The Provision of Access through the Expansion of Micro Hydro and Mini-grids

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1 An introduction to the main issues

1.1 It is a basic hypothesis for many people that micro hydro power schemes[1] involve a mature technology that in certain circumstances can provide "access" to electricity and motive power to relatively poor people on a financially and environmentally sustainable basis[2].

1.2 If this is a mature technology, the argument goes, is it now time for the grant-aided sector (of both official development assistance and non-governmental organisations) to hand over the challenge to the private sector and let them take up this technology and run with it.

1.3 It is certainly the case that the NGO sector, which has been a major promoter of the technology (at least outside China) cannot expand the scale of its operations without major private sector involvement. However, the evidence that micro hydro is a secure and profitable investment does not yet appear convincing to a significant number of financial institutions.

1.4 The answer to these issues has many points of entry: first, the evidence that micro hydro is financially profitable is not yet established (particularly in forms and from sources that investors find credible). Second, the growth and sustainability of the micro-hydro sub-sector depends on certain types of infrastructure and institutional investments. But it is not yet clear which of these is essential and how they are best financed. Third, the value of electricity to poor people may well exceed their ability to pay for it. This paper, and the on-going research upon which it is based[3], will try to shed light on these issues.

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[1] Micro hydro in this context is defined as being in the range 10 to 200 kW.

[2]. See for instance, **Rural Energy and Development**: Improving Supplies for Two Billion People. World Bank, 1996

[3]. This research is being carried out by Intermediate Technology under contract to the UK Department for International Development as part of the World Bank's programme to determine best practice in a number of areas of rural energy development. The project leader is Dr Smail Khennas (smailk@itdg.org.uk), and research teams have been established in Nepal, Sri Lanka, Peru, Zimbabwe, and the UK.

1.5 But first it is important to clear up a possible source of confusion. Aid Agencies (including the World Bank) start from a concern about providing access to "modern forms of energy" to resource-poor and marginalised people. Recent understanding suggests that even relatively poor people already spend considerable cash sums to meet their energy requirements (particularly for electricity, through batteries, and lighting, through kerosene). Suppliers of equipment, and supporters of particular technical options are interested in expanding their sector and selling their product. While increased sales (diffusion and market penetration) may help poor people, they do not necessarily do so. It is therefore important to distinguish between policy interventions that are primarily intended to increase sales (in this case) of micro hydro and those that are intended to increase the "access" of specific groups of people who are particularly resource-poor or live in remote areas (that will not be reached by the central grid for some time, if ever). Failure to make this clear appears frequently to result in disappointment and to ineffective policy advice[4].

1.6 A number of commentators now see the most pressing issue is to find ways of using public (soft) fund to "leverage" private (hard) funds from the private financial institutions to expand the access of renewable energy to relative poor rural communities, in some form of "public/private" initiatives[5]. This is probably a more interesting reformulating the more long standing arguments over the treatment of "subsidies". The issue now is not so much whether there should be subsidies (even the World Bank and IMF believe there are occasions - such as through the Global Environment Fund - when subsidies are justified), but rather the question is how to use public (and charity) funds in this sector in ways that are innovative and stimulating rather than stultifying and bureaucratic[6].

1.7 But the design of mechanisms to leverage of public and private finance depend heavily on whether the problem is how to kick start "an infant industry", or to compensate for the fact that the target "customers" do not have sufficient purchasing power to enter the market at all.

2 Background

2.1 There is now a quite wide range of experience in providing access to electricity for resource poor people. The largest experience is probably from China and Vietnam, but while these provide valuable lessons in terms of the technology, their unique social context, and the little documentation (so far) in English, limits their usefulness to the

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[4]. This confusion is well documented in the case of attempts to market photo-electric systems in India, where attempts to increase sales require quite different business choices from attempts to enable resource-poor people to gain access to PV systems (see PhD thesis by Damian Miller, Judge School of Management, Cambridge University UK, forthcoming).

[5]. "Financial Intermediation in Support of Small-Scale Energy Investments" a report to the World Bank by deLucia and Associates July 1998. See also Russel J de Lucia *Availability and Access for financial support for renewables: issues and an illustrative innovation,* **Natural Resources Forum** Volume 22, Number 2, May 1998.

[6]. These issues are discussed in more detail in a note by the author relating to the situation in Nepal.

current discussion. Similarly there are many lessons to be learned from OECD countries, particularly about financial and institutional innovation with but they are outside the direct scope of this paper.

2.2 The following table provides a summary of the experience of a number of countries with micro hydro programmes, and suggests that there is a huge diversity of experience and success.

Maturity of programmes	Strategy
Nepal Several hundred schemes.	Subsidies through the Agricultural Development Bank of Nepal, and focus on developing the manufacturing sector.
Sri Lanka Over 40 schemes	Institutional and managerial innovation through the creation of Electricity Consumer Societies in the target villages.
Peru Over 20 schemes	Innovations through a revolving fund based on Inter-American Development Bank loan.
Zimbabwe/Mozambique Less than 10 schemes	Experience of transferring Asian experience to the quite different circumstances of rural Africa.

2.3 Micro hydro, like many other renewables, is characterised by high up front capital costs, and low running costs, relative to the alternatives such as diesel generators. And as with many other means of generating electricity (ie except modules of PV) there are economies of scale particularly in distribution and transmission, such that the geographic density of demand, and the characteristics of the load (daily and seasonal peaks) makes a considerable difference to the viability of electricity supply at a particular location. The growth of micro hydro has been limited in some areas because the primary demand is for electricity for lighting, but unlike other productive uses, tends not to generate an adequate increase in cash flow. Related to this, the costs of end-use equipment is always significant, and may well represent more of a cost burden to consumers than gaining access to electricity supply.

3 An analytical framework

3.1 The early work on the economic analyses of renewables (or small scale decentralised energy supply options more generally) focussed on the “micro” analysis of individual investments. Unfortunately such analyses rarely compared the costs of one option against the costs of the best alternatives, and so were of only limited value to policy makers or to consumers.

3.2 These micro analyses also tended to neglect (or find difficult to deal with) the costs of the systems involved in supporting and marketing larger numbers of installations. In work

carried out in the late 1980's by IDRC[7] all the costs of these "macro" level inputs were referred to as the "system overhead costs" Such costs range from R and D to training of manufacturers, the identification of sites and equipment, the community development necessary to get communities to take ownership of the plant, design and installation, trouble shooting, repair and maintenance systems etc. What became clear, as these costs began to be uncovered, was that existing "conventional" technologies, such as diesel generators, had a considerable advantage in that the massive systems in support of these technologies were already in place (often as "sunk costs").

3.3 A key issue in the current policy debate is the identification of these activities at the macro or sub-sector level and how their costs are to be covered, and by whom. To some extent the costs are included in the price paid by the plant owner, but more generally they are paid (directly and indirectly, knowingly or inadvertently) by NGO and other agencies as a form of a grant or subsidy.

3.4 It is important to recognise that these are real costs and that real activities need to take place, how ever they are paid. As the sector is expanded there may well be "economies of scale" in that some of these costs will fall in relation to each hydro plant installed. But equally, inputs that are currently supplied at no cost (because the input is small or is provided by enthusiasts) may well have to be provided for directly if the sub-sector is to expand successfully. Neglect of these activities and their associated costs in any attempt to replicate hydro development in other countries is likely to undermine the sustainability of the sector.

3.5 The current challenge is how to bring together all these diverse concerns: the micro and macro analysis, the question of costs and who is to cover them, and efforts to combine public and private initiatives. One approach that appears to offer considerable analytical insight is to draw on the idea of "financial intermediation" and consider three additional forms of intermediation, namely technical intermediation, social intermediation and organisational intermediation[8].

3.6 In this approach an attempt is made to identify **all** the activities associated with the installation and operation of the individual plant (and quantify the associated costs) for all of the various actors (manufacturers, contractors, plant owners, customers and other beneficiaries, government, banks, utilities, and the various "intermediators").

3.7 The interest in intermediation derives from the observation that many of the so-called "win win options " in the area of energy and environment are not being implemented to the extent predicted. Various skills and enthusiasms are needed to get the schemes going and these things have costs. But current experience is suggesting that private financial institutions cannot or will not cover all or most of the cost associated with organisational

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[7]. *The Diffusion of Energy Technologies in the Rural Areas of Developing Countries: A synthesis of recent experience*" edited by Andrew Barnett, **World Development**, Volume 18 Number 4, April 1990, pages 539-615.

[8]. The various types of "intermediation" are described by DeLucia in his report mentioned earlier. See also the work of Lynn Bennet at the World Bank on "social intermediation".

and technological intermediation, and probably will have considerable difficulty in covering the relatively high transaction costs of even "retailing" their capital resources.

3.8 *Organisational Intermediation* involves not only the initiation and implementation of the programme, but also the lobbying and policy change required to construct an "environment" in which the technology and the various players can thrive. This will involve putting in place the necessary infrastructure, and getting the incentives firing the right way to encourage owners, contractors, and financiers.

3.9 Such organisational intermediation is probably usefully distinguished from the *Social Intermediation* involved in the identification of owners and beneficiaries and the development of the capacities necessary to take on and run each individual investment project. Social intermediation plays a major part in taking on the transaction costs that communities would have to incur if they themselves were to source, select and contract suppliers of everything from money and to machines.

3.10 *Technical Intermediation* may well have to start up stream by undertaking the necessary R and D, the importation of the technology and know-how, "down" through to the selection and development of the capacities to supply the necessary goods and services (site selection, system design and technology acquisition, construction and installation of civil, electro-mechanical and electrical components, operation, maintenance, Trouble Shooting, overhaul and refurbishment).

3.11 *Financial Intermediation* ranges from the "bundling" of projects together to make them attractive to finance agencies, dealing with the transaction costs of administering loans, assessment and assurance of the financial viability of schemes, assessment and assurance of the financial credibility of borrower, supply of wholesale finance (from aid agencies, governments, development banks), supply of retail finance (equity finance, loan finance), the management of guarantees, collateral ("financial conditioning") and the management of loan repayment.

3.12 These types of intermediation, which in practice will overlap and may be carried out by the same agencies, form the link with and between the numerous actors involved in micro hydro development. Even in a modest hydro development programme these are likely to involve: the government (national and local); the utility; the main change agents, the project developers or "agents", the aid agencies; the financial institutions; the equipment manufacturers, assemblers and suppliers; the providers of Technical Assistance; the contractors; the plant owners; the community developers ("animators"); the Communities; the beneficiaries (and indeed the people bypassed or harmed by the investment)..

3.13 Each of the functions carried out by "intermediators" operates on the context in which hydro development occurs. The viability of micro hydo is clearly context specific. But this specificity refers not only to the location of a particular site (is there enough water and enough concentrated "demand") at the micro level of analysis, but also at the specifics of the institutional arrangements at the macro level. The development of micro hydro has required one or more organisation to develop the national energy context and policy in ways that support (or are at least not hostile to) micro hydro. The characteristics of a favourable "enabling environment" are relatively easy to list, but often require huge effort

to put in place. They include policies for domestic direct and indirect taxes and subsidies (on things like equipment, training, R and D, surveys etc); import taxes, rules for depreciation and so on. In practice much of the pre-existing policy environment have unplanned and negative effects on the hydro sector, but are kept in place by the powerful forces that benefit from them.

3.14 Micro hydro development will also be helped or hindered by the regulatory context in which it operates (and the extent to which regulations are enforced). Usually there will be regulations about who can generate and sell electricity; and regulations covering both finance and construction (such as Health and safety in construction, safety standards for electricity installations, and environmental standards) but there may also be regulation of competition between energy supply options, water resource use, and land ownership (access and rights of way).

3.15 Intermediation also takes place in the context of the many markets in which micro hydro is to be developed. Certainly, in some countries there is concern as to whether there is a sufficiently large market to sustain more than a very few contractors and suppliers. And it is to be expected that, in remote locations, particular suppliers will have local monopolies. The local market will be influenced by these local monopolies and the effects of subsidies in the hydro and related sectors, and of course from competition from the grid, PV, diesel and other energy sources. The market itself will be strongly influenced by the capacities, skills and experience of the various actors involved. For instance, the market for finance for micro hydro plant is likely to limited because financial institutions will have little experience of the sector on which to base their judgements about projects and clients.

3.16 So this is the background, the hypotheses and the analytic framework for our analysis. The search is now on to identify and describe the "best practice" and innovative arrangements for dealing with each of them. In what follows, secondary sources of information are used to provides insights into some of these issues (though of course any errors of fact or interpretation remain the author's responsibility!)

4 The case of Peru[9]

4.1 One of the most successful programmes to develop micro hydro has been in Peru. The main innovation would appear to be the experience of a revolving credit fund, financed by a soft loan from the Inter-American Development Bank.

4.2 After the technical issues had been largely mastered in the early 1990's, the main difficulty appeared to be the lack of access to finance in general, and the lack of financial intermediaries who could "retail" credit in the rural areas in particular. It also became clear that the State was unwilling (even if it were able) to provide substantial grants to the

[9]. **The information in this section is largely taken from the paper by Alfonso Carrasco V "Alternatives for Rural Electrification" (June 1998) available from ITDG in Peru (Karina@itdg.org.pe), and from other internal documents from ITDG.**

micro hydro sector, because it was focussing it resources on the power grid. This led to the development of a revolving fund by the "intermediary" Intermediate Technology(IT), with resources provided by the Inter-American Development Bank. There was a soft loan of $400,000 (1% service charge and repayment in 25 years in local currency) and a technical assistance grant of $120,000. Since its initiation in 1992 this fund has now resulted in the installation of 15 plant. $465,718 worth of loans have been disbursed and these have drawn in other funds to a total value of $1.7m. The installed plant have ranged in size from 175 kW down to 3 kW with an average of 40 kW. The capital cost has averaged $2,874 per kW installed (giving an average cost per installation of $115,333).

4.3 Of the 15 loans, 5 were to individuals and 10 were to "municipalities" (as village organisations - Comités de Gestión -did not have legal status to accept loans). A certain amount of social intermediation was necessary to form these pre-electrification committees or other ad hoc organisations to operate and maintain the plant. The investments appear secure, but again considerable effort and cost is associated with building the necessary capacities to operate and maintain the plant and to administer the collection of tariffs. Only time will tell if this has been sufficient.

4.4 The lack of local financial intermediaries meant that the programme sponsors, Intermediate Technology, had to set up a "Credit Operator" to provide financial services such as financial assessment of each loan applicant, appraisal of each scheme, administration of the loans and their recovery (although Intermediate Technology remained responsible for the "wholesale" loan from the IDB). IT felt that it was essential that the financial intermediary operated at arms length from technical and organisational intermediation.

4.5 While this arrangement has worked very well, with very high loan repayment levels, two problems quickly emerged. First, that even with low interest rates, there was little demand for micro hydro. Considerable time and effort had to be expended to "market" both the fund and the idea of hydro. Potential consumers would also have had to incur considerable "transaction costs" to locate the technology, contractors and finance if IT had not acted as intermediary. These were costs that could not be carried by the financial intermediary, nor by the loan charges (interest and administrative fees).

4.6 And second, even when the demand did pick up, rural communities (where households are said to have an annual income of $500[10]) could not afford the full cost of the plant. At the current time for every $100 spent on a project:

$27 is covered by a loan and spent largely on equipment

$43 comes from grants and is spent on civil construction and distribution lines

$13 grant to TA and "promotion" of the demand

$17 is the equity contribution from the owners and is supplied in part by contributions in kind such as labour.

[10] It is not clear from the report whether this is a per capita income, or a total household cash income.

5 The case of Sri Lanka[11]

5.1 Sri Lanka also represents a very positive experience with micro hydro. The programme has essentially consisted of four strands: an effort to develop the technology and local capabilities through the rehabilitation of hydro on the Tea Estates; a village hydro scheme with a strong emphasis on community development; the nurturing of a group of village hydro specialists who act as "catalysts"; and, following the liberalisation of the power sector in 1994, grid connected systems. Approximately 40 village hydro plant have been constructed (or are nearing completion) in the 1990's.

5.2 The programme has had considerable success in absorbing the technological know-how and improving it through local manufacture (including electronic load controllers and the use of electric motors as generators), developing local capabilities in manufacture and installation, and in pushing for changes in the regulations to provide a viable standard for grid connection.

5.3 The village hydro programme set considerable store by the creation and involvement of Electricity Consumer Societies (ECS) who are responsible for implementing and operating each scheme. Extensive community development skills are deployed by the social intermediators to identify project "initiators" (who ideally become the Founding President of the ECS, so as to allow the leadership qualities of other village members) and to deal with the various village factions identified in preliminary socio-economic surveys of each site.

5.4 As the programme developed it has been possible to build up the capacities of six "manufacturer/catalysts" to guide ESC at the implementing stage, and to provide an outreach services to neighbouring areas. These grass roots specialists are enterprising individuals who usually come from within the villages with access to hydro electricity.

5.5 Substantial variation has been experienced in the cost of installations (partly as a function of variations in the standards which the different funding source stipulate), and that plant below 5kW are significantly more costly than those above this figure. Very approximately (using 56 Rupees to one US dollar, and taking no account of the changes in currency values over the 10 years of the programme) the average of cost of the small plant is $2,500 per kW, and the cost of the larger plant is $1,500 per kW. This means that a typical plant (eg the one at Andaradeniya) had a total capital cost of UD$ 39,200, for an installed capacity of 23 kW, supplying electricity to 100 beneficiary households ($392 per household) and 2 households were excluded by their remote location. The most expensive plant in terms of installed capacity (at Weddagala) cost $14,400 for 5kW ($2,880 per kW) for 25 households ($576 per household) and ten households were excluded.

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[11]. **This case draws largely on the work of Dr Moira Tampoe's draft evaluation report on micro hydro development for ITDG in Sri Lanka , 1997, Draft (contact Lahiru Pereira, E-Mail: lahiru@itdg.lanka.net).**

5.6 At the initiation of the programme it was accepted that people in these relatively remote areas were unlikely to be able to meet a substantial part of the cost of the schemes. There were considered to be part of the social infrastructure such as feeder roads, or water supply. But the scheme promoters (Intermediate Technology) insisted that the ECS provided 30% of the capital cost of the project and this would be provided in "cash, kind and sweat equity", and would cover civil works and transmission. A survey at the end of 1996 showed that most consumers pay less than one rupee per watt, averaging 50 rupees per month ($11/year) for each household (whereas a tariff which covered capital and operating costs would probably range from 80 to 170 rupees per household per month ($17-$36/year)[12].

5.7 From the point of view of mini-grids, it is interesting to note that the ECS were able to contribute their 30% of the cost to cover the civil works, but were often unable to raise the funds from their own resources to cover the cost of the transmission. They frequently had to seek supplementary funding from the Provincial Councils for this, thereby adding delays to the project implementation (often over a year), though in the end their perseverence resulted in success. The costs of transmission are greatly affected by the standards used, and where the Ceylon Electricity Board (CEB) Standards were use the cost could rise substantially.

5.8 Similarly house wiring costs have risen dramatically over the years from 2-3000 Rupees in the early 1990's to 4-8,000 rupees in 1997 ($70-$140). The standards required in schemes implemented by the CEB costs were as much as 11,000 rupees (nearly $200) per household.

[12]. Village Hydro Monitoring Report, November 1996, IT Sri Lanka, page 38. A rate of 56 Rupees to one US dollar has been assumed. It would appear that the tariff rates remain largely unchanged even in the face of inflation.

5.9 The electricity is used primarily for lighting and cassette radios, (but surveys also show some ownership of TV, electric irons and heaters). It is recognised that the financial viability of plant would be increased if cash generating end uses were included in the schemes (for instance battery charging and rice milling). In one case where there is a mill attached (Katepola), it was able to operate only 2 days a week, and while it does add significantly to the cash flow of the hydro scheme it would not be able to if it had to cover a commercial rate of interest on the mill itself[13].

5.10 Village hydro in Sri Lanka is now moving into a more commercial phase with attempts to introduce more commercial funding and to set up the catalyst/manufacturers as small businesses. The recently started World Bank's Energy Service Delivery Project (WB-ESDP) includes village hydro and has a grant component (funded by the Global Environment Facility) which softens the terms of commercial money by extending its payback period from between 2 and 5 years to ten years.

5.11 The Waddegala scheme mentioned above is also funded in part by a loan from the Hatton National Bank (negotiated before the WB-ESDP), with a grant from the Rotary Club of 200,000 Rupees ($3,500). The interest is at 20% over 5 years. Repayments were reported to be "satisfactory and on schedule".

6 The lessons learned

6.1 The first lesson is that while huge progress has been made in developing and understanding the technology, many of the plant examined are not (yet?) financially sustainable in the sense of bing able to recoup the full capital and running costs of the installations from revenues. Probably those larger plant that can be sell surplus power to the grid are far more financially attractive than plant that are primarily concerned with increasing access which are by definition remote from the grid. This must be a cause for concern, and until there are reliable data on costs and performance of a large sample of micro hydro plant, risk averse funding institutions will remain unwilling to invest.

[13]. "If the capital cost recovery is also calculated [the] rice mill will not be a profitable venture" Monitoring report 1996, page 63. But this should be contrasted with the statement in a more recent sources which states that "the income from the mill has been more than satisfactory and is an indicator of the economic viability of rice milling as a hydro end use", Tampoe, op cit, page 82, quoting 1997 data.

6.2 Second, the schemes in both countries described are making efforts to blend hard and soft money. This is an important trend if the sector is to be scaled up. But there are two clear consequences of this. Rightly, there will be greater pressure to undertake schemes with end-uses that generate a cash flow. This suggests that funding schemes will probably need to include complementary "down stream" investment in the funding packages[14]. But more troubling for people, such as the World Bank, concerned primarily about "access for poor people", will be the pressure to locate plant only in those areas that already have an ability to pay commercial rates of interest.

6.3 Third, the success of the current schemes has involved very active "intermediation" both at the macro level and at the micro level. Funding packages have needed to be put together from a wide range of funding sources, and time has to be spent begging for charitable donations to cover a large element of these transaction costs (though, there appears to be sufficient grant funds available for Micro hydro for those intermediaries with sufficient skill and persistence). It is not clear which of these tasks will be necessary in future, nor indeed how they can be delivered more cost efficiently in future (there are both economies and diseconomies of scale, but it is not yet clear which will rise or fall as the programmes are scaled up).

6.4 It seems probable that "soft" grant money will be required for some time to come. It will be required to enable people with insufficient purchasing power to gain access to electricity, to assist in the building of technical and other capacities in which the private sector tends to under invest (as the value of trainees is lost to them when staff move from one job to another), and to finance the finance the necessary intermediation and credit retailing.

6.5 Experience also suggests that the use of soft money can both help the expansion of the sector and harm it. The whole question of support to the sector (including subsidy, and tax policies) needs to be thought through both to establish which are necessary conditions for expansion and to define more clear what is best practice. The reasons why agencies of the state (whther national or multinational) should intervene are clear in the most general terms (to remove a hostile "enabling" environment, because there are clear externalities (health, educ, welfare, income, environmental); to kick start an infant industry; and for reasons of equity and human rights. But as always the "devil is in the detail" and in the specifics of each context.

[14]. This was one of the implications of the seminal work by Fred Fluitman, published in 1983! (The socio-economic impact of rural electrification in developing countries: a review of experience, World Employment Programme Research Working Paper, WEP 2022/wp 126, ILO

Annex 1:

A check list of options in considering the support necessary to expand and sustain the development of the Micro Hydro Sub-Sector.

The Ownership Options

how are the projects put together

What forms of ownership operate and why (is there a trade-off between the profitability of the plant, the type of owner - utility, individual or community - and of the type of beneficiary?)

The organisation of social and other pressure to repay loans

The Financial Options

how is the problem of high pre-investment costs dealt with

how is the problem of high cost of administering large numbers of small loans

how is technical assistance and the provision of financed linked - putting the "package together".

Tariffs (price per kWh) versus flat (capacity) charges

Metering as a option (prepayment as an option)

The Technology Options

What is the pre-existing technical capacities of Manufacturers, Contractors and system designers (and how much do they need to be enhanced).

How to identify, build and pay for the capacity to manufacture, install, maintain and operate (who, how, when at what cost, what problems, what lessons)

The relative costs and performance of domestic as opposed to imported equipment (particularly from China). What are the effects (costs and benefits) of local manufacture.

How much can villagers (owners) do and how much can be contracted from outside.

The Access Options

What effect arises from conflicts between the various objectives for MHP, such as to maximise the sale of Micro Hydro Plant, versus the need to provide poor people access to electricity, versus the need to protect the environment.

What attempts have been made in the selection of projects or in the design of projects to increase the access of relatively poor people to hydro power.

Is special attention given to increasing the access of women and children to power (should it be increased, how and why).

The Participation Options

How are the various parties consulted; What form of social organisation is required; how can it be improved; what are the costs of doing it and of not doing it.

The End-Use Options

Effects on the financial viability of the MHP

Novel markets

How is end use technology financed and owned.

The Environmental Options (land, diversion of water, fuel substitution etc).

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