case of non-payment for two consecutive months.

Rule 28

Only one private connection shall be given to one family. The holder shall not lease or sublet another connection from his connection to anyone else. The committee shall have the right of imposing pecuniary punishment/disconnection.

Rule 29

Open defecation, grazing of cattle, disposal of dead bodies, and rubbish dumping shall not be allowed within around 100 meters of the water source. If any one is found doing so, the committee shall have the right to impose a fine of Rs. 50 and even increase the pecuniary punishment in case the offence is repeated.

Rule 30

In cases of natural calamities/contingent situations the Gram Panchayat shall repair the works from its own resources.

ANNEX XI

CHECKLIST FOR RWSS PROJECT MONITORING AND EVALUATION INDICATORS

According to Project Cycle Stages

Pre-planning

- Information about project received by local government stakeholders and communities
- Self-assessment forms distributed and collected
- Partner organization contracted

Planning

- Community-based organizations mobilized, formed, and registered
- Feasibility studies and designs completed
- Staff in local government trained by the project

Implementation

- Percentage and total population covered by water supply facilities
- New sanitation facilities under construction, completed, and under rehabilitation by type
- Percentage community coverage by hygiene promotion
- Community-based organizations trained by type of training
- Project agreements maintained with local authorities
- Sector development plans and budget allocations approved

Operations and Maintenance

- Operations and maintenance expenditure and cost recovery rates
- Water quality
- Number of water users
- Sanitation facilities in regular use
- For hygiene awareness, handwashing after toilet use

According to Stakeholders Involved

Village/Community – Indicators	Phase
• Local government held community-wide meeting for community participation in project planning and management for (a) technology selection; (b) procurement of material in bulk; and (c) ratifying operations and maintenance charges	Planning, implementation
• Percentage of households that contributed cash/labor/kind against total number of user households	Planning, implementation
• Percentage of operations and maintenance collection against the required target	Operations and maintenance
District/Municipality – Indicators	**Phase**
• Multidisciplinary group in place	Pre-planning
• Amount of proposals approved by *(date)* as a percentage of allocations made and communicated by the state for the year	Planning
• Percentage of periodic review visits undertaken in the last quarter as against planned for the quarter	Planning, implementation, and operations and maintenance
State – Indicators	**Phase**
• Is there a signed MOU with the government based on a vision document along with an action plan?	Pre-planning
• Percentage of persons (different stakeholders) trained as against targeted in the quarter as per state's capacity building plan	All phases
• Percentage of periodic review visits undertaken in the last quarter as against planned for the quarter	Planning, implementation, and operations and maintenance

ANNEX XII

WATER SUPPLY, SANITATION, AND HEALTH IMPACT EVALUATION INDICATORS

Water Supply, Sanitation, and Health
• Health benefits
• Improved hygiene practices (like handwashing with soap and stool disposal)
• Improved coverage
• Equitable access
• Hygienic use of WSS (both water and sanitation) services
• Poverty alleviation by enhancing productivity
• More efficient use of time saved in collecting water
• Sustainable scheme management and maintenance
• Reduction in walking distance and time saved
• New water-related productive activities
• User satisfaction with water supply service and sanitation facilities
• Sustained access for all rural habitations to minimum xx liters per capita per day water from improved sources throughout the year
• Reduced incidence of water-related diseases

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Water and Sanitation Program, August 1999

Willingness to Pay

Giving Communities Choice Is Not Enough!
Jennifer Sara, World Bank

Promoting DRA in Lao PDR: Water Supply Informed Choice
Lao Country Office, World Bank

Willingness to Pay for Water in Remote Chinese Villages
Huang Ping, Chinese Academy of Social Sciences

Willing to Pay but Unwilling to Charge
Water and Sanitation Program

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Community Contracting, Rural and Small Towns Water and Sanitation

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Department for International Development (DFID)
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GARNET
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Global Water Partnership
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The Water Page
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The World Water Assessment Programme (WWAP)
http://www.skat.ch/ws/link/watsan/WW_tech.html

Third World Water Forum, Kyoto, Japan
http://www.waterforum.org/

UNICEF Water, Environment and Sanitation
http://www.unicef.org/programme/wes/

WaterAid
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Water Magazine
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Water and Sanitation Program
http://www.wsp.org/english/index.html

Water Web Organization
http://www.waterweb.org/

Water, Engineering and Development Centre (WEDC)
http://www.lboro.ac.uk/departments/cv/wedc/

World Commission on Dams
http://www.dams.org/

World Conservation Union
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World Health Organization Water, Sanitation and Health
http://www.who.int/water_sanitation_health/en/

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World Water Council
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http://www.worldbank.org/html/fpd/water/pdf/bluepages_2000.pdf

World Health Organization

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Fact sheets on environmental sanitation

Presentation

This document is intended for those dealing with the difficult task of identifying priorities and promoting and implementing programmes in environmental sanitation at the country level.

It covers four major areas: planning; water supply; sanitation; and hygiene education. However, considering the current urgency fact sheets on water are made available as a priority. The fact sheets on other topics will follow.

Introduction to fact sheets on water

The quantity and quality of the water that we drink is directly linked to health. If the water is contaminated with germs or chemicals, health will be affected. Outbreaks of diseases transmitted by water have a major impact on human health. Examples of diseases which can be transmitted by water include cholera, typhoid, hepatitis Aand many diarrhoea1 diseases. All of these diseases can also be spread by other means, but the quality of public water supplies is particularly important because such supplies are capable of transmitting contaminated water to many people.

The diseases mentioned above are transmitted through water when it is contaminated by human faeces. For this reason, water quality monitoring should include testing for indicators of faecal contamination such as thermotolerant (faecal) coliforms.

Water sources

Download the fact sheets

Fact sheet 2.1: Sanitary inspections [pdf 347kb]
Fact sheet 2.2: Dug wells [pdf 339kb]
Fact sheet 2.3: Boreholes and tubewells [pdf 282kb]
Fact sheet 2.4: Springs [pdf 443kb]
Fact sheet 2.5: Infiltration galleries [pdf 151kb]
Fact sheet 2.6: Rainwater collection [pdf 288kb]
Fact sheet 2.7: Surface water abstraction [pdf 336kb]

Fact sheet 2.8: Water treatment [pdf 219kb]
Fact sheet 2.9: Flow measurement and control [pdf 413kb]
Fact sheet 2.10: Simple sedimentation [pdf 103kb]
Fact sheet 2.11: Pre-filtration [pdf 157kb]
Fact sheet 2.12: Slow sand filtration [pdf 349kb]
Fact sheet 1.13: Coagulation, flocculation and clarification [pdf

Water sources can include rainwater, surface water (rivers, streams, lakes) and groundwater (from wells and springs). In general, it is cheaper to protect good quality groundwater supplies from contamination than to apply extensive treatment to sources that are already contaminated.

Groundwater sources are often of good quality and may only require source protection and disinfection in order to provide agood quality source of water for drinking. Surface waters are often contaminated and will require treatment before being used. Where treatment of water sources is required, it is important to select the best source available for the supply.

Fact Sheet 2.1 describes how to carry out on-site inspections of water supplies to identify actual and potential sources of contamination, while Fact Sheets 2.2 to 2.7 deal with the upgrading of specific types of water sources.

205kb]
Fact sheet 2.14: Rapid sand filtration [pdf 187kb]
Fact sheet 1.15: Storage tanks [pdf 142kb]
Fact sheet 2.16: Disinfectants [pdf 262kb]
Fact sheet 2.17: Chlorination concepts [pdf 260kb]
Fact sheet 2.18: Chlorine gas or liquid in cylinders [pdf 177kb]
Fact sheet 2.19: Calcium hypochlorite [pdf 223kb]
Fact sheet 2.20: Sodium hypochlorite [pdf 162kb]
Fact sheet 2.21: Continuous chlorination of dug wells [pdf 334kb]
Fact sheet 2.22: Dosing hypochlorite solutions [pdf 283kb]
Fact sheet 2.23: Dosing chlorine from cylinders [pdf 205kb]
Fact sheet 2.24: Hypochlorite tablet dosers [pdf 57kb]
Fact sheet 2.25: Cleaning and disinfection of wells [pdf 271kb]
Fact sheet 2.26: Cleaning and disinfection of storage tanks [pdf 215kb]
Fact sheet 2.27: Cleaning and disinfection of pipelines [pdf 259kb]
Fact sheet 2.28: Cleaning and disinfection of tanker trucks [pdf 268kb]
Fact sheet 2.29: Water quality monitoring [pdf 226kb]
Fact sheet 2.30: Chlorine monitoring at point sources and in piped distribution systems [pdf 329kb]
Fact sheet 2.31: Chlorine testing [pdf 232kb]
Fact sheet 2.32: Bacteriological testing [pdf 131kb]
Fact sheet 2.33: Turbidity measurement [pdf 72kb]
Fact sheet 2.34: Household water treatment and storage [pdf 386kb]

Water treatment

The purpose of water treatment is to remove substances which may be dangerous to human health, such as pathogens (disease causing microbes). Treatment also removes substances which may provoke consumers to reject the water in favour of a different source (which may in fact be a health risk). Where water has to be treated, it is important to select the best quality water source available. This will make the treatment processes much more efficient, which will reduce treatment costs.

Fact Sheets 2.8 to 2.15 deal with the different stages in a treatment process, highlighting key aspeck of relevance to improved treatment.

Disinfection

The purpose of disinfection is to kill or inactivate pathogenic (disease causing) microbes. Disinfection of water is therefore an important step in the control of water-borne diseases such as cholera, typhoid, hepatitis A and many diarrhoeal diseases, although as mentioned above, all of these diseases may be transmitted in other ways as well. Any programme to control the spread of cholera or other water-borne diseases should include improved water supply, improved sanitation and hygiene education.

Disinfected water is not necessarily sterile. Bacteria dangerous to health are killed by disinfection but others not dangerous to health may survive. Water may be disinfected by chemical or physical means. Disinfection should be constant and should not be relied upon as the sole treatment for poor quality water for public distribution. This is because even a short-term fault with disinfection may lead to wide distribution of contaminated water. It is therefore important that disinfection is combined with source protection and, where appropriate, water treatment.

Fact Sheets 2.16 to 2.28 cover various aspects of disinfection.

Water quality monitoring

In any water supply, there is always a risk that water may become contaminated with pathogens (disease causing micro-organisms) either at the source or during treatment and distribution. In all water supplies, especially where there are epidemic diseases such as cholera and typhoid, it is important to test water supplies regularly to make sure that the water is safe to use. Where regular water quality testing is carried out, contaminated water supplies can be quickly identified and remedial measures taken to improve the supply. Water quality monitoring should not only include water quality tests but also sanitary inspections.

A sanitary inspection is an assessment of potential sources of contamination of a water supply in its immediate environment. The key observations to make for each type of water supply are shown in Fact Sheets 2.1 to 2.15. Detailed descriptions of how to undertake sanitary inspections and examples of inspection forms are given in WHO Guidelines for drinking water quality, Volume I (Geneva, 1993) which also provides information on the monitoring of small water supplies.

In general, the risk of contamination of water supplies with pathogens, particularly if they are from excreta, is far greater than the risk associated with chemical contamination. As this series of Fact Sheets concentrates on environmental sanitation for the control of infectious diarrhoeal disease, the health effects of chemical contamination of water are not covered. For further information on the health effects of all contaminants of water, refer to WHO Guidelines for drinking water quality, Volumes I (Geneva, 1995).

Water quality monitoring should be carried out at set intervals depending on the number of people served by the water supply. In many countries, water quality monitoring is not carried out as often as it should be, because there are few laboratories, costs of transport are high, and samples may deteriorate during prolonged transport. Even where laboratories are close by, there is always some delay before the results of water testing are available at the site of the test.

For these reasons, particularly in remote areas, it is better to carry out water quality monitoring using on-site testing methods. In addition, community motivation in protecting and improving their water supply is likely to be higher when they see the test being carried out and the results of the test. Fact Sheets 2.29 to 2.33 cover different types of on-site testing used in water quality monitoring.

Household water treatment and storage

The water that we drink can have a major impact on health and well-being. If the water is contaminated with germs or chemicals, health may be affected. Many people worldwide collect water from wells, streams, rivers or springs, which may contain germs, or receive contaminated water from pipe distribution systems or vendors. This contaminated water can transmit typhoid, cholera, hepatitis A and other diarrhoea1 diseases.

Water can very easily and quickly be contaminated during household storage. This presents an especially high health risk where members of a family or community do not all practice good hygiene. Good hygiene includes :

- having and using excreta disposal facilities, such as latrines or toilets ;
- regular handwashing especially after defecation and before preparing food or eating ;
- personal and domestic hygiene.

Water stored in the home may become contaminated during handling if it is not stored and protected properly. So even if water is purified or collected from a clean and properly protected water source, it may become contaminated. Fact Sheets 2.2 to 2.6 explain about protection of water sources. Fact Sheet 2.34 deals specifically with household water treatment and storage.

The water cycle

Water covers two-thirds of the earth's surface, however 97% of all water is in the oceans and is difficult and expensive to use in drinking water supplies.

Water evaporates from the oceans into the atmosphere, where it condenses to form clouds. The water held in clouds eventually falls as rain and snow. Some rain falls onto the land where it is either intercepted by vegetation, or it runs off to streams, or it infiltrates into the soil. Some of the water intercepted by vegetation evaporates back into the atmosphere. The water flowing into the streams flows back to the oceans. Some of the water infiltrating into the soil is held there and used by plants. Some seeps down into the earth and becomes groundwater. Figure 1 summarizes the water cycle.

Water sources

Sources of water for drinking water supplies fall into three broad categories :

- Groundwater sources, including dug wells, boreholes, infiltration galleries and springs ;
- Rainwater collection from roof and ground surfaces ;
- Surface water sources, including intakes from streams and rivers, lakes and small dams.

Groundwater sources

Groundwater is water which is held in pores, voids or fissures underground. Pores are the spaces between grains in rocks or loose sediments, such as gravel or sand. These rocks and loose sediments which hold water are called aquifers. The level at which groundwater is first found when digging from the surface is called the water table. The water table often varies seasonally, the lowest level being found at the end of the dry season.

Good aquifers are those which have many interconnected pores. Examples of good aquifers are : sand and gravel deposits, some sandstones and limestones. These deposits tend to produce water that has little or no faecal contamination. This is because the water passing through the soil and rock is naturally filtered. This water can still contain chemical pollutants, for instance iron, and so may require treatment.

Other rocks may contain available water only in joints and fissures. This is very common in hard limestone areas where rivers and streams flow underground. It is possible to use this water, but it is often difficult to find and, as it has received little natural filtering, it may not be free of faecal contamination. In some geologically active areas (e.g. African rift valley) water extracted from crystalline rocks such as granite may contain high concentrations of chemicals such as fluoride, which can be harmful to health.

In some rocks and sediments, particularly those rich in clay, there is water but it cannot be abstracted. This is because, although there are many pores, very few are connected. These are called impermeable layers and they can force groundwater to the surface as springs.

Groundwater can be tapped for drinking water supplies by sinking dug wells and boreholes, building infiltration galleries or by protecting springs. Wells and boreholes are shafts which are sunk directly down to the water table. Springs are where the water table crosses the land surface and water appears on the surface. Infiltration galleries are horizontal drains laid through aquifers.

Dug wells

These are one of the oldest and most common forms of water supply worldwide. In their most basic form, they are unlined holes in the ground which reach the water table. Such wells should be upgraded wherever possible, usually by lining with concrete and adding a hygienic cover. The well should be

sunk at least 2 metres below the dry season water table and the intake surrounded by gravel to act as an extra filter. The water can be lifted from the well by a hand pump, a rope and bucket or windlass. Mateller method is used for water lifting it is important that the water is raised in a hygienic manner.

Dug wells are described in detail in Fact Sheet 2.2.

Boreholes and tubewells

These are narrow diameter wells which are usually fitted with either a hand pump or a powered pump. There are a number of ways to sink boreholes and tubewells. Shallow tubewells may be sunk using an auger, by driving a pipe into the ground or by jetting. Boreholes and deep tubewells are sunk using drilling rigs and can be up to 200 metres deep. Boreholes and tubewells are lined with pipe from the surface to the water table. The section of pipe under the water table is either slotted or perforated to allow water to enter. This is called the well screen. A gravel pack is developed around the well screen to provide extra filtering of the water and to remove any solids which could block the intake. Boreholes and tubewells are covered in more detail in Fact Sheet 2.3.

Tubewells can be used in many different situations. They have been commonly used in small rural communities as an alternative to dug wells. They can also be used in low to medium density urban communities and in refugee camps. Deeper tubewells tend to be sunk where a permanent water supply is required. Care should be taken, when siting wells, to ensure that adjacent wells are not so close together that they cause excessive lowering of the water table. Boreholes, or deep tubewells, are most appropriate where large quantities of water are required, for instance for medium sized towns. Boreholes are useful when the water table is deep and where the aquifer is rocky.

Infiltration galleries

These are horizontal or slightly sloping drains made from open-jointed pipes or tiles, which are laid below the water table to collect groundwater. They are used to tap spring lines, increase the yield of dug wells and are sometimes laid near rivers to collect the sub-surface flow of water. The drains should be surrounded with gravel to remove any suspended solids in the water. Infiltration galleries can vary in size from a few tens of metres to two kilometres or longer. Infiltration galleries are covered in greater detail in Fact Sheet 2.5.

Springs

A spring is the point at which groundwater appears on the surface. This can result from the water table intersecting the level of the land surface, or the release of groundwater from between two impermeable layers or from a rock fissure. Springs where the water has been filtered by moving through the aquifer often have water of high quality, which may only require protection and need no treatment. Springs from rock fissures may require treatment as well as protection.

Springs can be protected by surrounding the outlet, or" eye ", of the spring with a water-tight concrete box into which the spring water flows. This is called a spring box. The water is then allowed to overflow from the box through a pipe which may be connected to a distribution system.

Springs are favoured water sources as they often produce high quality water, are inexpensive to protect and do not require a pump to bring the water to the surface. If a spring occurs uphill of the community to be served, it can be connected to a gravity-fed piped distribution system. If the spring occurs downhill of the target community, the water can be pumped up to a storage tank. Springs close to small communities where a piped system is not feasible can be protected and allowed to overflow from the spring box permanently or be connected to a storage tank fitted with a low-lift hand pump.

Springs are dealt with in more detail in Fact Sheet 2.4.

Rainwater collection

This is most commonly a household-level activity, although rainwater can be, collected at schools to provide supplementary drinking water. Rainwater used for drinking is most commonly collected from roofs but it can also be collected from ground surfaces.

Rainwater supplies are often used as a supplement to other water sources, particularly in the period at the start of the dry season. Rainwater collection has many applications and. provided there is sufficient space for a storage tank, can be practised anywhere. It is particularly important in small, dispersed communities where other forms of water supply may be too expensive. Rainwater collection is covered in more detail in Fact Sheet 2.6.

Surface water sources

Surface water sources are rivers, streams, lakes and reservoirs. Surface water generally requires treatment before consumption as it is easily contaminated by faecal and organic matter and may carry silt. Water treatment is covered in Fact Sheets 2.1 1 to 2.34. Surface water sources are often used for large urban water supplies, as rivers and lakes can provide a large, regular volume of water. Where the surface water source is at a lower elevation than the treatment works or community, it will have to be pumped? thus increasing costs. Surface water can be abstracted in a number of ways and the method chosen will depend on cost, population to be served and technology available. Surface water abstraction is covered in more detail in Fact Sheet 2.7.

Rivers

A simple way to abstract water from a river is to sink a well on the river bank, up to 50 metres from the river. There must be sufficient permeable material, such as sand and gravel, between the river and the well.

A similar method requires the construction of infiltration galleries alongside or under the riverbank. Water obtained by these two methods has already been naturally filtered and may only require disinfection prior to consumption. Most commonly. however, water from rivers is taken directly from the river channel. This water will almost always require treatment prior to consumption. If this water is not treated it represents a major health hazard. Direct abstraction of water from rivers is a high cost solution as treatment works must be built. If the intake and treatment plant is upstream of the community, the water can run into a storage tank by gravity to supply the distribution network, otherwise it will have to be pumped. Direct river abstraction is most commonly used to supply urban areas where there is sufficient money to build and operate the system.

Lakes and dams

Water can be abstracted directly from natural lakes or reservoirs, or by means of a dam. Lake water quality varies widely, but there is always a high risk of human and animal faecal pollution near the shores. Small lakes and ponds have a high risk of pollution and all such sources should be treated prior to consumption. Water can either be abstracted directly from the lake or by means of a dam. Natural and dammed lakes, used as reservoirs, are often located above the community to be served, so gravity can be used to transport the water to a treatment plant and then to a storage tank prior to distribution. Lake water, like all surface water, should be treated unless it can be shown that the intake is not polluted. It is rare for lake water not to be polluted, and the additional costs of treatment make lake abstraction relatively expensive.

Introduction to fact sheets on sanitation

Excreta disposal

Human excreta always contain large numbers of germs, some of which may cause diarrhoea. When people become infected with diseases such as cholera, typhoid and hepatitis A, their excreta will contain large amounts of the germs which cause the disease. Fact Sheet 3.1 discusses excreta disposal options.

When people defecate in the open, flies will feed on the excreta and can carry small amounts of the excreta away on their bodies and feet. When they touch food, the excreta and the germs in the excreta are passed onto the food, which may later be eaten by another person. Some germs can grow on food and in a few hours their numbers can increase very quickly. Where there are germs there is always a risk of disease.

During the rainy season, excreta may be washed away by rain-water and can run into wells and streams. The germs in the excreta will then contaminate the water which may be used for drinking.

Many common diseases that can give diarrhoea can spread from one person to another when people defecate in the open air. Disposing of excreta safely, isolating excreta from flies and other insects, and preventing faecal contamination of water supplies would greatly reduce the spread of diseases. Fact Sheet 3.2 deals with open-air defecation, while Fact Sheet 3.3 covers cartage.

Download the fact sheets

Fact sheet 3.1: Excreta disposal options [pdf 230kb]
Fact sheet 3.2: Open-air defecation [pdf 157kb]
Fact sheet 3.3: Cartage [pdf 103kb]
Fact sheet 3.4: Simple pit latrines [pdf 472kb]
Fact sheet 3.5: VIP and ROEC latrines [pdf 389kb]
Fact sheet 3.6: Pour flush latrines [pdf 352kb]
Fact sheet 3.7: Composting latrines [pdf 375kb]
Fact sheet 3.8: Aquaprivies [pdf 388kb]
Fact sheet 3.9: Septic tanks [pdf 277kb]
Fact sheet 3.10: Disposal of sullage and drainage [pdf 188kb]
Fact sheet 3.11: Sewerage and sewage treatment [pdf 171kb]
Fact sheet 3.12: Solid waste disposal [pdf 141kb]
Fact sheet 3.13: Reuse of sewage in agriculture and aquaculture [pdf 171kb]
Fact sheet 3.14: Sanitation in public places [pdf 233kb]
Fact sheet 3.15: Sanitation in hospitals and health centres [pdf 128kb]

In many cultures it is believed that children's faeces are harmless and do not cause disease. This is not true. A child's faeces contain as many germs as an adult's, and it is very important to collect and dispose of children's faeces quickly and safely.

Fact Sheets 3.4 to 3.8 describe the construction of different types of latrines, and Fact Sheet 3.9 provides information on septic tanks.

The disposal of excreta alone is, however, not enough to control the spread of cholera and other diarrhoea1 diseases. Personal hygiene is very important, particularly washing hands after defecation and before eating and cooking.

Wastewater disposal and reuse

Wherever crops are grown, they always need nutrients and water. Wastewater is often used in agriculture as it contains water, minerals, nutrients and its disposal is often expensive. Where effluent is used for irrigation, good quality water can be reserved exclusively for drinking water. Wastewater can also be used as a fertilizer, thus minimizing the need for chemical fertilizers. This reduces costs, energy, expenditure and industrial pollution. Wastewater is also commonly used in aquaculture, or fish farming.

Fact Sheet 3.10 deals with disposal of sullage and drainage, while Fact Sheet 3.1 1 covers sewerage and sewage treatment. The reuse of sewage in agriculture and aquaculture is addressed in Fact Sheet 3.13.

Solid waste disposal

The disposal of refuse can have a significant effect on the health of communities. Where refuse is not disposed of properly, it can lead to pollution of surface water, as rain washes refuse into rivers and streams. There may also be a significant risk of groundwater contamination. Refuse disposed of in storm drains may cause blockages and encourage fly and mosquito breeding. It is therefore very important that household waste is disposed of properly.

Fact Sheet 3.12 deals with solid waste disposal but does not cover industrial solid waste disposal, as this is complex and requires specialist techniques. It is, however, important that industrial waste is disposed of safely, as it is sometimes toxic and highly dangerous to human health.

Sanitation in public places

Where a large number of people are using one area, such as a bus station or school, especially when they are eating food from the same source, there is a greater risk of the spread of diseases such as cholera, hepatitis A, typhoid and other diarrhoea1 diseases.

These places vary in the number of people using them, the amount of time that people spend there and the type of activity that occurs in the area, but all public places need to have adequate sanitation and hygiene facilities. Fact Sheet 3.14 covers sanitation in public places.

Responsibility for the provision of sanitation facilities in public places is not always obvious, especially where these are informal gathering places. It is vital, however, that an agency monitors the sanitation facilities in public places on behalf of the users. Ideally, this should be part of the role of the ministry of health, or its equivalent. Special attention should be paid to the adequacy of facilities, their availability to the public, and the conditions of their operation.

There are several basic rules for sanitation in public places :

- There should be sufficient toilet facilities for the maximum number of people using the area during the day. This normally means one toilet compartment for every 25 users. The toilet facilities should be arranged in separate blocks for men and women. The men's toilet block should have urinals and toilet compartments ; the women's block, toilet compartments only. The total number of urinals plus compartments in the men's block should equal the total number of compartments in the women's block.
- Toilet facilities should not be connected directly to kitchens. This is in order to reduce the number of flies entering the kitchen and to reduce odours reaching the kitchen. It is important that people using the toilet facilities cannot pass directly through the kitchen.
- There must be a handwashing basin with clean water and soap close to the toilet facilities. There should be separate, similar facilities near to kitchens or where food is handled.
- There must be a clean and reliable water supply for handwashing, personal hygiene and flushing of toilet facilities. The water supply should meet quality standards and be regularly tested to ensure that any contamination is discovered quickly and that appropriate remedial action is taken.
- Refuse must be disposed of properly and not allowed to build up, as it will attract flies and vermin.

Responsibilities for cleaning sanitation facilities should be very clearly defined. Dirty facilities make it more likely that people will continue to use the facilities badly or not at all. Clean facilities set a good example to users.

It is important to make sure that information about health is available in public places. Such information should be displayed in an eye-catching, simple and accurate way. Where appropriate, large posters with bright colours and well chosen messages, put up in obvious places, are effective.

Health and hygiene messages may be passed on to the public using such posters in public places. These messages should include the promotion of :

- Handwashing.
- Use of refuse bins.
- Care of toilet facilities.
- Protection of water supplies.

Local school children and college students can be involved in preparing educational posters and notices for public places. Hygiene education is covered in Fact Sheets 4.1 to 4.12.

Introduction to fact sheets on hygiene education

Health education and communication are essential components for the success of any progamme to promote hygiene and prevent cholera. It is important to consider each stage of a programme to assess where uptake and effectiveness can be improved through a well chosen communication strategy. This series of Fact Sheets gives practical guidance on coping with health promotion issues within a cholera control programme.

Health promotion and hygiene education activities should be associated with measures aimed at providing a safe water supply, improving sanitation coverage, and enhancing food safety control.

The following fact sheets on hygiene education suggest activities to complement the overall planning and implementation of environmental sanitation, with particular emphasis on preventing and controlling cholera and other diarrhoeal diseases.

Download the fact sheets

Fact sheet 4.1: The role of hygiene education [pdf 168kb]
Fact sheet 4.2: Focusing on key behaviours [pdf 121kb]
Fact sheet 4.3: Collecting information about current hygiene practices [pdf 291kb]
Fact sheet 4.4: Planning and organization of an education programme [pdf 187kb]
Fact sheet 4.5: Selecting target groups for hygiene education [pdf 119kb]
Fact sheet 4.6: Setting objectives for hygiene education [pdf 96kb]
Fact sheet 4.7: Developing hygiene education messages [pdf 119kb]
Fact sheet 4.8: Selecting appropriate communication methods for hygiene education [pdf 159kb]
Fact sheet 4.9: Teaching and learning methods for hygiene education [pdf 130kb]
Fact sheet 4.10: Using the mass media for hygiene education [pdf 258kb]
Fact sheet 4.11: Using popular or people's media for hygiene education [pdf 128kb]
Fact sheet 4.12: Hygiene education for young people [pdf 181kb]
Fact sheet 4.13: Evaluation of a hygiene education programme [pdf 187kb]

World Health Organization

Guidelines for the safe use of wastewater, excreta and greywater

The following volumes are in preparation for publication in the first half of 2006:

- Volume 1, Policy and regulatory aspects
- Volume 2, Wastewater use in agriculture
- Volume 3, Wastewater and excreta use in aquaculture
- Volume 4, Excreta and greywater use in agriculture

Background papers

The papers below were drafted as comprehensive background materials for the meeting on the draft Guidelines for the safe use of wastewater, excreta and greywater (May 2005). The opinions expressed in these papers are those of the authors alone and do not necessarily reflect the views or policies of the World Health Organization.

Developing human health-related chemical guidelines for reclaimed waster and sewage sludge applications in agriculture [pdf 373kb]
A. C. Chang, University of California, Riverside, California, Genxing Pan, Nanjing Agricultural University, Nanjing, People's Republic of China, A. L. Page, University of California, Riverside, California, and Takashi Asano, University of California, Davis, California, USA

Household food security and wastewater-dependent livelihood activities along the Musi river in Andhra Pradesh, India [pdf 418kb]
Stephanie Buechler, Gayathri Devi, International Water Management Institute, Pantancheru, Andhra Pradesh, India

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A Guide to the Development of on-Site Sanitation, © WHO, 1992
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