Water treatment

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A safe type of water source that is well protected from pollution is the preferred way to get pure water. An example would be a tube well 20 to 30m up hill from any pollution and equipped with a pump, tight fitting cap and a well designed apron. Unfortunately good sources are not always available and some treatment will be advisable. Three methods will be discussed briefly.

Boiling

A 208 litre oil drum may be cleaned and then mounted horizontally over a brick fire box as shown in Figure 14.21. A tap should be fitted at the bottom of one end and enough clearance to get a bucket under the tap will indicate a proper height for the tank. The tank should not be filled completely and the filler plug should never be installed tightly. Water should be boiled 1 5 to 20 minutes and a litre or two drawn from the tap during the boiling. Once cooled the 200 litres should provide drinking water for several days.

Filtering

There are a number of filter designs that will clarify water and remove some bacteria. They all require periodic cleaning, the difficulty of which depends on the size and type of filter.

Figure 14.21 Water Boiler.

A medium-sized upward-flow sand filter can do a good job of reducing suspended solids and is easy to clean and maintain. The filter containers can be made from 208 litre drums or from 175 to 200 litre concrete tanks made by using a hessian bag filled with sand or sawdust as a form over which mortaris applied. Small-sized tanks will not need reinforcing if good quality mortar is used. A filter cross section is shown in Figure 14.22. Successive layers, first of stones then gravel, coarse sand and fine sand are put in the tank until it is about half full. A layer of charcoal, crushed to about 5mm size, is desirable in that it will contain bacteria, which are helpful in removing disease carrying micro-organisms from the water. The charcoal bed is enclosed with thin cloth and weighted down by a top layer of sand.

Water poured into the top tank flows through the tube to the bottom, where it percolates up through the gravel, sand and charcoal and out the hose to a water jar. Before actual use, some water should be passed through the filter to establish proper filter action. The drain plug at the bottom should be large in size so that when it is removed water will flow rapidly back through the sand and flush away all accumulated sediment. Experience will indicate when back flushing is necessary.

Figure 14.22 Upward-flow water filter for filtering up to 401/day.

Note that each layer should be 20-25cm.

Chlorination

Proper attention to details is needed to do a satisfactory job of chlorination. However, properly done, it can make drinking water much safer. After adding the correct amount of chlorine material, it is necessary to thoroughly mix it into the water and allow it to stand for at least 30 minutes.

Treatment levels are given in parts per million (ppm), 1mg/m equals 1ppm Water that is clear and not suspected of dangerous contamination can be treated with 5ppm of active chlorine. If the water is a little cloudy 10ppm is safer. The sources of chlorine vary considerably in the amount of active chlorine available. Table 14.6 gives information about several materials.

While these quantities may be reduced proportionately for smaller quantities of water, for amounts under 100 litres measurements become more critical and it is advisable to have a chemist weigh out several packages of treating material to match the quantity of water to be treated each time.

Table 14.6 ***Sources of Chlorine for Water Treatment***

Compound	**Active Chlorine % of weight**	**Quantity to add to 100 litres to get the following concentration (grams)**			
		5ppm	**10ppm**	**15ppm**	**50ppm**
HTH $Ca(OCl)_1$	70	8	15	23	80
Chlorinated lime	25	20	40	60	200
Sodium Hypochlorite	14	38	75	113	380
(NaOCl)					
Sodium Hypochlorite	10	48	95	143	480
Laundry bleach	5.25	95	190	285	950

The 50ppm column is shown in the table as being the level at which to treat a new or

repaired well or cistern. The dosage is left for 24 hours before flushing out.

Open channel flow

A knowledge of the principles of open channel flow is necessary in designing ditches to carry water into grade level storages and channels to carry away storm water without causing erosion. The same principles apply to the design of irrigation canals, road splashes and drifts. The most common problems are:

- **1 Estimating the flow in a channel when the cross-section gradient, depth, etc. are known or can be measured. This is useful in planning irrigation canals, ditches, and natural watercourses;**
- **2 Estimating the depth of flow at which a given channel will carry a given rate of flow. This can be useful in estimating how high a river flood crest will rise, or how deep the flow will be in an irrigation channel or over a drift;**
- **3 Designing a channel to carry a given rate of pow. This is useful in designing channels to carry storm run-off away from buildings or other structures;**
- **4 Designing a channel to carry an estimated maximum flow, when the velocity must not exceed a given maximum value. This is a problem of designing stormwater diversion drains or other unlined channels when the velocity must be low enough to avoid scouring of the channel. A suitable cross section and gradient must be**

chosen.

The quantity of water flowing in an open drainage channel is the product of the cross-section area of the channel and the speed of flow.

$Q = A \times V$ where:

Q is the flow in cubic metres per second (m/s) A is the cross-section area of the channel (m) V is the average velocity of flow (m/s)

If the velocity is checked at any cross section in a channel it will be found that the water is flowing slower along the sides and bottom. This is due to frictional resistance and is more pronounced along vegetated than paved channels. In practice, however, a theoretical average velocity is used.

The equation of continuity shows that for a constant discharge, Q. the velocity must change inversely with the section area of the channel.

$$Q = A_1 \times V_1 = A_2 \times V_2 = A_3 \times V_3$$

There are two types of flow in a channel which may give the same discharge but at different velocities and depths. A rapid, shallow flow is called super-critical or shooting

flow. A deeper, slower flow is called sub-critical flow. An example of each type of flow is found on a dam spillway. The thin layer rushing down the spillway surface is supercritical flow. After hitting the standing wave at the bottom the water moves away much more slowly in a sub-critical flow. In general, super-critical flow should be avoided as erosion will occur in all channels which are not lined with concrete.

The velocity of flow in a channel is determined by the gradient, the shape and size of the cross section and the roughness of the surfaces. It is quite obvious that the velocity will be greater in steep, smooth channels. It is not as obvious that two channels with the same cross-section area but with different shapes can have different velocities. This results from the differing amount of surface contact and frictional resistance.

The effect of cross-section shape is measured by the hydraulic radius of the channel (R). It is found by the equation:

R = A/ P where:

R = hydraulic radius, m
A = Cross-section area, m
P = wetted perimeter, m

The wetted perimeter is the length of the cross section in contact with the water. Figure

14.23 illustrates the effect of shape on the hydraulic radius. Both channels have an area of 24, but a) has a larger R.

Figure 14.23 Channels of equal area but different hydraulic radii.

When other factors are equal, the channel with the larger R will have the higher channel velocity.

The two most common shapes for earth channels are shown in Figure 14.24. The trapezoidal shape has a tendency to gradually change to the parabolic shape over a period of time.

The variables which affect the velocity of flow are related as shown in the empirical equation called the Manning formula for open channel flow.

$V = 1 / n \times R^{2/3} \times S^{1/2}$ where: n

V = velocity, m/s
R = hydraulic radius, m
S = gradient in m/m
n = Manning's roughness coefficient

R = A/P Where:

A = cross-sectional area, m
P = wetted perimeter, m

Table 14.7 ***Value of Manning's Roughness Coefficient n***

(a) Channels free from vegetation	n
Uniform cross section, regular alignment, free from pebbles and vegetation, in fine sedimentary soils	0.016
Uniform cross section, regular alignment, few pebbles, little vegetation, in clay loam	0.020
Irregular alignment, ripples on bottom, in gravelly soil or shale, with jagged banks or vegetation	0.025
Irregular section and alignment, scattered rocks and loose gravel on bottom, or considerable weed on sloping banks, or in	0.030

gravelly material up to 150mm diameter	
(b) Vegetated channels	
Short grass (50-150mm)	0.030-0.060
Medium grass (150-250mm)	0.030-0.085
Long grass (250-600mm)	0.040 0.150
(c) Natural stream channels	
Clean and straight	0.025-0.030
Winding, with pools and shoals	0.033-0.040
Very weedy, winding, and overgrown	0.075-0.150

Extracted from "Field Engineering for Agriculture Development" by Hudson.

With the Manning formula any three variables can be used to find the fourth. When, for example, R. S and n can be measured or estimated it is possible to calculate velocity.

Open-channel problems may vary in detail, but the principle is usually the same. The designer has some fixed quantities, such as a given discharge to be carried, and some variables such as gradient and velocity which have restricted ranges. Using these, a size and shape can be determined. Usually there is no one unique solution, but a range of

satisfactory alternatives.

Example:

An earth or grass-lined channel should be designed with a flow velocity fast enough to avoid sediment deposits but not so fast that erosion will occur. Table 14.8 suggests maximum velocities for various channel soils and vegetative covers.

Table 14.8 ***Maximum Channel Velocities, m/s (Cover after two seasons)***

	Vegetative cover		
Soil	**Bare**	**Medium grass**	**Good gras**
Light silty sand	0.3	0.75	1.5
Coarse sand	0.75	1.25	1.7
Firm clay loam	1.0	1.7	2.3
Coarse gravel	1.5	1.8	
Shale, hardpan	1.8	2.1	
Rock	2.5	-	-

Table 14.9 Design velocities for grass waterways, m/s

	Slope		
Soil	0-5%	5-l0%	10%
Erosion resistant veils	2.0	1.75	1.50
Erosion prone soils	1.75	1.50	1.25

Source: Department of Conservation, Government of Zimbabwe

Figure 14.24 Basic dimensions of common channel sections.

For convenience, Figure 14.25 may be used to solve open channel flow problems. For example, assume a channel is to be designed for a firm clay-loam soil with a medium grass cover (200mm) to be established. A flow of 2.0m/s is the maximum expected and the gradient is approximately 0.025m/m. Choose a channel shape and determine a satisfactory size.

From Table 14.7 read a value for roughness coefficient (n) of 0.030 to 0.085; choose 0.04.

From Table 14.8 read 1.7m/s acceptable velocity.

From Figure 14.25 read 0.30m hydraulic radius.

Arbitrarily choose a parabolic shape.

A=Q/V=2/1.7= 1.18m

P = A/R = 1.18/0.30 = 3.93m

P = t +8d^2 / 3t(assume a value for t of 3.75m)
d^2 = (P - t) x 3t/8
d^2 = (3.93 3.75) x 3 x 3.75/8 = 0.25 d = 0.5m

A = 2/3 td
A = 2/3 x 3.75 x 0.5 = 1.25m

which is close to the previous A = 1.18m

In summary, a parabolic-shape channel 3.75m wide and 0.5m deep will be satisfactory.

Rural sanitation

When dealing with the problems of poor sanitation in rural areas of developing countries, one is tempted to assume that improved technology is the answer and that new latrines will provide the "technological fix". But technology alone does not solve anything, for it has been found that new latrines when built are not fully used, and when used do not wipe out diseases that stem from poor sanitation. Good sanitation depends on people and how they organize hygiene-related activities. It depends on a large "package" of hygiene measures and latrines are only a part of this package.

Technology does have a part to play and many rural communities need basic technical assistance. Latrines may not always be a practical solution but if they are, they must be carefully designed to match local cultural patterns.

Pit Latrines

There are many designs for latrines to be built in areas where more sophisticated sanitary systems are not possible. The simplest design is the pit latrine and there are certain characteristics that are common to the many variations on this design. A latrine should always be dug at least 30m downhill from a well if that is the source of the family water supply. However, in areas where the water table is very high the distance should be increased to 200m or more. The latrine should also be at least 10m from the nearest house or kitchen.

A pit that is a little less than 1 m in diameter is sufficient, but a pit that is a 0.7m by 1.5m oval will provide more convenient space for the person digging. The depth is at

Figure 14.25 Nomograph for Manning's formula.

least partially dependent on the stability of the soil and therefore how deep the hole can be dug without danger of a cave-in. While a depth of 4 to 5m is the normal in stable soil, an increase to 7m will decrease the problem with flies. In areas with a high water table, the depth may have to be decreased as the bottom of the pit should be not less than 1 m above the highest ground water level to avoid pollution. A pit which has a diameter of 90cm and is 5m deep will last for about 5 years if used by a family of 6 persons.

The desired depth and the character of the soil will determine whether a stabilizing liner will be necessary. Most latrines should have a block or brick liner for at least the top metre. To install a stabilizing liner, a hole is dug a little less than 1 m deep and about 1 m in diameter and lined with concrete blocks or bricks. After curing for a few days, the balance of the pit can be dug out being careful not to get the diameter so large as to allow the blocks to sink. If the soil is sandy, then a complete liner may be necessary. Bamboo is one possibility for lining the remainder of the pit sides.

A simple floor to cover the pit can be made of bamboo or timber. However, a much

more durable and sanitary slab can be cast of concrete. See Figure 14.27 and the accompanying paragraphs for the design and construction of a two-piece cast concrete slab that includes foot pads and a slope toward the hole.

The type of structure built above the slab to give privacy is largely a matter of personal preference. Bamboo, offcuts, concrete blocks or corrugated steel are all possibilities for wall construction. Corrugated steel or thatch may be used for roofing.

A desirable feature to include is a vent pipe. A vent will not only reduce odours, but, if screened at the top, will catch numerous flies. The vent hole can be cast in the slab so that the vent is just outside the privy hut. To be most effective the vent should be located on the side with prevailing sunshine, be as large in diameter as possible and painted black, and have a screen over the top. This combination of design features tends to produce a significant air current that carries off the odors and traps the flies. Figure 14.26 shows a latrine of this type. The vent pipe can be made at low cost using hollowed bamboo, but other materials such as masonry, cement/sisal, reeds/mud, PVC or galvanised iron can also be used. A piece of glass fitted at the base of the vent pipe will provide light to attract flies away from the squatting hole and trap them in the vent pipe.

Figure 14.26 Pit latrine with vent pipe.

Latrine Slab

Latrine Slab can be built to cast and finish a perfectly satisfactory 2-piece slab that will be easy to handle. First a small mould is constructed to cast the footpads which should be approximately 10 by 30 by 2cm with rounded corners. They are cast a few days prior to casting the slab and stored in a bucket of water to cure. The form for the slab is then built of 4 boards that are 7 by 1 20cm and any convenient thickness. A round block 5cm thick and 10 to 12cm in diameter and a rectangular block 10 by 20 by 5cm are needed for the hole. If a vent pipe is to be installed another round block will be needed that is 7cm thick with a diameter to match that of the pipe. Two screeds are required, one straight and the other curved enough to be 1 to 2cm low in the middle. Three pieces of polythene are cut to lengths required to serve as separators between the two halves of the slab. See Figure 14.27, section B-B. Six pieces of 8mm reinforcing rod cut to just fit into the form are also needed.

Find a flat surface (floor or leveled earth), spread a piece of polythene, position the form and the wood blocks on it. Mix a 1:3 cement to sand concrete (or 1:2:2 cement to sand to small gravel) using just enough water to get a workable mixture. Position the polythene separators and place a uniform 2.5cm layer of concrete on either side. Place the reinforcing bars as shown in Figure 14.27, Section A-A. Fill the form, and compact and level the concrete with the straight screed. Then, using the curved screed in the

middle third of the form, work out the center of the concrete in both directions to give the sloping surface. Smooth lightly with a steel trowel. Place the dampened foot pads in place, working them into the surface slightly. Use any excess concrete to cast a pad to be put just outside the privy entrance.

After all signs of free water have disappeared from the surface, finish the concrete with a steel trowel. Cover and keep damp for several days. Handle with care. There are a number of variations and refinements in latrine use and design that may be considered.

Placing a thick pad of grass in the bottom of a newly dug latrine and then adding some vegetative wastes regularly will turn the latrine into a compost pit with a substantial reduction in odor. When the pit fills, it is necessary to dig a new latrine hole and move the slab and hut. The full hole is covered and left at least six months after which the compost may be removed and used as fertilizer.

Figure 14.27 Concrete stab cast in two pieces.

Aqua Privies

Aqua privies are usually equipped with either a water-trap hole or a discharge that is below water level. Either of these will reduce odors considerably. However, some water must be added daily for complete decomposition of the waste and a soakaway pit is

essential to dispose of the effluent that is discharged. See Figure 14.28.

One way to ensure that extra water is added each day is to combine a bath house with the privy. Figure 14.29 shows the plans for such a combination. In the illustration a separate soakaway is shown for the bath as it is combined with a pit latrine. However, if it was combined with an aqua privy, the water would be directed into the privy tank.

Figure 14.28 Aqua privy with soakaway pit.

The bath house is an inexpensive but convenient addition for a family to have either with or without piped water.

The farm home with an adequate and continuous water supply can be equipped with a water closet toilet. A w.c. system uses a much larger quantity of water than the other systems mentioned and requires the installation of a septic tank plus a large soakaway or drainage field to handle the considerable amount of effluent.

Septic Tanks

The septic tank is a large concrete or concrete block tank, the base of which is at least 150cm below the inlet and outlet level. The raw sewage flows into the tank through an open tee and the effluent leaves the tank through a similar tee. The tank is divided by a

wooden baffle that extends from 50cm above the bottom to 25cm above the sewage level. A heavy scum forms on the surface and all digestive action is by anaerobic bacteria, i.e. bacteria that live and multiply without the presence of air. Figure 14.30 shows a cross section of a septic tank.

Soakaway Trenches

The effluent from a properly operating septic tank will be almost free of solids and further biological activity in the soakaway trench or pit will be aerobic in nature, i.e. some air needs to be present. Because of this, trenches with a depth of about 50cm are preferred over deep pits.

Before a tank and soakaway system are installed, it is important to check with local authorities concerning design specification requirements. If there are no specific rules, the information given in Table 14.9 may be used.

Percolation time is found by digging a hole 30cm square and 60cm deep. Fill the hole with water and let it drain completely. Refill and then measure the seconds/ mm rate at which the water level falls.

Figure 14.29 Bath house and latrine (All dimensions in cm).

Figure 14.30 Septic tank and distribution box.

Figure 14.31 Tank and soakawaypeld.

Table 14.10 ***Septic Tank and Sookaway Trench Sizes***

No of people regularly in home	Tank indside dimensions(cm below drain level)	Soakaway trench (m)* with percolation rates seconds/mm)			
	L x W x D	10-30	30 60	60-100	100-140
24	200X 100 x 150	10	30	60	100
6	250 x 125 x 150	15	45	90	150
8	250 x 125 x 150	20	60	120	200
10	250 x 150 x 150	25	75	150	250

***Trenches should be 100cm wide and 50cm deep.**

The outlet from the septic tank should be approximately 50cm below ground level. However, site gradients and the need to install the tank low enough so that the sewerage lines will drain into it sometimes makes this difficult. The soakaway field is

ordinarily close to the tank but may need to be separated by some distance because of site conditions.

The soakaway tench should be approximately 100cm wide and 50cm deep and with very little slope. A layer of gravel or broken stone is placed in the bottom of the trench, and then 100mm clay tile or 100mm perforated PVC pipe is laid in the trench. The maximum slope of the soakaway lines is 1:200. If, because of a sloping site, lines have to be installed at different levels, leakproof pipe or tile should be used to carry the effluent from one level to the other, but the seepage lines themselves should always be nearly level. Gravel or stone is added until the lines are covered. Hay, grass or newspapers can be put over the stones before backfilling to prevent the soil from filling the open spaces between the stones. See Figure 14.31. Although both the aqua privies and septic tanks need to be cleaned out periodically, if they are built large enough, the period between clean-outs can be up to two to three years depending on how heavily the system is used.

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SI units

Appendix 1: 1 The seven base units in the International System of Units (SI)

Quantity	Name of base SI Unit	Symbol
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Amount of substance	mole	mol
Luminous intensity	candela	cd

Appendix 1: 2 Some derived SI-units with their symbol/derivation

Quantity	common	Unit	Symbol	Derivation

	symbol			
Term		Term		
Length	a, b, c	metre	m	SI-base unit
Area	A	square metre	m^2	
Volume	V	cubic metre	m^3	
Mass	m	kilogramme	kg	SI-base unit
Density	ρ (rho)	kilogramme per cubic metre	kg/m^3	
Force	F	Newton	N	IN = 1 kgm/s2
Weight force	W	Newton	N	9.80665N = 1 kgf
Time	t	second	s	SI-base unit
Velocity	v	metre per second	m/s	
Acceleration	a	meter per second per second	m/ s2	
Frequency (cycles per second)	f	Hertz	Hz	IHz = Ic/s

Bending moment	M	Newton metre	Nm	
Pressure	P. F	Newton per square metre	N/m^2	$IMN/m^2 = IN/mm^2$
Stress	σ (sigma)	Newton per square metre	N/ m^2	
Work, energy	W	Joule	J	IJ = INm
Power	P	Watt	W	IW = IJ/s
Quantity of heat	Q	Joule	J	
Thermodynamic temperature	T	Kelvin	K	SI-base unit
Specific heat capacity	c	Joule per kilogram degree Kelvin	J/ kg x o K	
Thermal conductivity	k	Watt per metre degree Kelvin	W/m x o K	
Coefficient of heat	U	Watt per square metre Kelvin	w/ m^2 x o K	

Appendix 1: 3 Multiples and sub multiples of SI-Units commonly used in construction

theory

Factor	Prefix	Symbol
106	mega	M
103	kilo	k
(102	hecto	h)
(10	deka	da)
(10 1	deci	d)
(l0 2	centi	c)
10 3	milk	m
10 6	micro	u

Prefix in brackets should be avoided.

Conversion tables

Practical values for use in everyday calculations

Note, the conversion factors marked * are exact

Appendix II.I Length

m	inch	foot	yard
1 *	39.3701	3.2808	1.0936
0.0254$	1 *	0.0833	0.0278
0.3048*	12	1*	0.3333
0.9144*	36	3	1*

1km = 0.6214 miles

Appendix II:2 Area

m^2	cm^2	mm^2	in^2	ft^2	yd^2	acre	ha
1*	10.000	106*	1550.0031	10.7639	1.196	0.2471 x 10-3	0,1 x 10-3
0.1 x 10-3	1*	100*	0155	1.0764 x	1 1 96 x	24 71 x	0.1 X 10-

				10-3	103	10-9	6*
10-6*	0.01*	1*	1.55 x 10-3	10.7639 x 10-6	1.196 x 106	0.2471 x 10-9	0,1 X 10-9*
0.64516 x 10-3	6.4516*	645.16*	1*	6.9444 x 10-3	0.7716 X 10-3	0.1594 x 10-6	64.516 x 10-9
0.09290304*	929.0304	92903.044	144*	1*	0.1111	22.9568 x 10-6	9.2903 x 10-6
0.83612736*	8361.2736	0.8361 x 106	1296*	9*	1*	0.2066 x 10-3	83.6136 x 10-6
4046.8561	40.4685 x io6	4.0469 x 109	6272640*	43560*	4840*	1*	0.4047
100000*	100 x 106	109	15.5 x 106	107639.1	11959.9	2.4711	1*

Appendix II: 3 Volume

m³	cm³	in3	ft3	yd3
* 106	61023.744	35.3147	1.3080	-

10-6	1*	0.0610	35.3146 x 10-5	1.3080x 10-6
16.387 x 10-6	16.387064*	1*	0.5787 x 10-3	21.4334 x 10-6
0.0283	28316.847	1728*	1*	0.0320
0.7646	764554.86	46656*	27*	1*

Appendix II:4 Mass

kg	**g**	**pound**	**oz**
1*	1000*	2.2046	35.274
0.001*	1*	2.205 x 10-3	0.0353
0.45359237*	453.5924	1*	16*
0.0283	28.3495	0.0625*	1*

Appendix II: 5 Density

kg/m^3	lb/ ft3	lb/ in3
1*	0.0624	3.6106 x 10-5
16.0185	1*	5.787 x 10-4

27679.906	1728*	1*

Appendix II:6 Force

N	kgf (=kp)	Lbf
1*	0.102	0.2248
9.80665*	1 *	0.2246
4.4482	0.4536	1 *

Appendix II: 7 Pressure and Stress

Pa = N/m²	mm Hg	UK ton-force/in2	Pound force/in2
	(0°C)	(tonf/in2)	(LBF/in2 (= psi))
1*	7.5006 x 10-3	64.7488 x 10-9	0.145 x 10-3
133.322	1*	115841.53	0.0193
06	8.6325 x l0-6	1*	2239.4237
6894.76	51.7283	446.543 K 10 6	1*

Appendix II: 8 Velocity

m/s	km/in	ft/s	mile/hr
1 *	3.6*	3.2808	2.2369
0.2778	1*	0.9113	0.6214
0.3048*	1.0973	1*	0.6818
0.447	1.609344*	1.4667	1 *

Appendix II: 9 Temperature

°C	°F	°K
°C	(1.8 x °C) + 32*	°C + 273-15*
(F - 32)1.8*	°F*	(° F - 32)/ 1.8 + 273.15*
°K - 273.15*	(1.8(0K - 273.15)) + 32'	°K*

Appendix II: 10 Energv

J. Nm, Ws	kWh	kcal	ft Ibf	therm
1*			0.7376	

3.6 x 106*	0.2778 x 106 1*	0.2388 x 10-3 859.845	2.6552 x 106	9.4781 x 10-9 0.341
4.1868 x 103	1.163 x 10-3	1*	3.088 x 103	39.6832 x 10-6
1.3558 0.3766 x 10-6	0.3238 x 10-3	1*	12.8506 x 10-9	
05,505 x 106	29.3071	25199.56	77.8168 x 106	1*

Greek alphabet

Capital	Lower-case	Name	Capital	LowerCase	Name
A	α	alpha	N	ν	nu
B	β	beta	Ξ	ε	xi
Γ	γ	gamma	O	o	omicron
Δ	δ	delta	Π	π	pi
E	ε	epsilon	P	ρ	rho
Z	ζ	zeta	Σ	σ (at end of word) c	sigma

H	η	eta	T	ι	tau
Θ	θ	theta	Y	τ	upsilon
I	i	iota	Φ	ϕ	phi
K	κ	kappa	X	x	chi
Λ	λ	lambda	Ψ	ψ	psi
M	μ	mu	Ω	ω	omega

Requirements for batching ordinary concrete mixes of various grades and of medium workability

Appendix V: 1 Requirements for Batching Ordinary Concrete Mixes of Various Grades and of Medium Workability

Requirements for batching ordinary concrete mixes of various grades and of high workability

Appendix V:2 Requirements for Batching Ordinary Concrete Mixes of Various Grades and of High Workability

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Dimensions and properties of steel I beams

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Appendix V: 3 Dimensions and Properties of Steel I Beams

Nominal size	Mass per metre	Depth of section D	Width of section B	Thickness		Radius		Depth between fillets d	Area of section
				Web t	Flange T	Root r1	Toe r2		
mm	kg	mm	mm	mm	mm	mm	mm	mm	cm
254 x 203	81.85	254.0	203.2	10.2	19.9	19.6	9.7	166.0	104.4
254X 114	37.20	254.0	114.3	7.6	12.8	12.4	6.1	199.2	47.4

203 x 152	52.09	203.2	152.4	8.9	16.5	15.5	7.6	133.2	66.4
203X 102	25.33	203.2	101.6	5.8	10.4	9.4	3.2	161.0	32.3
178 x 102	21.54	177.8	101.6	5.3	9.0	9.4	3.2	138.2	27.4
152X 127	37.20	152.4	127.0	10.4	13.2	13.5	6.6	94.3	47.5
152 x 89	17.09	152.4	88.9	4.9	8.3	7.9	2.4	117.7	21.8
152 x 76	17.86	152.4	76.2	5.8	9.6	9.4	4.6	111.9	22.8
127 x 114	29.76	127.0	114.3	10.2	11.5	9.9	4.8	79.4	37.3
127 x 114 .	26.79	127.0	114.3	7.4	11.4	9.9	5.0	79.5	34.1
127 x 76	16.37	127.0	76.2	5.6	9.6	9.4	4.6	86.5	21.0
127 x 76	13.36	127.0	76.2	4.5	7.6	7.9	2.4	94.2	17.0
114 x 114	26.79	114.3	114.3	9.5	10.7	14.2	3.2	60.8	34.4
102X 102	23.07	101.6	101.6	9.5	10.3	11.1	3.2	55.1	29.4
102 x 64	9.65	101.6	63.5	4.1	6.6	6.9	2.4	73.2	12.3
102 x 44	7 44	101.6	44.4	4.3	6.1	6.9	3.3	74.7	9.5
89 x 89	19.35	88.9	88.9	9.5	9.9	11.1	3.2	44.1	24.9

76x 76	14.67	76.2	80.0	8.9	8.4	9.4	4.6	38.0	19.1
76 x 76	12.65	76.2	76.2	5.1	8.4	9.4	4.6	37.9	16.3

Appendix V:3 Continued: Joists, Dimension and Properties

Miminal	**Moment of inertia**			**Radius of gyration**		**Elastic Modulus**		**Ratio D/T**
size	Axis x-x		Axis y-y	Axis x-x	Axis y-y	Axis x-x	Axis y-y	
	Gross	Net						
mm	cm4	cm4	cm4	cm	cm	cm	cm4	
254 x 203	12016	10527	2278	10.7	4.67	946.1	224.3	12.8
254x 114	5092	4243	270.1	10.4	2.39	401.0	47.19	19.8
203 x 152	4789	4177	813.2	8.48	3.51	471.4	106.7	12.3
203 x 102	2294	2024	162.6	8.43	2.25	225.8	32.02	19.6

178 x 102	1519	1339	139.2	7.44	2.25	170.9	27.41	19.7
152 x 127	1818	1627	378.8	6.20	2.82	238.7	59.65	11.5
152 x 89	881.1	762.6	85.98	6.36	1.99	115.6	19.34	18.4
152 x 76	873.7	736.2	60.77	6.20	1.63	114.7	15.90	15.9
127X 114	979.0	800.9	241.9	5.12	2.55	154.2	42.32	11.0
127X 114	944.8	834.6	235.4	5.26	2.63	148.8	41.19	11.2
127 x 76	569.4	476.1	60.35	5.21	1.70	89.66	15.90	13.3
127 x 76	475.9	400.0	50.18	5.29	1.72	74.94	13.17	16.7
114X 114	735.4	651.2	223.1	4.62	2.54	128.6	39.00	10.7
102 x 102	486.1	425.1	154.4	4.06	2.29	95.72	30.32	9.9
102 x 64	217.6	182.2	25.30	4.21	1.43	42.84	7.97	15.4

102 x 44	152.3	126.9	7.91	4.01	0.91	30.02	3.44	16.7
89 x 89	306.7	263.7	101.1	3.51	2.01	69.04	22.78	9.0
76 x 76	171.9	144.1	60.77	3.00	1.78	45.06	15.24	9.1
76x 76	158.6	130.7	52.03	3.12	1.78	41.62	13.60	9.1

In calculating the net movement of inertia, one hole is deducted from each range.

Psychrometric chart sea level

PSYCHROMETRIC CHART NORMAL TEMPERATURES Sl METRIC UNITS Barometric Pressure 101.325 kPa SEA LEVEL

Psychrometric chart 750m above sea level

PSYCHROMETRIC CHART NORMAL TEMPERATURES Sl METRIC UNITS Barometric Pressure 92.600 kPa 750m Above Sea Level

Psychrometric chart 1500m above sea level

PSYCHROMETRIC CHART NORMAL TEMPERATURES Sl METRIC UNITS Barometric Pressure 84.600 kPa 1500m Above SEA LEVEL

Typical properties of cohesionless materials

Appendix V: 7 Typical Properties of Cohesionless materials

Material	Angle of Shearing	Specific
	Resistance θ (deg)	Mass (kg/m)
Gravel	35 - 45	16 - 20
Sand - loose	25 - 35	17 - 19
- compact	30 - 40	18 - 21
Organic Topsoil	15 - 30	13 - 18
Broken Brick	35 - 45	1 1-16
Ashes and Clinker	35 - 45	6 - 10
Maize Corn	30	7 - 8
Rice	30 - 45	5 - 6

Millet	30 - 45	6 - 7
Soya	30	7 - 8.5
Potatoes	35	7
Fertilizer (General)	35	10

Multiplied by 10

Typical specific mass of materials

Appendix V: 8 Typical Specific Mass of Materials

Material	**Specific Mass (kg/m) ***
Concrete - Unreinforced	23
- Reinforced	24
- Lightweight	7 - 15
Masonry - granite	26

- limestone	20 - 26
- sandstone	21 - 25
- slate	25 - 28
Brickwork	12 - 20
Timber	
- softwoods	4 - 7
- hardwoods	6 - 12
Steel	

Multiplied by 10^2

Typical allowable bearing capacities

Appendix V: 9 Typical Allowable Bearing Capacities

Material	**Allowable Bearing**
	Capacity (kN/m)

Plain concrete	2000 - 6000
Masonry or brickwork	1500 - 5000
Compact sands and gravels	300 - 600
Loose sands and gravels	150 - 400
Solid non-fissured rocks	600 - 3000
Hard clays and soft rocks	300 - 600
Stiff clays and sandy clays	150 - 300
Firm clays and sandy days	75 - 150
Soft clays and silts	0 - 75
Fill and made ground	Variable

Note: The above values for soils apply where the foundation is 1m or more wide and at a depth of at least 0.6m. The allowable bearing capacity is about one-third of the ultimate bearing capacity.

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Typical strength properties and allowable stresses

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Appendix V: 10 Typical Strength Properties and Allowable Stresses (N/mm)

Mild-Steel Sections		
Youngs Modulus (E)	206,000	
Tension or compression stress		
in bending	155 -165	
Axial tension	155 (depends on slenderness ratio)	
Bearing	190	
Shear	115	

Mild-Steel Rivets and Bolts		
Axial tension: rivets	100	
bolts	120	
Shear: rivets	90 -100	
bolts	80	
Bearing		
(double shear): rivets	265 - 315	
bolts	200	
Timber (Green > 18% Moisture)		
	Softwoods (values in thousands)	Hardwood
Young Modulus (E)	4 - 12	5 - 19
Bending or tension parallel to grain	3 -1 1	4 - 27
Compression paralled to grain	21/2 - 81/2	4 - 27
Compression perpendicular to	3/4 - 11/2	11/2 - 51/2

grain		
Shear parallel to grain	1/2 -11/4	3/4 - 3 1/2

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Linform Wood, Milton Keynes, MK14 6LE, England.

Number of pens required for pig housing

Appendix VI: Number of pens and stalls required in breeding pig units of various sizes (Choose values at the upper part of the intervals given where management, housing and production performance is of good standard and the intensity in the production is high

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Preserving tomatoes

Three home-processing and preservation techniques

Contents (35 p.)

FILMSTRIP COMMENTARY

This brochure contains the commentary accompanying the filmstrip "Preserving tomatoes". The photos illustrating it are black-and-white reproductions of the colour slides in the filmstrip. At the end there is some additional information that makes this brochure a useful handbook for distribution to trainees, and a list of recommendations to the projectionist so that the filmstrip may be shown in the best possible conditions. A commentary recorded on cassette is also available.

This audio-visual course explains in great detail three techniques for home-processing and preservation of tomatoes, namely: the preparation of peeled tomato preserves, tomato pulp and dried tomatoes.

It is intended to help trainers and extension agents in their educational work with

women's groups also farmers who run into serious problems every year when they are obliged to sell roups and village cooperatives, their surplus production at a loss.

At the request of the Ministry of Family Promotion in Burkina Faso - where all the photographs were taken and with financing from project TCP/BKF/6658(T), "Tomato processing and preservation", the filmstrip was made by the Information Division of the Food and Agriculture Organization of the United Nations (FAO).

Text: Giuseppe Amoriggi
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Three home-processing and preservation techniques

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1. Preserving tomatoes. Three home-processing and preservation techniques.

2. With red tomatoes, it is easy to make preserves. We shall explain how. How to prepare jars of peeled tomatoes, bottles of tomato pulp and dried tomatoes. With the help of these techniques, we shall be able to make red sauces and other preparations all year round, even when there are no more fresh tomatoes on the market.

3. Sunrise is the best time to pick tomatoes.They are still cool from the last hours of the night.

4. Red, really red, completely red, these are the right tomatoes for us! They are the richest in vitamins.

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5. Very red, ripe but fairly firm with no black spots or blemishes, these tomatoes will make firstrate preserves.

6. To transport these fine fruits, we use basins or crates. But be careful not to put in too many at a time.

7. Did you notice that the boxes are not completely full? So, when we put one on top of the other, the tomatoes underneath will not be squashed. Remember that we can't make good preserves out of damaged tomatoes.

8. We've got to quickly get our tomatoes to the house. Our team is waiting to start work.

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9. Hey, we said "quick!" This is not the moment to stop for a chat! You may be in the shade, but your tomatoes are in the sun. They are going to go bad, man! And you can't make good preserves out of tomatoes that have been lying in the sun.

10. At last! Now, let's get moving!

11. Let's start by washing our hands, without using scented soap: the scent clinging to the skin will give the tomatoes a bad taste.

12. And then let's wash our tomatoes.

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13. Let's take the best ones to make peeled tomato preserves. So that they look nice, we choose tomatoes all more or less the same size.

14. The others will be kept to make pulp or dried. Later on we will see how.

15. To begin with, we are going to explain how to prepare peeled tomato preserves.

16. A small quantity of washed tomatoes are put into a bowl.

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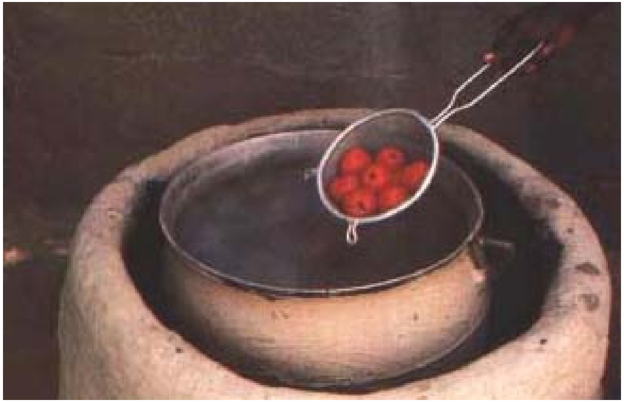
17. They are dipped gently into boiling water for thirty seconds.



18. After thirty seconds, they are taken out of the cooking pot as quickly as possible with a sieve.

19. They are plunged immediately into cold water for a few minutes. Immersion in cold water after the boiling water helps to loosen the skin.

20. We peel tomatoes completely

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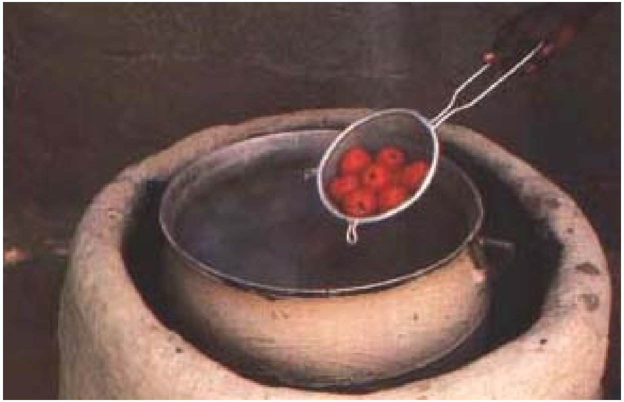

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20. We peel tomatoes completely

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21. ... without leaving any skin on them. Without leaving even the tiniest bit of skin.

22. The jars and the lids must also be clean. Let's wash them with hot water. If they are very dirty, we can rub them clean with sand or small pebbles.

23. Everything is clean, so now the jars can be filled with the peeled tomatoes.

24. The tomatoes are packed in by tapping the bottom of the jar with one hand' so the tomatoes are shaken down and fit snugly against each other.

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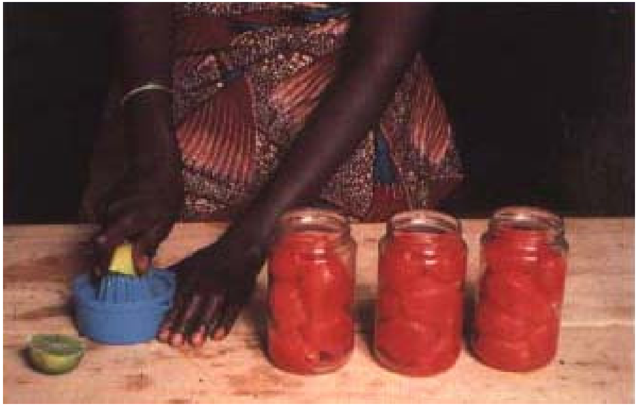
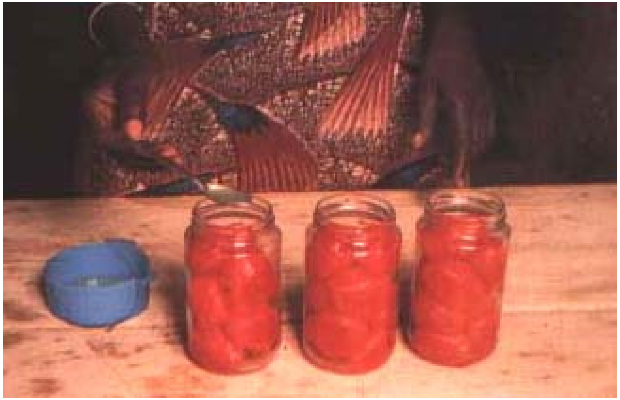


25. This is the moment to add to each jar a little lemon juice without pips. Watch for the pips!



26. The lemon juice is necessary for preservation. One coffee-spoonful per half-litre jar is enough.

27. We also add some hot pulp to fill up the jar. The jar must not be filled right to the top! Leave about one centimetre of air underneath the lid.

28. Be sure to screw the lid on tightly.

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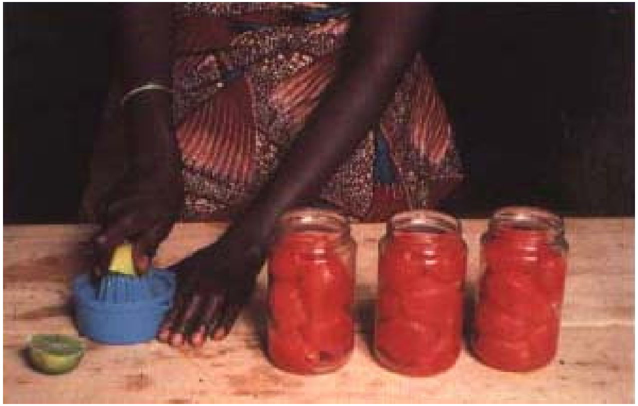

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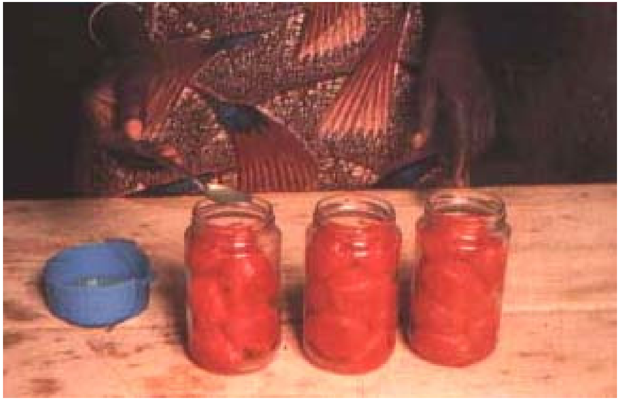

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29. The jars are closed and must now be sterilized.

30. The bottom of a pot is covered with straw. The jars are placed on it, and then more straw put in between the jars to prevent them from knocking against each other.

31. A flat lid and a big stone on top of it will keep the jars steady and in place.

32. The pot is filled with water. The top jars must be at least two centimetres under the water.

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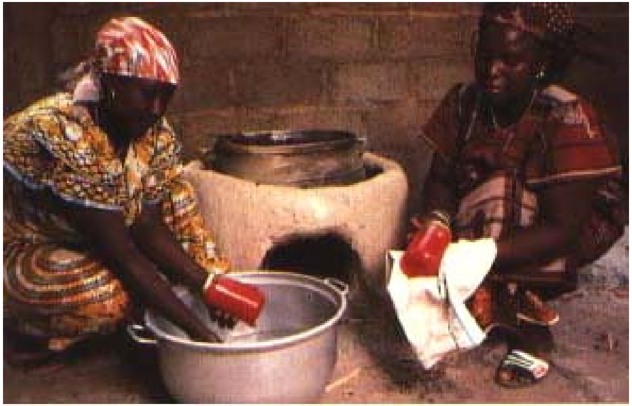
33. This is the moment to light a fire. The water will soon start boiling. It should boil for 45 minutes. 45 minutes for half-litre jars. There's no point in boiling them any longer, it's a waste of wood.

34. After 45 minutes, the preserves are sterilized. The fire is put out while the jars are left to cool.



35. Next morning the jars are rinsed and dried.

36. A label is stuck on every jar

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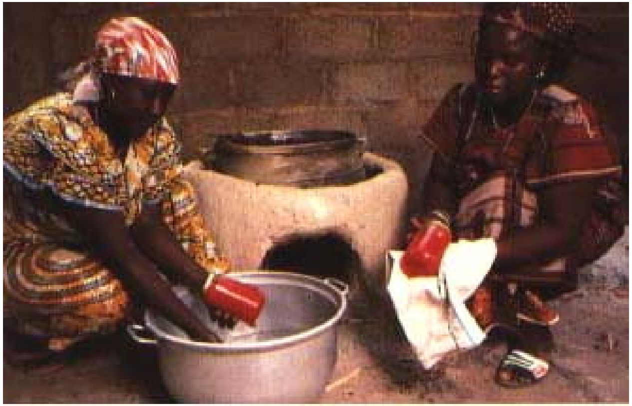

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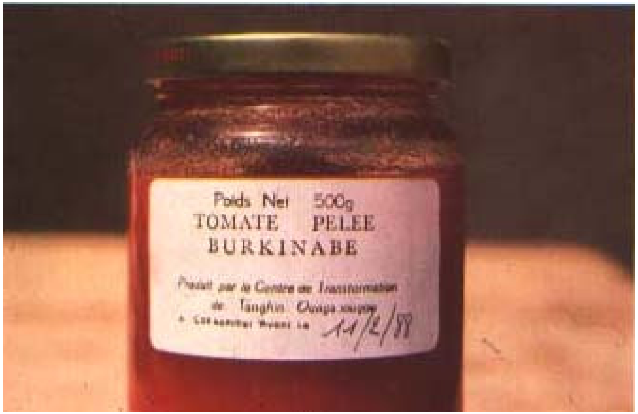
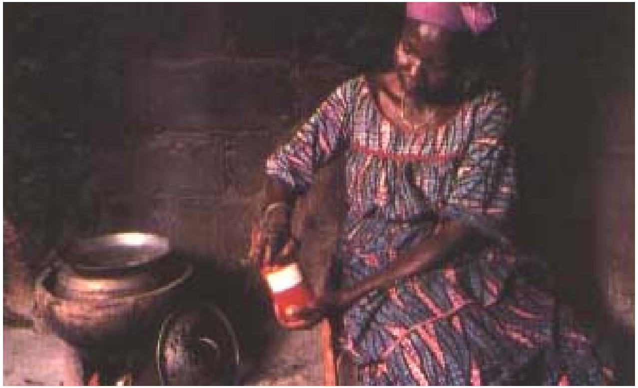


37. ... with the name of the product, the name of the group or cooperative and the expiry date.

38. Preferably, these jars should be kept in a cool, dark place. These preserves should be consumed within the year. They can be used to make sauces and other preparations when there are no fresh tomatoes on the market.

39. What are you up to? You're dipping your finger in the jar to find out if it's good? Of course it's good! But once the lid has been unscrewed, the tomatoes won't keep long: they must be used the same day or kept in the fridge.



40. So open the jar only when you are ready to use the peeled tomatoes.

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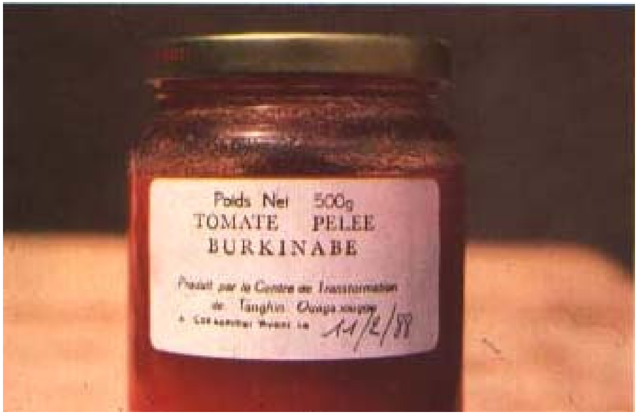
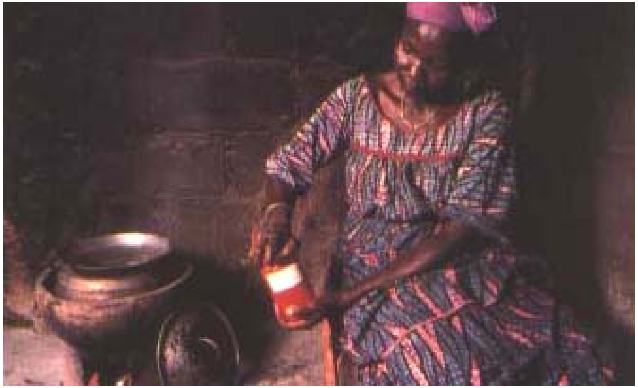


37. ... with the name of the product, the name of the group or cooperative and the expiry date.

38. Preferably, these jars should be kept in a cool, dark place. These preserves should be consumed within the year. They can be used to make sauces and other preparations when there are no fresh tomatoes on the market.

39. What are you up to? You're dipping your finger in the jar to find out if it's good? Of course it's good! But once the lid has been unscrewed, the tomatoes won't keep long: they must be used the same day or kept in the fridge.



40. So open the jar only when you are ready to use the peeled tomatoes.

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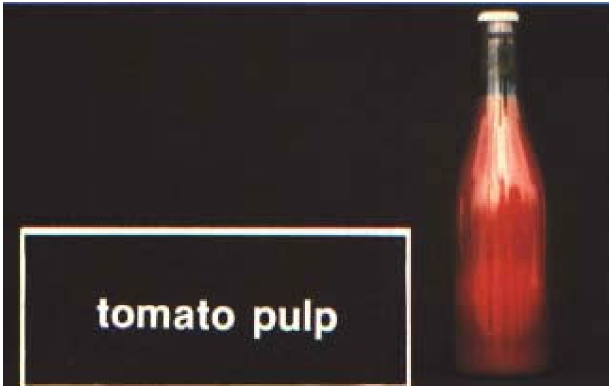
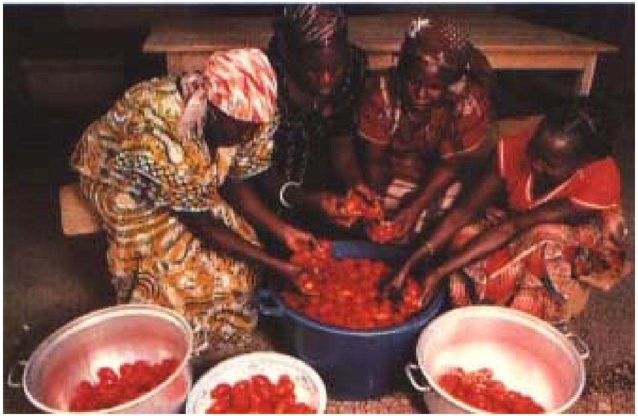
41. Peeled tomatoes are hygienic and rich in vitamins. They are therefore very good for children's health.



42. We are now going to see how to prepare tomato pulp.

43. First we wash our hands.



44. Let's take the tomatoes of different shapes and sizes that we put aside just now. Your remember they were picked in the morning. They were not squashed during trasport, they were not left in the sun and they have been carefully washed.

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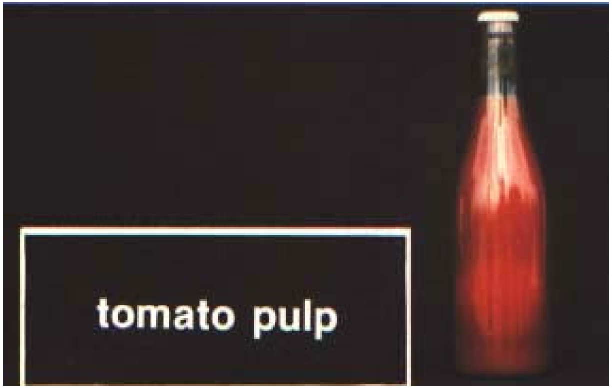

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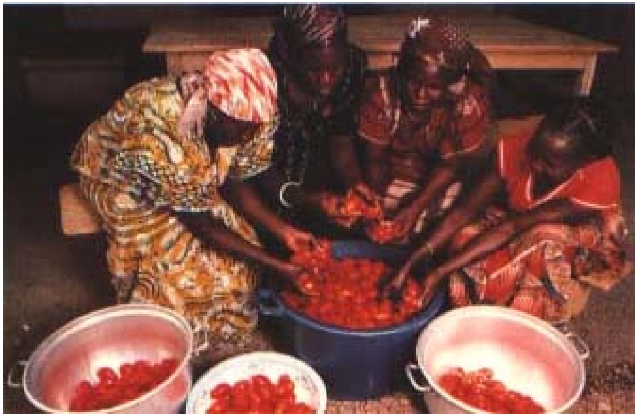

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45. They must also be well drained.

46. The bottles are washed with hot water and sand or small pebbles. Soap is not necessary and it could leave a bad taste.

47. The tomatoes are cut in half

48. ... and checked inside for any that might be rotten.

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49. The opened tomatoes go into a device called an extractor. It extracts the pulp. It separates the pulp from the seeds and the skin.

50. The tomatoes are pressed down with a wooden spoon from time to time.

51. The seeds and and the skin are put back into the extractor several times, to help crush the pulp and increase the yield.

52. When all the pulp is collected, we pour it into a cooking pot.

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53. The pot is placed on the fire for what is called the pre-heating. It must simmer without ever boiling.

54. A small spoonful of lemon juice without pips goes into each clean, empty bottle.

55. The bottles are filled, but not completely.

56. A space of two or three must be left, otherwise the bottles will burst during sterilization.

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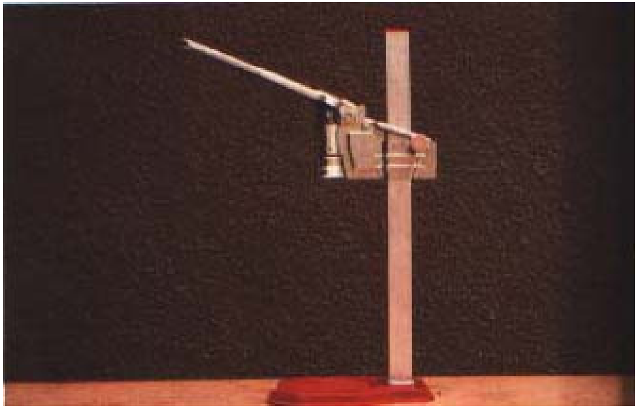

57. This is the device to close the bottle. It's called a bottle-capper.

58. And here is a cap.

59. The bottle is closed with the capper.

60.

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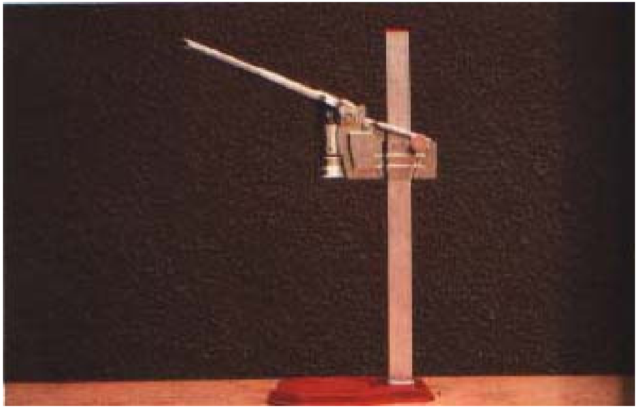

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61. Once the bottles are capped, they are sterilized in a pot, just as with the jars of peeled tomatoes, with straw, a big stone to hold them down, and water which will be boiled for 45 minutes.

62. Bottles can be sterilized at the same time as the half-litre jars if there is enough room in the pot.

63. Next morning, when the bottles are cold, they are rinsed and dried.

64. They are labelled with the name of the product, the name of the group or cooperative and expiry date.

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65. They can be stored for up to a year and used whenever needed, particularly when there are no more fresh tomatoes on the market. But, as with the peeled tomatoes, an open bottle of pulp must be consumed the same day.

66. We will now see how to prepare dried tomatoes.

67. Whatever their shape, all red tomatoes are good for drying.

68. That said, now and every time we handle food, don't let's forget to wash our hands first.

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69. We wash the tomatoes,...

70. ... cut them in half, lengthwise

71. ... and pick out the pips using our thumbs, without crushing the pulp.

72. These pips are left to dry in the sun. They will provide us with new tomato plants.

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73. We cut each half-tomato into slices one centimetre thick, as evenly as possible. Slices of the same thickness will take the same time to dry.

74. Just drying these tomatoes means that they can be kept for at least three months.

75. But additional processing is necessary if we want to keep them longer.

76. To do that, first add to the water in the pot a soupspoonful of salt ...

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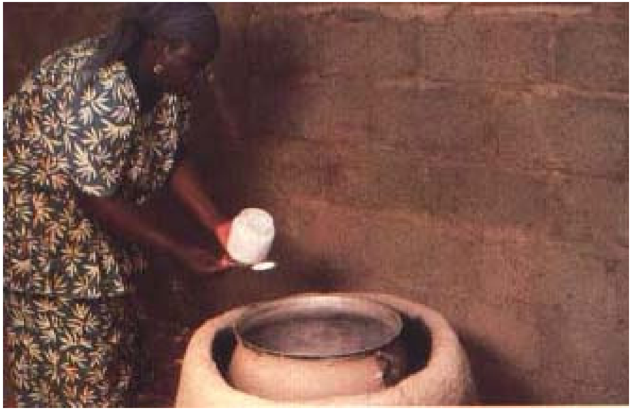

77. ... and a soup-spoonful of preservative per litre of water.

78. Then we boil it, stirring with a wooden spoon.

79. We put the tomato slices in a piece of cloth or in a very clean basket, and plunge the whole thing into this boiling water for three minutes. This is called "blanching".

80. Then we drain them.

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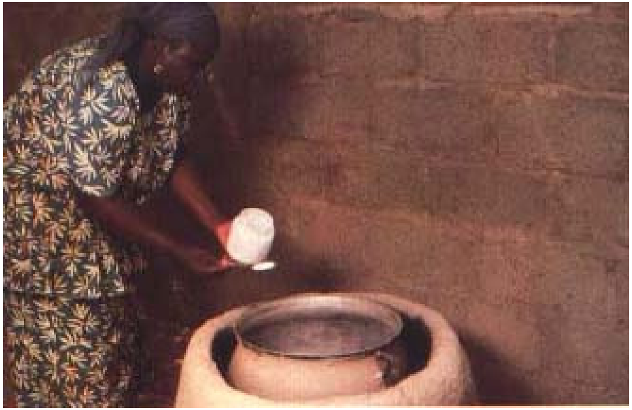

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81. The tomato slices are ready to be put in the dryer.

82. There are several types of modern dryers, of varying sizes. This one is a fixed solar drier.

83. This one is simpler, cheaper to build and mobile. But the drying system is the same. First of all, the plastic retains the heat of the sun and, secondly, the air circulates inside, coming in at the bottom and going out at the top.

84. Inside the dryers, the tomato slices will be placed on trays made of slatted plastic and mosquito netting.

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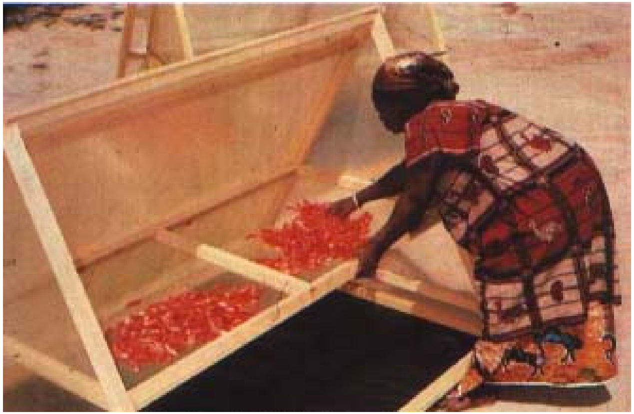
85. The tomato slices are spread out on the tray.



86. . as evenly as possible .

87. ... over the whole surface of the tray.

88. The dryer is shut immediately to protect the tomatoes from dust and flies.

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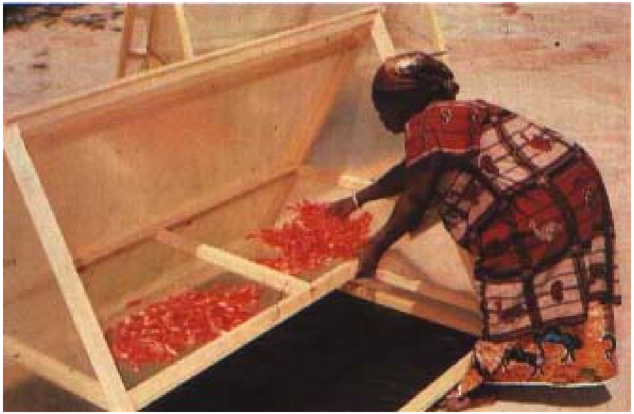

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89. Two and a half days later, the tomatoes are dry.

90. They are gathered up

91. ... and are cooled off for half an hour in a shady place.

92. They can then be put in polythene bags.

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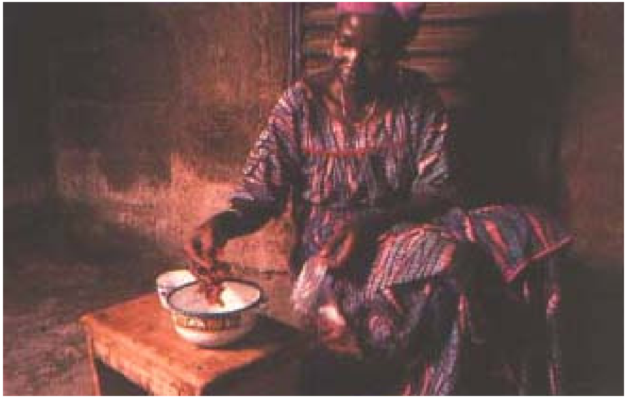
93. A label is stuck on each bag indicating the name of the produce, the name of the group or cooperative and the expiry date.

94. The bags of dried tomatoes are kept in cardboard boxes with straw to protect them from damp.

95. In this way they will keep for a year.



96. When we want to use the dried tomatoes, we soak them in cold water for two hours before preparing a sauce.

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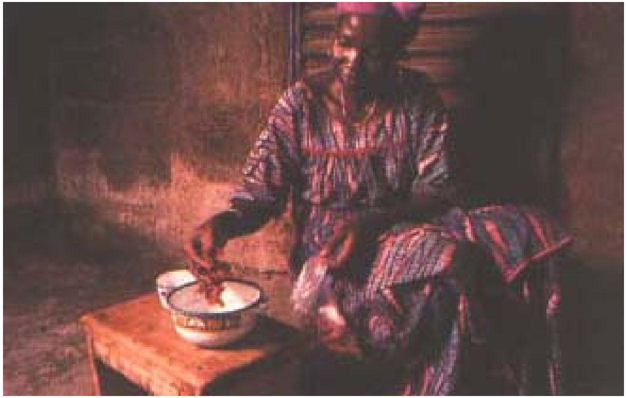

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97. They can also be ground into tomato powder.

98. A soup-spoonful of this powder is enough for a sauce for six to eight people.

99. Peeled tomatoes, tomato pulp and dried tomatoes: three preservation techniques to be used when there is a glut of tomatoes, thus saving food which would otherwise go to waste.

100. Yes, it is easy to preserve tomatoes! And these wholesome and nourishing preserves improve the quality of our meals, which will be rich in vitamins throughout the year.

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Production diagram for the three preservation techniques

Production diagram for the three preservation techniques

storage time

Jars of peeled tomatoes and bottles of pulp for making sauces and other preparations can be used for twelve months, and dried tomatoes for three or twelve months depending on the processing (see the expiry date on the label).

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Recommendations

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1. **Wash your hands before every operation. This rule is particularly important in preparing dried tomatoes.**
2. **Remove the damaged parts of fresh tomatoes.**
3. **Wash utensils, equipment and trays after use in clean water.**
4. **Addition of the preservative, potassium metabisulphite, protects the tomatoes froms bacteria, yeast and moulds. However, this solution cannot prevent the multiplication of germs if the preparation and drying are done in unsanitary**

conditions.

5. **For each finished product jar, bottle, bag) the label must show:**

   - the nature of the product (peeled tomatoes, tomato pulp, dried tomatoes)
   - the net weight
   - the origin (name of the group or cooperative)
   - the expiry date

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Size of container in litres	**Temperature of the contents**	**Sterilization time**
0,33	60 �C	40 minutes
0,50	60 �C	45 minutes
0,66	60 �C	55 minutes
0,75	60 �C	60 minuses
1 litre	60 �C	70 minutes

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Sterilization time

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Processing materials and equipment

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PROCESSING MATERIALS AND EQUIPMENT

� Aluminium or plastic 20-litre buckets	� Stainless-steel or plastic strainers
� Plastic 40 litre basin	� Stainless-steel or plastic funnels
. Stainless-steel or aluminium 30-litre cooking pots	� Lemon squeezer � Small spoons
� Aluminium 25-litre pots	� Chemical products: potassium metabisulphite
� Half-litre jars and lids	
� Half-litre bottles and caps	
� Polythene bags and bands to close them	
� Labels	
� Knives	
. Wooden spoons	
� Stainless-steel or aluminium skimmers	
� Stainless-steel or aluminium ladles	

EQUIPMENT

� Improved stove
� Extractor
� Bottle-capper
� Solar dryer

N.B. Never use copper utensils, because this metal destroys some of the vitamin C

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PROCESSING MATERIALS AND EQUIPMENT

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	Small spoons
Aluminium 25-litre pots	Chemical products: potassium metabisulphite
Half-litre jars and lids	
Half-litre bottles and caps	
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The filmstrip, "Preserving tomatoes", is an audiovisual teaching aid. Its purpose is to show, during a training course, three preservation techniques. It is intended for extension workers, women's groups, farmers and anyone likely to be making tomato

preserves.

To ensure the active participation of trainees and to use this audio-visual in the most effective way, the following recommendations should be borne in mind before a showing is organized.

The discussion leader

The discussion leader must have assimilated the content of the material he is going to present and must have thought out, in advance, the difficulties that could be encountered by the trainees so that he can, without hesitation, provide them with the necessary clarifications. The discussion leader must be familiar in projection equipment, audio-visual presentation techniques and in handling and maintaining projection equipment.

The discussion leader using the filmstrip must have been trained in the three preservation techniques and know how to make tomato preserves.

Projection

Two projections may be envisaged during one training course, one at the beginning and one at the end, so as to recapitulate what has been learned and reformulate the

principles and rules to be applied in making good tomato preserves.

It is a good idea to combine the showing with an exhibition of relevant materials such as:

- **posters, photos, press cuttings, sketches, etc...;**
- **materials used in making preserves;**
- **some finished products. These could be set out for trainees to taste.**

The filmstrip is accompanied by a brochure and a commentary recorded on cassette. Signals are also recorded on the tape. These are reference points to ensure that the projection of the images is synchronized with the commentary. But the discussion leader can, if he prefers, read the text himself, dwell on certain parts of it, add comments or control the presentation and make sure that the group is taking it all in.

To obtain the full attention of the trainees, the discussion leader must prepare the projection well by:

- **briefing the trainees with a short introduction before the projection starts;**
- **ensuring that nobody comes into the room during the projection, so that the trainees' attention will not be distracted or the message garbled;**
- **ensuring that no material difficulties will spring up to interrupt the**

projection. We shall see later the precautions to be taken;
- allowing time for questions during or at the end of the projection.

The projection may well attract uninvited spectators whose presence will render it virtully useless. The filmstrip should be shown to a small group of trainees, possibly with an additional performance for people who are interested or just curious.

Materials

To avoid the many practical difficulties that could arise, the discussion leader should make a list of accessories not to be forgotten and checks to be made, such as:

- make sure that the projector is working before the session;
- if the projection is done with a 12-volt battery, check the charge of the battery before setting out for the field;
- remember to check the voltage of the projector lamp: 110 or 220 volts with alternative current, 12 volts with the battery;
- remember to bring a spare lamp; know how to change it quickly if necessary;
- make sure there are several cables, all long enough, and a 3-way plug;
- remember to bring the right filmstrip adaptor for the filmstrip to be projected
- orizontal or vertical;
- before the session, check that the filmstrip is put in the projector properly

and will run smoothly;

- if the filmstrip is accompanied by a soundtrack recorded on cassette, check the recorder for sound and for the state of the batteries;

- etc....

Each discussion leader must draw up his own list depending on the material he has and the conditions of use.

The role of discussion leader is of paramount importance. The discussion leader must make sure that the knowledge transmitted by the audio-visual has been understood. The filmstrip can in no case replace the discussion leader. On the contrary, the filmstrip must be considered as a teaching aid, an instrument that the presenter uses to reinforce, facilitate and improve his work.

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Recommendations for using the filmstrip

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The filmstrip, "Preserving tomatoes", is an audiovisual teaching aid. Its purpose is to show, during a training course, three preservation techniques. It is intended for extension workers, women's groups, farmers and anyone likely to be making tomato preserves.

To ensure the active participation of trainees and to use this audio-visual in the most effective way, the following recommendations should be borne in mind before a showing is organized.

The discussion leader

The discussion leader must have assimilated the content of the material he is going to present and must have thought out, in advance, the difficulties that could be encountered by the trainees so that he can, without hesitation, provide them with the necessary clarifications. The discussion leader must be familiar in projection equipment, audio-visual presentation techniques and in handling and maintaining projection equipment.

The discussion leader using the filmstrip must have been trained in the three preservation techniques and know how to make tomato preserves.

Projection

Two projections may be envisaged during one training course, one at the beginning and one at the end, so as to recapitulate what has been learned and reformulate the principles and rules to be applied in making good tomato preserves.

It is a good idea to combine the showing with an exhibition of relevant materials such as:

- **posters, photos, press cuttings, sketches, etc...;**
- **materials used in making preserves;**
- **some finished products. These could be set out for trainees to taste.**

The filmstrip is accompanied by a brochure and a commentary recorded on cassette. Signals are also recorded on the tape. These are reference points to ensure that the projection of the images is synchronized with the commentary. But the discussion leader can, if he prefers, read the text himself, dwell on certain parts of it, add comments or control the presentation and make sure that the group is taking it all in.

To obtain the full attention of the trainees, the discussion leader must prepare the projection well by:

- briefing the trainees with a short introduction before the projection starts;
- ensuring that nobody comes into the room during the projection, so that the trainees' attention will not be distracted or the message garbled;
- ensuring that no material difficulties will spring up to interrupt the projection. We shall see later the precautions to be taken;
- allowing time for questions during or at the end of the projection.

The projection may well attract uninvited spectators whose presence will render it virtully useless. The filmstrip should be shown to a small group of trainees, possibly with an additional performance for people who are interested or just curious.

Materials

To avoid the many practical difficulties that could arise, the discussion leader should make a list of accessories not to be forgotten and checks to be made, such as:

- make sure that the projector is working before the session;
- if the projection is done with a 12-volt battery, check the charge of the battery before setting out for the field;

- remember to check the voltage of the projector lamp: 110 or 220 volts with alternative current, 12 volts with the battery;
- remember to bring a spare lamp; know how to change it quickly if necessary;
- make sure there are several cables, all long enough, and a 3-way plug;
- remember to bring the right filmstrip adaptor for the filmstrip to be projected
- orizontal or vertical;
- before the session, check that the filmstrip is put in the projector properly and will run smoothly;
- if the filmstrip is accompanied by a soundtrack recorded on cassette, check the recorder for sound and for the state of the batteries;
- etc....

Each discussion leader must draw up his own list depending on the material he has and the conditions of use.

The role of discussion leader is of paramount importance. The discussion leader must make sure that the knowledge transmitted by the audio-visual has been understood. The filmstrip can in no case replace the discussion leader. On the contrary, the filmstrip must be considered as a teaching aid, an instrument that the presenter uses to reinforce, facilitate and improve his work.

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Comment conserver les tomates

Trois techniques de transformation et de conservation artisanales

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Tables de matières (35 p.)

COMMENTAIRE DU FILM FIXE

Cette brochure contient le commentaire qui accompagne le film fixe intitulé "Comment conserver les tomates." Les photos qui l'illustrent sont des reproductions en noir et blanc des diapositives en couleurs qui composent le film fixe. On trouvera en annexe un complément d'informations qui font de cette brochure un manuel qui est distribué aux stagiaires, ainsi qu'une liste de recommandations adressées au projectionniste pour que le film fixe soit utilisé dans les meilleures conditions possibles. Un commentaire

enregistré sur cassette est également disponible.

Ce cours audiovisuel explique, dans tous leurs détails d'exécution, trois techniques de transformation et de conservation artisanales des tomates. A savoir: la préparation de conserves de tomates pelées, de pulpe de tomate et de tomates séchées.

Il est destiné à aider les formateurs et vulgarisateurs dans leur travail éducatif au niveau des groupements féminins et des coopératives villageoises, mais aussi les maraîchers qui connaissent chaque année les graves problèmes de surproduction et de mévente.

A la demande du Ministère de l'essor familial du Burkina Faso - où toutes les photographies ont été prises - et grâce au financement du projet TCP/BKF/6658 (T) transformation et conservation de la tomate , il a été réalisé par la Division de l'information de l'Organisation des Nations Unies pour l'alimentation et l'agriculture (FAO).

Scénario : Giuseppe Amoriggi
Marie-Colette Zanga
Yves Vequaud
Photos : Christian Errath

Tables des matières (35 p.)

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Trois techniques de transformation et de conservation artisanales

Table des mati�res - Suivante

1. Comment conserver les tomates. Trois techniques de transformation et de conservation artisanales

2. Avec des tomates rouges, c'est facile de faire des conserves! Nous allons expliquer comment. Comment pr�parer des bocaux de tomates pel�es, des bouteilles de pulpe de tomate et des tomates s�ch�es. Gr�ce � ces techniques, toute l'ann�e, nous pourrons cuire des sauces rouges, m�me lorsqu'il n'y a plus de tomates fra�ches au march�.

3. Quand le soleil se l�ve, c'est le bon moment pour cueillir les tomates, car elles sont encore fra�ches des derni�res heures de la nuit.

4. Rouges, vraiment rouges, tout � fait rouges, voil� les tomates qu'il nous faut! Ce sont les plus riches en vitamines.

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5. Bien rouges, bien m�res, mais un peu dures, sans taches noires, sans d�fauts, ces tomates donneront des conserves de premi�re qualit�.

6. Pour transporter ces beaux fruits, utilisons des cuvettes ou des cageots. Mais attention, il ne faut pas en mettre trop � la fois.

7. Regardons les cageots, ils ne sont pas compl�tement remplis. Aussi, quand nous les poserons l'un sur l'autre, les tomates d'en bas ne seront pas �cras�es. Souvenons-nous qu'avec des tomates ab�m�es, on ne peut pas faire de bonnes conserves.

8. Vite! Maintenant, il faut rejoindre la maison, o� nous allons travailler en �quipe.

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9. Eh Mamadou! On a dit "vite!" Ce n'est pas le moment de s'arr�ter pour bavarder! Toi, tu es � l'ombre, mais tes tomates sont au soleil. Elles vont s'ab�mer, mon ami! Avec des tomates qui attendent au soleil, on ne pourra pas pr�parer de bonnes conserves.

10. Enfin! Alors, ne tra�nons pas!

11. Commen�ons par nous laver les mains, sans utiliser de savon parfum�: le parfum restant sur la peau donnerait un mauvais go�t aux tomates.

12. Et puis ... lavons nos tomates!

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13. Prenons les plus belles pour en faire des tomates pel�es. Et pour avoir de belles conserves, choisissons les tomates qui ont � peu pr�s la m�me taille.

14. Les autres, nous les gardons pour faire de la pulpe. On verra comment tout � l'heure.

15. Donc, pour commencer, nous allons expliquer comment pr�parer des conserves de tomates pel�es.

16. Dans une cuvette, nous mettons une petite quantit� de tomates d�j� lav�es et de m�me grosseur, si possible.

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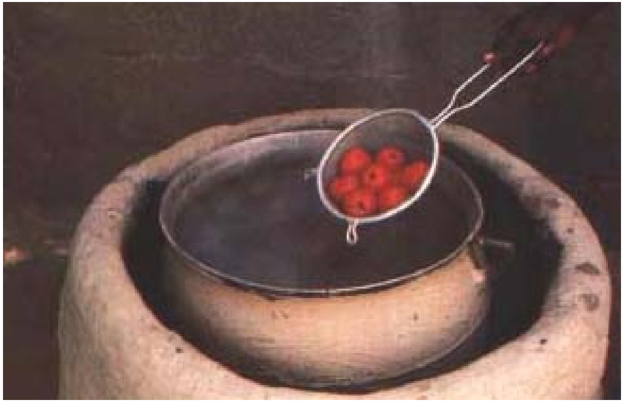
17. Nous les versons doucement dans de l'eau bouillante et nous attendons trente secondes.



18. Au bout de trente secondes, le plus rapidement possible, nous les retirons de la marmite avec une �cumoire.

19. Et nous les plongeons aussit�t dans de l'eau froide pendant quelques minutes. L'eau froide apr�s l'eau bouillante aide la peau � se d�coller.

20. Nous �pluchons les tomates compl�tement ...

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21. ... sans laisser de peau. Sans laisser le plus petit morceau de peau.

22. Les bocaux et les couvercles doivent �tre propres aussi. Lavons-les avec de l'eau chaude. S'ils sont tr�s sales, frottons-les avec du sable ou des petits cailloux pour gratter la salet�.

23. Tout est propre, nous pouvons donc remplir les bocaux avec les tomates �pluch�es.

24. Nous les tassons en tapant le fond du bocal avec la main, pour que les tomates descendent et se serrent les unes contre les autres.

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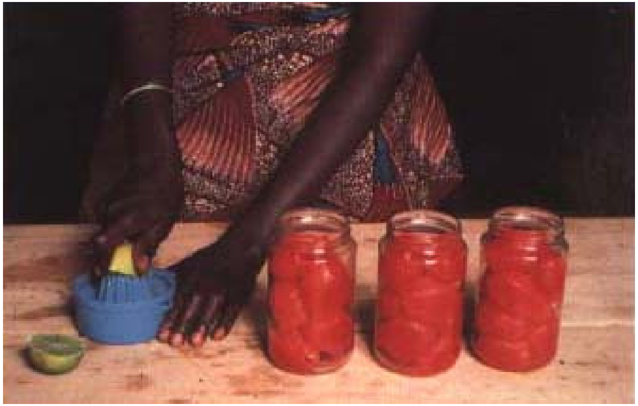
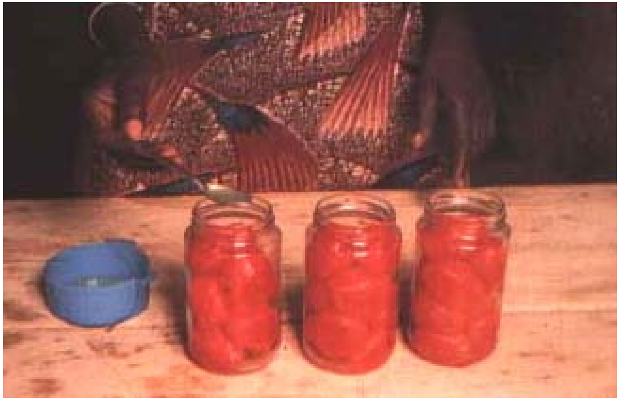


25. Dans chaque bocal, c'est le moment d'ajouter un peu de jus de citron sans p�pins. Attention aux p�pins!



26. Le jus de citron est n�cessaire pour la conservation. Il suffit d'en verser une cuill�re � caf� par bocal d'un demilitre.

27. Pour bien remplir le bocal, nous ajoutons aussi de la pulpe chaude.

28. Pour fermer, il faut bien serrer le couvercle.

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29. Il ne faut pas que le bocal soit plein jusqu'en haut! En dessous du couvercle, nous laissons un centim�tre d'air environ. Voil�, les bocaux sont ferm�s. Si nous voulons les conserver, nous devons maintenant les st�riliser.

30. Dans le fond d'une marmite, nous mettons de la paille, et puis des bocaux, et puis de la paille entre les bocaux, pour �viter les chocs.

31. On cale le tout avec un couvercle et une grosse pierre, pour maintenir les bocaux.

32. Ensuite, on remplit la marmite avec de l'eau. Les bocaux du dessus doivent �tre noy�s sous deux centim�tres d'eau.

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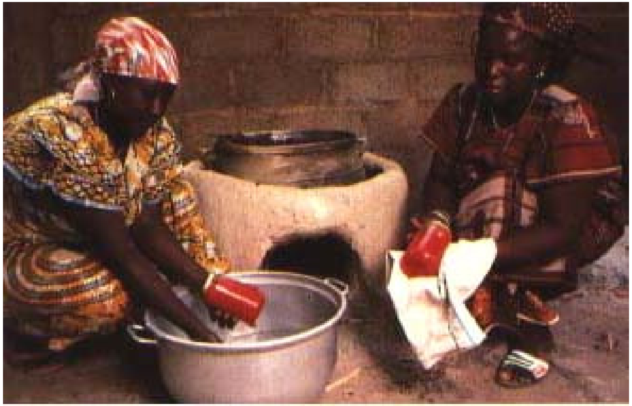
33. C'est le moment d'allumer le feu. Bient�t, l'eau va bouillir. Il faut laisser bouillir pendant 45 minutes. Pendant 45 minutes pour les bocaux d'un demi-litre. Faire bouillir plus longtemps, c'est inutile, c'est gaspiller du bois!

34. Au bout de 45 minutes, les conserves sont st�rilis�es. On �teint donc le feu, et on laisse refroidir doucement.



35. Le lendemain matin, on lave les bocaux et on les essuie.

36. Sur chaque bocal, on colle une �tiquette ...

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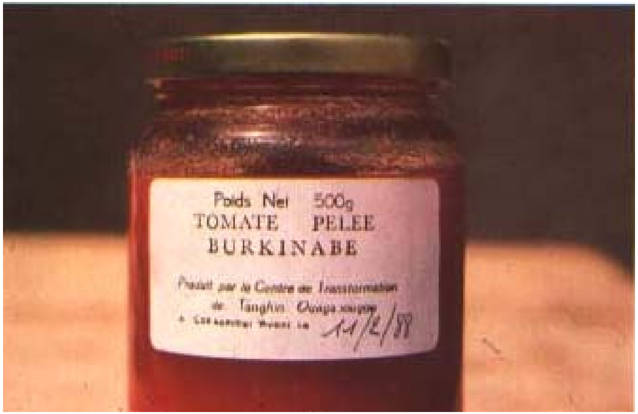
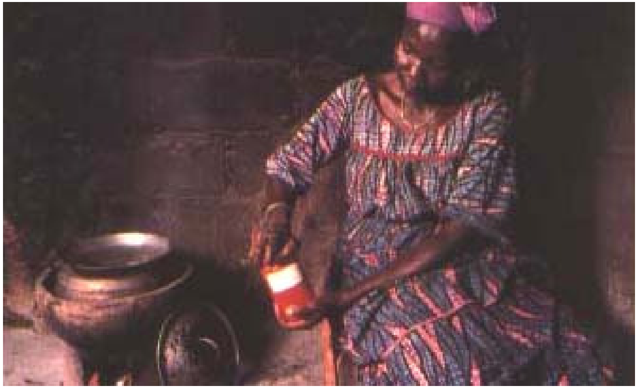


37. ... avec le nom du produit, le nom du groupement ou de la coop�rative et la date limite de consommation.

38. De pr�f�rence, on garde ces bocaux dans un endroit sombre et frais. Toutes ces conserves doivent �tre consomm�es dans l'ann�e. Elles serviront � pr�parer des sauces quand il n'y a plus de tomates fra�ches au march�.

39. Que fais-tu Aminata? Tu trempes ton doigt dans le bocal pour savoir si c'est bon? Bien s�r que c'est bon! Mais si on d�visse le couvercle une seule fois, les tomates ne vont plus se conserver. Quand on a d�viss� le couvercle, il faut utiliser les tomates tout de suite, sans attendre demain.



40. On ouvre donc le bocal au dernier moment, quand on veut pr�parer une sauce.

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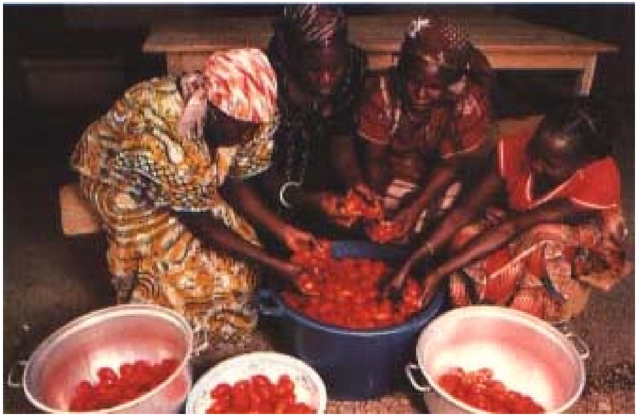
41. Les tomates pel�es sont hygi�niques et riches en vitamines. Elles sont donc tr�s bonnes pour la sant� des enfants.

42. A pr�sent, nous allons apprendre comment pr�parer de la pulpe de tomate.

43. Mais, lavons-nous d'abord les mains.



44. Reprenons nos tomates plus ou moins grosses et de formes diverses que nous avons laiss�es de c�t� tout � l'heure. Vous vous souvenez qu'elles ont �t� ceuillies le matin, qu'elles n'ont pas �t� �cras�es pendant le transport, qu'elles ne sont pas rest�es au soleil et qu'elles ont �t� lav�es soigneusement.

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45. Il faut aussi bien les �goutter.

46. Et laver les bouteilles avec de l'eau chaude, du sable ou des petits cailloux. Le savon n'est pas n�cessaire et il laisserait peut-�tre un mauvais go�t.

47. Maintenant, nous ouvrons les tomates en deux.

48. Nous v�rifions qu'elles sont saines.

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49. Et nous mettons ces tomates ouvertes dans l'appareil qui s'appelle un extracteur. Il sert � extraire la pulpe. Il sert � s�parer la pulpe des graines et de la peau.

50. De temps en temps, nous tassons avec une cuill�re en bois.

51. Et nous remettons dans l'extracteur les graines et la peau plusieurs fois, pour aider � �craser la pulpe et am�liorer l'extraction.

52. Quand nous avons recueilli toute la pulpe, nous la versons dans une marmite.

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53. Puis nous posons cette marmite sur un feu, pour ce qu'on appelle le pr�chauffage. Il faut laisser chauffer, mais il ne faut jamais faire bouillir!

54. Dans les bouteilles vides et propres, nous versons une petite cuill�re de jus de citron sans p�pins.

55. Ensuite, nous remplissons les bouteilles, mais pas compl�tement.

56. Il faut laisser 2 ou 3 centim�tres de vide, autrement les bouteilles �clateraient pendant la st�rilisation.

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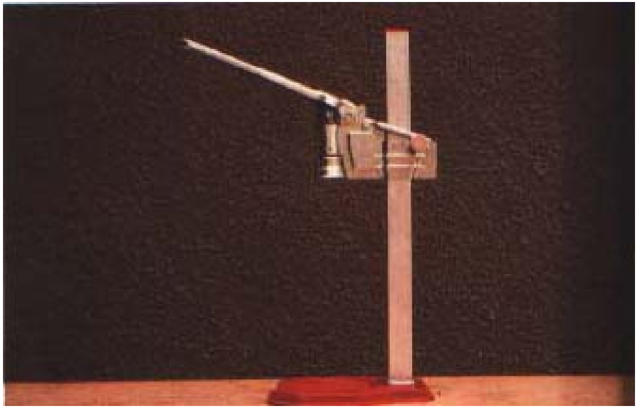

57. Voici l'appareil qui va fermer la bouteille. On l'appelle un capsuleur.

58. Et voil� une capsule.

59. On ferme avec le capsuleur.

60. La bouteille est capsul�e, bien ferm�e!

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61. Une fois capsul�es, les bouteilles sont st�rilis�es dans une marmite avec de la paille, une grosse pierre et de l'eau que l'on va laisser bouillir 45 minutes, comme pour les conserves de tomates pel�es.

62. D'ailleurs, on peut st�riliser les bouteilles en m�me temps que les bocaux d'un demi-litre, si l'on a de la place dans une marmite.

63. Le lendemain matin, quand les bouteilles sont froides, on les lave et on les essuie.

64. On les �tiquette.

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65. Et puis on les stocke. On peut les conserver pendant un an. Pendant un an, on peut les utiliser quand on veut pour pr�parer une sauce, surtout quand il n'y a plus de tomates fra�ches sur le march�. Mais, comme pour les tomates pel�es, une bouteille de pulpe ouverte doit �tre consomm�e le m�me jour.

66. Enfin, pour terminer, nous allons voir comment pr�parer des tomates s�ch�es.

67. Quelle que soit leur forme, toutes les tomates cueillies rouges sont bonnes pour �tre s�ch�es.

68. Cela dit et comme chaque fois que nous nous occupons de nourriture, n'oublions pas d'abord de nous laver les mains.

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69. Ensuite, nous pouvons laver les tomates.

70. Et puis les couper en deux, dans le sens de la longueur.

71. Nous retirons les graines en nous servant de nos pouces, sans �craser la pulpe.

72. Ces graines, nous les laissons s�cher au soleil. Elles nous permettront d'obtenir de nouveaux plants de tomates.

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73. Nous d�coupons chaque moiti� de tomate en tranches �paisses d'un centim�tre, le plus r�guli�rement possible. Ces tranches de m�me �paisseur mettront donc le m�me temps pour s�cher.

74. Simplement s�ch�es, ces tomates pourront �tre gard�es au moins trois mois.

75. Mais une pr�paration suppl�mentaire est n�cesssaire si nous voulons les conserver plus longtemps.

76. Dans une marmite, nous versons une cuill�re � soupe de sel ...

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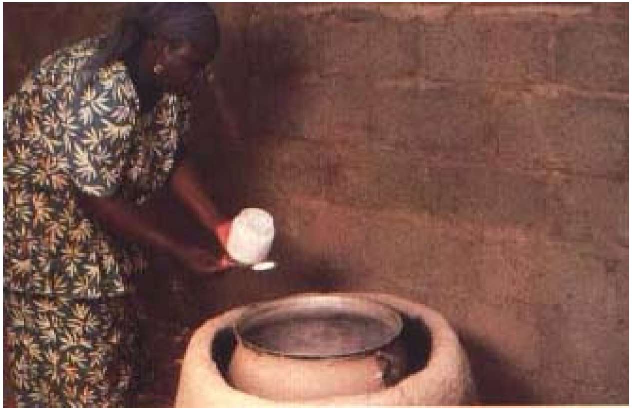

77. ... et une cuill�re � soupe de conservateur par litre d'eau.

78. Puis nous faisons bouillir en tournant avec une cuill�re en bois.

79. Nous mettons les tranches de tomate dans un tissu ou dans un panier bien propre, et nous plongeons le tout dans cette eau bouillante pendant trois minutes. C'est ce qu'on appelle le trempage.

80. Ensuite, nous �gouttons.

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81. Les tranches de tomate sont pr�tes pour �tre confi�es au s�choir.

82. Des s�choirs modernes, il en existe de plusieurs formes, plus ou moins grands. Celui-ci est en banco.

83. Celui-l� est plus simple, sa construction co�te moins cher. Mais le syst�me de s�chage reste le m�me. Premi�rement, le plastique retient la chaleur du soleil et, deuxi�mement, l'air circule � l'int�rieur, entrant par le bas, sortant par le haut.

84. A l'int�rieur des s�choirs, des plateaux de grillage en plastique vont recevoir les tranches de tomate. On appelle ces plateaux des claies.

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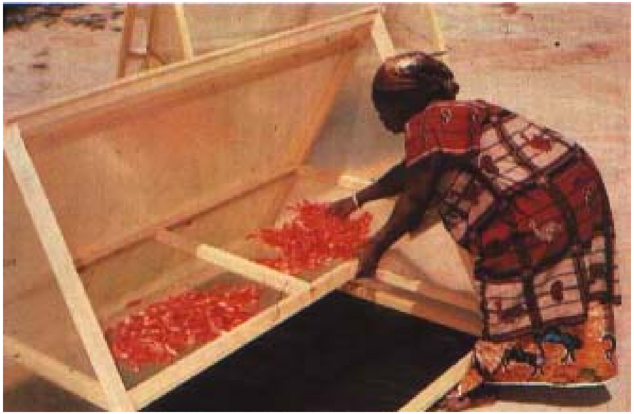
85. Nous mettons donc les tranches de tomate sur une claie.



86. Nous �talons ces tranches de tomate le mieux possible ...

87. ... sur toute la surface de la claie.

88. Et nous refermons ausit�t le s�choir pour prot�ger les tomates de la poussi�re et des mouches.

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89. Deux jours et demi plus tard, les tomates sont s�ches.

90. Alors, nous les ramassons.

91. Nous les laissons refroidir une demiheure.

92. Et nous les mettons en sachet.

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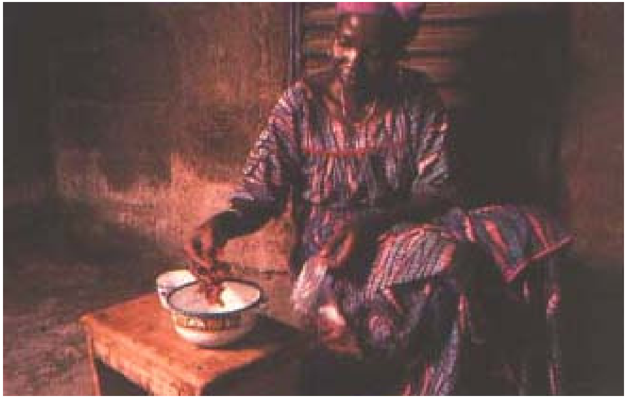
93. Sur les sachets, on colle une �tiquette, comme sur les bocaux et les bouteilles.

94. Les sachets de tomates s�ch�es sont gard�s dans des cartons avec de la paille, pour les prot�ger de l'humidit�.

95. De cette fa�on, ils se conservent pendant un an.



96. Quand nous voulons utiliser des tomates s�ch�es, nous les trempons dans de l'eau froide pendant deux heures avant de pr�parer une sauce.

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97. Mais nous pouvons aussi les piler et nous obtenons alors de la vraie poudre de tomate.

98. Une cuill�re � soupe de cette vraie poudre est suffisante dans une sauce pour six � huit personnes.

99. Tomates pel�es, bouteilles de pulpe et tomates s�ch�es, voil� donc trois techniques de conservation permettant, au moment de la surproduction, de sauver des tomates qui, autrement, seraient perdues pour tout le monde.

100. Oui, c'est facile de conserver des tomates! Et ces conserves saines, nourrissantes, am�liorent la qualit� de nos repas, qui restent riches en vitamines toute l'ann�e.

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Diagramme de production des trois techniques de conservation

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Diagramme de production des trois techniques de conservation

Conservation

Pour la pr�paration des sauces on peut utiliser les bocaux de tomates pel�es et les bouteilles de pulpe pendant douze mois et l�s tomates s�ch�es trois ou douze mois selon le traitement qu'elles ont subi (voir la date limite de conservation indiqu�e sur l'�tiquette).

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Recommandations

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1. **Avant toute op�ration, on se lavera les mains. Cette r�gle s'applique plus particuli�rement pour la pr�paration des tomates s�ch�es.**
2. **Les parties endommag�es des tomates fra�ches seront �limin�es.**
3. **Apr�s utilisation, les ustensiles, les �quipements, les claies seront soigneusement lav�s...�, l'eau propre**
4. **L'addition du conservateur, le m�tabisulfite de potassium, permet de prot�ger les fruits des bact�ries, des levures et d es moisissures. Toutefois cette solution ne peut pr�venir la multiplication des germes lorsque les pr�parations et le s�chage sont faits dans des conditions insalubres.**
5. **Pour chaque produit fini (bocal, bouteille, sachet), on n'oubliera pas d'indiquer sur l'�tiquette**

   - la nature du produit (tomates pel�es, pulpe de tomate ou tomates s�ch�es)
   - le poids net
   - la provenance (nom du groupement ou de la coop�rative)
   - la date limite de consommation.

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Tableau des temps de sterilisation

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Contenance	Prechauffage	Temps de
en litre		sterilisation
0,33	60 �C	40 minutes
0,50	60 �C	45 minutes
0,66	60 �C	55 minutes
0,75	60 �C	60 minutes
1 litre	60 �C	70 minutes

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Rendement

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Taux moyen de rendement entre la mati�re premi�re et le produit fin.

pulpe de tomate	0,65	1,5/ 1
tomate pel�e	0,75	1,3/ 1
tomate s�ch�e	0,04	25/1

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Materiel et equipement de transformation

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MATERIEL

� Seaux de 20 1 en aluminium ou en plastique.	� Passoires en acier inoxydable ou en plastique.

� Cuvettes de 40 1 en plastique.	. Entonnoirs en acier inoxydable ou en plastique.
� Marmites de 30 1 en acier inoxydable ou en aluminium.	� Presse-citron. � Petites cuill�res.
� Marmites de 250 1 en aluminium.	� Produits chimiques M�tabisulfite de potassium.
� Bocaux de 0,5 1 et couvercles.	
� Bouteilles de 0,5 1 et capsules.	
� Sacs en poly�thyl�ne et bogues de fermeture.	
� Etiquettes.	
� Couteaux.	
� Cuill�res en bois.	
� Louches en acier inoxydable ou en aluminium.	
� Ecumoires en acier inoxydable ou en aluminium.	

Equipement

� Foyer am�lior�.
� Extracteur.
� Capsuleur.
� S�choir solaire.

A noter: Ne jamais utiliser d'ustensiles en cuivre, car ce m�tal d�truit une partie des vitamines C.

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Organisation et recommandations pour utiliser le film fixe

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Le film fixe Comment conserver les tomates est un audiovisuel en apport de connaissances. Son objectif est de montrer, pendant un stage de formation, trois techniques de conservation. Il s'adresse � des vulgarisateurs, des femmes faisant partie d'un groupement, des producteurs de tomates, � toute personne suceptible de fabriquer des conserves de tomates.

Pour obtenir la participation active des stagiaires, pour utiliser cet audiovisuel de la fa�on la plus efficace, on doit tenir compte des recommandations qui suivent avant d'organiser une s�ance de projection.

L'animateur

L'animateur se doit d'avoir assimil� tout le contenu du mat�riel qu'il va pr�senter et d'avoir r�fl�chi, par avance, aux difficult�s que peuvent rencontrer les stagiaires, pour pouvoir, sans h�sitation, leur apporter les �claircissements n�cessaires. L'animateur doit �tre form� � la p�dagogie de l'audiovisuel et au maniement et � l'entretien du mat�riel.

L'animateur qui utilisera le film fixe devra avoir re�u une formation sur les trois techniques de conservation et savoir lui-m�me fabriquer des conserves de tomates.

La projection

Dans le cadre d'un stage de formation, il peut �tre pr�vu deux projections. Une au d�but du stage et une en fin de stage, de mani�re � r�capituler ce qui a �t� appris et reformuler les principes et les r�gles qui doivent �tre appliqu�s pour fabriquer de bonnes conserves de tomates.

Il est bon de raccorder la projection � des r�alit�s concr�tes expos�es pendant la s�ance:

-des planches murales pr�sentant des affiches, des photos, des articles de presse, des croquis, etc ...;
- du mat�riel utilis� pour la fabrication des conserves;
- des produits finis; une d�gustation de ces produits peut �tre pr�par�e.

Le film fixe est accompagn� d'une brochure et d'un commentaire enregistr� sur cassette. Des tops sonores sont �galement enregistr�s sur la bande magn�tique. Ce sont des rep�res qui permettent de projeter les images et le commentaire synchronis�s � la cadence du sc�nario. Mais l'animateur peut, s'il pr�f�re, lire le texte lui-m�me, insister sur certains �l�ments, revenir en arri�re, ajouter des observations ou contr�ler le rythme de la pr�sentation et s'assurer de la r�ceptivit� du groupe.

Pour obtenir toute l'attention des stagiaires, l'animateur se doit de bien pr�parer la projection:

- avant de projeter, mettre les stagiaires en condition, en commen�ant par une petite introduction;
- veiller � ce que personne n'entre dans la salle pendant la projection pour ne pas distraire l'attention des stagiaires et alt�rer le message;
- veiller � ne pas avoir � affronter des difficult�s mat�rielles qui pourraient interrrompre la projection. Nous verrons plus loin les pr�cautions � prendre;
- pr�voir en fin de projection du temps pour r�pondre aux questions que poseront les stagiaires.

L'attrait g�n�r� par la projection risque d'attirer des spectateurs non pr�vus et r�duire � n�ant l'utilit� de la projection. Celle-ci doit �tre faite au groupe restreint des stagiaires, quitte � pr�voir une s�ance suppl�mentaire pour les personnes int�ress�es ou pour les curieux.

Mat�riel

Pour �viter les multiples difficult�s mat�rielles qui peuvent surgir, il est bon que l'animateur n'oublie pas de se r�f�rer pour m�moire � une liste des accessoires � ne pas oublier et des contr�les � effectuer:

- v�rifier l'�tat de marche du projecteur avant la s�ance;
- si la projection se fait dans un lieu disposant de 220 volts, v�rifier l'�tat des prises;
- si la projection se fait � l'aide d'une batterie 12 volts, v�rifier la charge de la batterie au d�part sur le terrain;
- penser � v�rifier le voltage de la lampe du projecteur: 200 volts avec le courant alternatif, 12 volts avec la batterie;
- penser � prendre une lampe de rechange;
- pr�voir plusieurs cables suffisamment longs et une prise multiple;
- penser � prendre l'adapteur film fixe qui correspond au film fixe que l'on veut projeter, horizontal ou vertical;
- avant la s�ance, v�rifier que le film fixe est bien � l'endroit et qu'il se d�roulera sans effort;
- si le film fixe est accompagn� d'une bande son enregistr�e sur cassette, v�rifier l'�tat des piles du magn�tophone;
- etc ...

Chaque animateur doit dresser sa propre liste en fonction du mat�riel dont il dispose et des conditions d'utilisation.

Le r�le de l'animateur est d'une importance fondamentale. L'animateur doit s'assurer

que les connaissances transmises par l'audio-visuel ont �t� bien comprises. Le film fixe ne peut en aucun cas remplacer l'animateur. Au contraire, il faut consid�rer le film fixe comme un outil p�dagogique, un instrument que l'animateur utilise pour renforcer, faciliter et am�liorer son travail.

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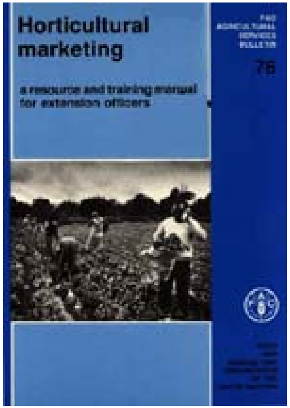

Horticultural marketing - a resource and training manual for extension officers

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Foreword

If farmers are to increase production, more attention needs to be paid to the fact that their output must be marketed at a rewarding price. Commercialization of the small farm sector requires the development of market-orientated production, as opposed to the occasional sale of subsistence surpluses. Success in commercializing this sector thus depends on the orientation of production to meet market demand and on the removal, or reduction, of a broad range of marketing constraints.

In most countries marketing problems are currently regarded as beyond the scope of field-level agricultural extension workers who are the officers in direct contact with the farmers. Even when extension workers are able to identify marketing problems faced by farmers their lack of expertise in this field, or knowledge of appropriate sources of assistance, makes them unable to help.

This manual, which has been prepared by G. Dixie of High Value Horticulture plc, U.K. on behalf of the Food and Agriculture Organization of the United Nations (FAO), aims to provide appropriate resource and training material on marketing for extension officers working with farmers who produce horticultural produce for both domestic and export markets. Although the manual is too detailed for everyday use by most extension workers, it is hoped that it will be used by agricultural colleges for their training courses in agricultural marketing and, indeed, may encourage such colleges to devote a greater part of their curricula to marketing. Further, it is also expected that this manual will be

used by marketing officers working with ministries of agriculture in training field-level extension officers and that it will be a valuable reference work for marketing extension workers where resources permit such specialization. The manual should also prove of value to processing organizations, traders' associations and others working in the area of horticultural marketing.

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Introduction

As agriculture and society develop, marketing becomes ever more important. In subsistence agriculture a farmer will mainly be feeding himself and his neighbours. The

local community's taste and requirements are well understood. Transport and post-harvest losses are not serious problems. As the populations of the cities expand farmers have the added responsibility of feeding not only the rural market but the growing distant urban markets. The farmer therefore has to take on commercial and marketing skills. Marketing is the process by which the space between the producer and the consumer is bridged. The process obviously involves transport and techniques for minimizing crop losses. An effective distribution system will also require the establishment of rural businesses such as truck drivers and packaging manufacturers, contractors and wholesalers. The production/marketing chain is a twoway process. Produce flows from the rural areas into the cities and money and market information should flow back. As tastes in the city market evolve the rural community can use this market information to target its production accordingly.

In horticultural farming, where prices are rarely regulated, financial viability depends as much upon business and marketing skills as on the farmer's technical expertise. It is high-value crops which are often a crucial component of viable small farms. This manual is a response to that growing farmer need for commercial and marketing knowledge and is an entirely practical handbook. The techniques and advice have been tested and proven in the field.

After an introduction to horticultural marketing in Chapter 1, Chapter 2 gives examples

of successful horticultural marketing case studies. The book then covers the three stages in horticultural marketing projects. Research and analysis are discussed in Chapter 3 and decision making and agreeing on an action plan in Chapter 4. Chapter 5 discusses some of the many different actions, activities and functions which can help to resolve marketing problems. Chapter 6 concludes the manual by setting out some of the most common mistakes that have bedevilled marketing projects.

Chapter 1 - The marketing process

What is marketing?

The chairman of one of the world's largest retail groups once said:

Marketing involves finding out what your customers want and supplying it to them at a profit.

This description stresses the two crucial points that govern marketing:

***Firstly,* that the whole marketing process has to be customer oriented. Production must supply customers with what they want or need. This is the only reason people spend**

their money.

***Secondly*, that marketing is a commercial process and is only sustainable if it provides all the participants with a profit.**

A more classical definition is:

The series of services involved in moving a product (or commodity) from the point of production to the point of consumption.

This definition emphasizes that agricultural marketing is achieved by a series of processes. In this we include harvesting techniques, the grading and sorting of crops and the packing, transport, storage, processing, distribution and selling of products. These are the mechanics of marketing.

A broader view of marketing is provided by the following definition:

The series of activities involved in making available services and information which influence the desired level of production relative to market requirements, and the movement of the product (or commodity) from the point of production to the point of consumption.

This definition covers the services which should be covered by the extension officer, such as providing information and advice. This role includes:

Finding out what the customer wants

Supplying him at a profit

- collection, evaluation and dissemination of market information;
- assistance in the planning and scheduling of production;
- securing the market for producers, e.g. through contracts with buyers;
- advice on the best practical post-harvest practices;
- coordination of inputs, transport, storage, credit and post-harvest facilities.

Although this definition is more comprehensive it still only describes the activities involved in marketing. The key activity of an extension officer, or any public servant concerned with improving agricultural marketing, is the commercialization of the rural economy. This involves: finding out what the customer wants and helping to set up the production/marketing system which supplies that demand and maximizes the income of rural areas.

Progress is achieved by concerted effort. Very often the marketing officer's role is to take an overview and coordinate the efforts of others.

Why is marketing important?

The importance of good marketing can be conveniently considered from the four different perspectives of the national economy, the farmer, the product and the consumer.

At the national level as societies and countries develop there is a movement of people from the countryside into the towns and cities.

Populations in developing countries are expanding, normally at around three percent a year. Urban populations, however, are expanding on average at about four percent a year. This means that the number of people needing to be fed by the rural communities will double in 16 years. In addition, since the amount of food eaten by each individual normally increases as people become wealthier, the supply of food for the towns and cities will need to double approximately every 10 to 14 years.

This change in population distribution will create new or improved opportunities for both farmers and rural employment, particularly if new roads and improved transport are provided.

Subsistence farming (that is, just providing enough food for the farmer and the

immediate family) will become less important. Although proportionately there will be fewer farmers, their role will become ever more important because their task will be to feed the growing urban populations. To do so will require the farmer to become more specialized and more skilled so that more food can be produced. The extension officer's first role in marketing is to guide and assist farmers in the process of change from subsistence farming to commercial farming. There is a role for him or her at each stage in the development of agriculture, encouraging farmers to develop new skills needed to market and sell their produce. Even in highly developed societies where farmers are acknowledged as highly skilled producers they are very often weakest at marketing.

The second important role is to try to secure and maximize rural incomes. The reasons why people move from the countryside into the town vary from country to country and from case to case. Possibly the most important factor is the high relative incomes that can be earned in the towns and on regular employment. An important part of the extension officer's role should be to encourage and help the rural community to take control and develop the marketing of its food products. They should try to ensure that the maximum proportion of the retail price is circulated back to the rural areas.

At the farmer level the most disadvantaged farmers are those with small units of land. These farmers will find that they cannot generate sufficient funds from their small land area to support themselves and their families by growing only traditional crops, e.g.

wheat and rice. They will find it difficult to compete with produce grown by large farms using mechanization.

In developed agriculture successful small farms can and do survive. We can learn lessons from their survival. Viable small farms tend to specialize in highoutput enterprises. These are crop or livestock systems which are capable of generating high incomes per unit of land. Typical examples in livestock are dairy and chickens, and in crops are fruit, vegetables and flowers. In the United Kingdom, for example, the average size of a cereal farm is around 120 hectares (300 acres), a dairy farm is 60 hectares (150 acres), a typical field vegetable farm would be about 30 hectares (75 acres), a fruit farm 25 hectares (63 acres) and a glasshouse holding 1.5 hectares (4 acres).

Importance of marketing for the country

The strengths and weaknesses of big and small farms are summarized in Table 1.

It is by understanding the strengths and weaknesses of both groups of farmers that it is possible to promote crops and cropping systems which favour the smaller farm. These growers need help in access to markets, by being provided with good production advice and market information to strengthen their ability to negotiate.

Horticultural products are mainly sold fresh; some are eaten raw while others are

cooked. Some horticultural products have traditionally been processed when no other form of storage was available, e.g. dried fruit and jams. As society develops and becomes more affluent the market for processed and prepared horticultural products develops. A market also develops for horticultural products such as flowers and house and garden plants which are sold for purely aesthetic reasons. Increased wealth also brings with it an increased demand for product diversity in the form of new crops, off-season supplies and different flavours.

TABLE 1. Strengths and weaknesses of large and small farms

Small Farms	
Strengths	*Weaknesses*
More labour available, especially family labour, therefore suitable for labour-intensive crops which cannot be mechanized, such as those requiring transplanting. Pruning, training and multiple hand harvesting	The need to generate high incomes from small areas
Crops requiring skilled management and	Education standards are often low, difficulty

attention detail	in obtaining, Information, capital and support
Growing for and servicing small specialized markets, e.g. direct sales of herbs, flowers and ornamental plants	Weak in negotiation
	Need income stability
Large Farms	
Strengths	*Weaknesses*
Mechanized, large-scale agricultural production for major crops like wheat, sugar cane and maize	High overhead cost
Crops which require a large capital investment	Poor at mobilizing and controlling labour
Selling produce in large volumes to major buyers	Low labour numbers per unit area necessitate avoiding time-consuming activities

Horticultural products are perhaps most easily defined as what they are not. They are not cereals or the major industrial crops. Generally, but not exclusively, they are not staple crops. Table 2 lists examples of some of the major horticultural products.

Important characteristics of horticultural crops are:

- **that they are mainly eaten for their contribution to the flavour and interest of food and for the supply of minor but essential nutrients, especially vitamins;**
- **that they are not basic food commodities; people will put off buying if the price is too high;**
- **that consumption levels vary, depending on the selling price and the income of the buyer,**
- **that many of the crops are not traded in large volumes and there is a limited market;**
- **that the products are perishable, which means there is always a reduction in quality if they are not sold immediately, usually leading to a fall in value;**
- **that there is a wide range and variety of horticultural products (see Table 2). If one product is too highly priced the consumer will generally buy another;**
- **that the products are normally traded in a very free market where price is determined by supply and demand.**

All these factors contribute to the crucial and reoccurring fact about horticultural crops: that prices, and especially the prices the farmers obtain, are variable and difficult to predict.

Take an extreme example, but one that occurs regularly:

A farmer who has high quality tomatoes to sell when few other crops are available may easily get a price equivalent to many times his growing cost. However, a farmer who is trying to sell tomatoes when the market is oversupplied and his fruit is two days old may not be able to sell his produce at all.

Wholesale prices may double or halve in the same day, depending on the skill of the salespeople and on consumer demand.

Horticultural crop prices can fluctuate widely:

- **from year to year;**
- **from the start of the season to the main supply period;**
- **from day to day; and**
- **from market to market.**

This extreme variance in price makes horticultural production potentially both very profitable and very risky. Often, success depends on marketing skills and on obtaining good prices rather than on production expertise. Table 3 gives an example of the effect that price differences can have on farmer profitability.

TABLE 2. Some major horticultural products

Tree fruit
Orange, lemon, lime, mandarin, grapefruit, apple, mango, banana, guava, soursop, lichee, peach, apricot, pear, plum, rambutan, fig, quince, persimmon, durian, chichu, pawpaw, pomegranate, mangosteen, loquat, carambola, cherimoya, cherry, date, mulberry.
Vine fruit
Grape, passion fruit, kiwi fruit (or Chinese gooseberry).
Other fruit
Strawberry, pineapple, Cape gooseberry, watermelon, sweet melon, raspberry, blackberry, blackcurrant, gooseberry, cranberry, blueberry, rhubarb, loganberry.
Tree nuts
Cashew, walnut, hazelnut, macadamia, pistachio, pecan, coconut, almond, Brazil.
Fruit that are normally considered as vegetables
Breadfruit, avocado, tomato, egg plant (brinjal or aubergines) hot pepper, sweet pepper, karella (or bitter gourd), squash, marrow, gourd, cucumber, luffa, pumpkin,

plantain, christophine or choyote.
Vegetables derived from seeds and flowers
Broccoli, cauliflower, artichoke, pea, bean, lentil, chickpea, broad bean, okra, mangetout pea, asparagus pea, yardlong bean, sweetcorn.
Leaf and stem vegetables
Lettuce, cabbage, spinach, chard, brussels sprout, endive, watercress, celery, asparagus, celeriac, green onion, leek, amaranthus, bean sprout, bok choy, Chinese cabbage, Chinese celery, spinach, chicory, kohlrabi, fennel.
Root vegetables
Arrowhead, onion, potato, sweet potato, cassava, yam, taro, garlic, radish, carrot, turnip, parsnip,
beetroot, Jerusalem artichoke, dasheen, eddoe.
Herbs
Parsley, mint, coriander, dill, basil, rosemary, thyme, sage.
Spices
Black pepper, chili pepper, cardamon, ginger, clove, cinnamon, bay leaf, turmeric.
Cut flowers

Rose, chrysanthemum, carnation, gladiolus, tulip, narcissus, orchid.
Cut follage
Asparagus tern, leather feat fern, soft ruscus.
Tropical plants for house and garden
Dieffenbachia, coleus, yucca, cordyline, dracaena, monstera, fatshedera, ficus, maranta.
Temperate plants for garden
Roses, ornamental shrubs, herbaceous flowers, bedding plants, conifers, flowering bulbs.

TABLE 3. Effect of different prices farmer profit

Item	**Farmer A**	**Farmer B**	**Farmer C**		**Farmer D**
Income					
Yield/Ha (Kg)	10 000	10 000	9 000		12 000
Price/Kg	1.0	1.5	2.0		0.3
Sales	10 000	15 000	18 000		3 600

Costs					
Production	5 000	5 000	5 500		5 500
Marketing	5 000	5 000	4 500		6 000
Gross profit	-	5 000	8 000	Loss	7 900

NOTE: Marketing costs will include harvesting, packaging, grading, transport and market commissions.

As Table 3 demonstrates, farmer B made a profit because he was able to sell his produce at a 50 percent higher price than farmer A who just broke even. The example of farmer C shows that sometimes even higher profits can be obtained when lower yields are achieved, for example by off-season production. Sometimes, in situations of over-supply, prices fall so low that farmers are best advised to minimize their loss by not harvesting their crops. Farmer D would have made a lower loss if he had not bothered to harvest and market his produce.

This manual will look at some of the techniques which can be used to maximize farmer prices. These include:

- **improving the quality and presentation of the produce;**

- **identifying the highest price buyer,**
- **negotiating from strength;**
- **scheduling production when there is limited competing supply.**

Equally important is the extension offficer's role in helping farmers to minimize risks. Generally, risk and profit are related. In other words highly profitable crops are often very risky. We will further explain some of the techniques available to minimize risk, such as:

- **selling a proportion of produce at firm contract prices;**
- **growing a crop range which includes a mix of high and low risk products;**
- **investing in technology which increases yield stability and therefore income stability.**

The importance of good marketing for the consumer

In effect the extension officer has a role as the farmers' lousiness adviser. Very often farmers will already carry out some of these strategies but with discussion the techniques can be improved and new strategies introduced.

The consumer is particularly important. Finding out what the consumer wants and satisfying his demand is the key to successful marketing and, in itself, is a valuable

service to society.

Fruit and vegetables are universally considered as vital elements in a healthy diet. Not only do they provide crucial vitamins and proteins, but an increasing weight of medical evidence is demonstrating broader health giving qualities. Some of these are set out below:

- **The fibre content of horticultural products is believed to be valuable in preventing heart disease and bowel complaints.**
- **Vitamin C can help prevent stomach cancer and gum disease.**
- **Vitamin D, in the vegetable-derived carotene, may reduce the incidence of lung cancer.**
- **Lack of vitamin A causes children to go blind. Research in Indonesia showed that even well-nourished children who lack Vitamin A had greater risk of illness and even death than undernourished children with an adequate Vitamin A supply. Vitamin A is available from dark green leaf vegetables, tomatoes, carrots, pumpkins, papaya and sweet potatoes.**

Generally the amount of fruit and vegetables eaten is relatively low in the developing world. The low consumption levels are normally blamed on high prices. An efficient marketing system which minimizes transport costs and particularly wastage will

significantly lower retail prices. It is the challenging task of the extension officer to accelerate the introduction of more efficient marketing processes which will lead to the lowering of consumer prices. As a result of lower prices, consumption will increase, which will offer the potential for expanded production.

Summary

This chapter has explained how urban markets will inevitably become bigger and more important. In addition to improved agricultural skills, farmers in the future will have to take on greater commercial skills.

Profitable production, particularly of high value crops, depends on supplying the customers with what they want. With the increased distances between the area of production and the points of consumption, systems will have to be set up to:

- deliver produce regularly and reliably to the market;
- provide a feed-back of information between the market and the growers so that production can be constantly oriented towards consumer demand.

It is up to the extension officer to use both ingenuity and intelligence to ensure that the maximum proportion of the retail price of food is returned to the rural community.

Efficient marketing will reduce the cost of fresh produce, bringing with it improvements in the nation's health as well as expanding the market for high-value crops, which are themselves a crucial component of viable small-farmer systems.

Chapter 2 - Successful case studies in horticultural marketing

Introduction

In this chapter are six examples of how market knowledge has been used to significantly improve farmers' incomes. These examples cover the range of development of market-oriented horticultural production. They begin with an example of farmers starting to sell their products for the first time. Three examples then show how farmers in the developing world have improved marketing and thereby increased their incomes. Finally, two horticultural export examples are cited, in the first where a country started horticultural exports and the second where improved quality control helped an exporting country to maintain its market share. These case studies are not necessarily to be copied but it is important to study the techniques and skills used and how the farmers adapted their production and distribution to meet the needs of their customers.

Case 1 - Starting marketing, Hunza, northern Pakistan

Perspective

The high altitude areas of Pakistan, such as Hunza, were brought into contact with the major markets in the Punjab Plain by the building of the Karakoram Highway. The major crops grown were apricots, which were mainly dried, and some other deciduous fruits. Apart from very small volumes sold in the local markets, farmers only grew crops for their own needs. They had no experience or expertise of marketing and were completely unaware of prices, transport costs and the packaging and grading required by the major markets in Rawalpindi and Lahore. In addition they had no knowledge of how fruit was marketed let alone the names of reputable traders and their typical terms of trade. Because of the arduous nature of their living conditions there was close cooperation between families and the extreme isolation of the villages served to build a strong sense of community.

Action

As part of a large rural development project the villages were asked to form committees and to elect individuals for specific responsibilities, including one for marketing. The village marketing agents were called together and given specialist training. The responsibilities of the job were explained to them. These were to collect, transport and sell the villages' produce in the city markets. The agents would return to the growers the prices received less apportioned costs and a percentage commission. They were taken on a study tour of the potential markets to observe quality, price and market mechanisms and to help identify potential trading partners.

Selected traders and commission agents were invited to Hunza to train the village marketing agents in how they wanted the produce picked, packed and presented. The village agents then had the responsibility of training the growers in their area.

Prior to harvest, packaging and transport were organized and the agents, as planned, sold the produce in the main markets of the northern Punjab plain.

Result

The villages sold commercial volumes of produce for the first time ever. This has not only provided a cash income but also encouraged further developments in both production and processing. It is interesting to note that some of Hunza's dried apricots have been exported to European health food shops. They are in demand because they have been grown without either chemical fertilizer or pesticide.

Important notes

1. **The new road opened up marketing opportunities.**
2. **The isolated nature of the villages made the growers particularly suitable for group marketing as they already had the necessary level of mutual trust. They also understood that they would have to work together if they were to succeed.**
3. **As this was an entirely new enterprise it was relatively easy to introduce a new marketing system which was both cooperative and provided a profit incentive for the village marketing agent.**
4. **The traders and commission agents were encouraged to assist and provide training, which they were prepared to do as it was in their own best interests. They recognized that new sources of supply would benefit their businesses.**

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Case 2 - Loose cooperation to fully exploit market opportunities, Al Bayda, Yemen

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Perspective

In the Yemen Arab Republic onions have traditionally been supplied from Al Mawsa on the Tihama Plain and from the mountain plateau. The supply pattern was seasonal, the yield relatively poor and the quality low. In an area northeast of Al Bayda, in the southeast corner of Yemen, a farmer had experimentally introduced onions in 1978. The crop had proved ideally suited to the area. As a result of ideal agronomic conditions incredible yields were achieved, about 120 tonnes per hectare. The quality was excellent and harvesting was possible throughout the year. All the growers in the area took up onion production and transported the onions in one-tonne trucks to the distant city markets.

Action

Clearly the growers had a comparative advantage in onion production over other farmers in this part of the Arabian peninsula. The challenge was to exploit this advantage fully. All the growers belonged to the same tribe and the tribal chief was encouraged to play a leading role in organizing them. Firstly, they agreed to coordinate their transport, so instead of sending small volumes of produce to the market in one-tonne pick-up trucks, which cost 0.5 Yemeni rials per kg, they decided to hire eight-tonne lorries. This reduced the transport cost to 0.2 Yemeni rials per kg. Instead of just

growing the highyielding variety of onion (Texas Grano) the growers also grew an Indian red variety (Red Puna) which had significantly better keeping qualities. The growers coordinated their growing in order to achieve a smooth supply of onions throughout the year After harvest the produce was allowed to dry for three days and packed into 25-kg sacks to await collection at the side of the road.

Result

The eight-tonne trucks were sent to market with both Red Puna and Texas Grano onions packed in separate sacks. The farmers never sent more than one lorry to each of the main markets at one time, thus ensuring that they did not oversupply the market. Instead of delivering their produce to wholesalers the truck driver and the grower representative would sell the onions by the bag off the back of the lorry direct to retailers. Normally the onions with the shorter shelf life were sold first, and the longer-storing varieties were stored at the back of the lorry for later sales. Table 4 demonstrates that this approach to marketing, i.e. collective transport and direct sales, improved grower returns by over 40 percent.

By making bulk shipments and having a product mix which ensured a relatively long shelf life the farmers could afford to carry out their own marketing. Because of their much lower costs of production the Al Bayda growers could undercut the other

suppliers. They used this to attract custom away from the traditional wholesalers. By coordinating the supply to all the markets they ensured that the markets were never glutted and thus maintained good prices. Both the social pressure of being a member of the tribe and the improved prices prevented growers from attempting to market individually.

It is interesting to note that this farmer group had also registered itself as a cooperative in the People's Democratic Republic of Yemen, the border between these two countries being very indistinct. Whenever they heard by radio that the prices were higher there, they would redirect their transport accordingly.

TABLE 4. A comparison of farmer prices for onions from Al Bayda & Al Mausa, Yemen

	At Bayda	**Al Mawsa**
Item	**Direct sale**	**Via wholesaler**
Retail price	5.00	5.00
Retail margin	2.10	2.00
Wholesale price	2.90	3.00
Wholesale margin	-	0.50
	0.20	0.50

Transport costs	0.20	0.30
Sack cost	0.06	0.06
Farmer price	2.64	1.94

Important notes

1. The tribal chief imposed the necessary collectivism and discipline on the growers in terms of varieties grown, programming production and trusting the farmer representative who undertook the selling on their behalf.

2. The growers had sufficient comparative advantage and market strength to sell direct and not through the normal wholesaler system. Initially they could afford to offer onions at lower prices than wholesalers which gave the retailer the chance of a higher profit margin.

3. The farmers kept themselves well informed on the market by an information network, which included radio, telephone messages to the nearest town and messengers so that further lorryloads were dispatched when market supplies were getting low.

Case 3 - Market-oriented production by an individual small farmer,

Antigua

Perspective

This case study is taken from a small island in the Caribbean with a population of 70 000. The main industry is tourism. Most vegetable growers planted their crops at traditional times of the year. The supply pattern had become increasingly seasonal with major supplies arriving on the market from October through to December while during the period April to August domestic supplies of vegetable commodities were insignificant. Prices fluctuated greatly depending on whether the vegetables were in or out of season. There was a strong demand, particularly from the catering trade, for offseason vegetables.

Action

One taxi driver and part-dine farmer recognized the opportunities for high prices if he could provide off-season vegetables consistently. He was not in a position of m eke any investment in machinery. His only capital investment was a crop sprayer. Ploughing and soil cultivation was carried out by a neighbouring farmer on contract. He did have his own transport which provided opportunities to deliver produce direct and establish close contacts with buyers.

The farmer purposely planted his vegetable crops when the majority of growers were not growing. To save labour costs for weeding end to conserve moisture-and therefore extend production into the dry season-he developed a production technique using weedkiller. In the early crop stages he would cover the plants with large tins and spray the entire field. Later he would use a spray hood to ensure that there was no crop damage. The dead weeds acted as a mulch to conserve moisture as well as giving other benefits such as weed suppression, soil temperature moderation and protection against erosion.

Result

Off-season vegetable production was achieved with minimal investment in equipment or labour. High prices were obtained by direct sales to supermarkets, hotels and restaurants. Increasingly the farmer plans his crops to match the requirements of his buyers. The farmer has now invested in a pick-up truck and become a full-time farmer. He rents out his taxi cab to a driver at a profit.

Important notes

1. The farmer organized his production to meet the demands of the buyers.

2. He minimized his risk by keeping his production costs strictly under control.

Investments were kept to a minimum. Money was spent on a sprayer and crop protection chemicals which would ensure him a harvest.

3. He has intelligently utilized his resources, land, transport and good contacts with the hotel trade.

4. This approach would only suit individual farmers or a small group of farmers. If too many farmers concentrate on this relatively small, high price, off-season market then prices will fall.

Case 4 - Large successful farmer exploiting new technology and a changing market, Egypt

Perspective

In Egypt there have been significant changes recently in the marketing of horticultural produce. Firstly, the major wholesale market in Cairo is so overcrowded that an increasing proportion of produce is by-passing the market and being sold direct. Although the bulk of the produce is still sold by street stalls there is a growing demand amongst the wealthy for higher quality produce. Specialist shops and supermarkets represent new and developing points of sale. Secondly, with regard to production there

has been an expansion in the use of walk-in and low polythene tunnels. Tomatoes, cucumbers, peppers and sweet melons can now be supplied virtually all the year round. Growing under polythene tunnels has also improved the quality of produce. A new exchange rate policy has improved the viability of exporting produce. The transport links to external markets are constantly improving.

Action

One farmer had made a significant investment in walk-in tunnels. His financial viability depended on maximizing his income as his level of fixed costs, or overheads, was much above those of small farmers. In order to maintain his profit levels he pursued a policy with two major objectives.

Firstly, he aimed at maximizing his yields. He gave his staff specialist responsibilities with specific targets. For example, each group of six tunnels had an individual manager who was given a bonus if his tunnels could yield above a target.

Secondly, he completely changed his marketing policy. He recognized that his business had special advantages which could be exploited. He could supply crops over an extended season and he could produce high quality crops. He also recognized that he could reduce the risk from changes in market prices by selling his produce through a number of different outlets.

He established contact with supermarkets in Cairo and agreed to supply them with his top-quality produce. Depending on the requirements of the individual shops crops were sold either packed in reusable plastic boxes, or prepacked in one-kg nets. Supermarket sales accounted for 40 percent of his sales.

He also arranged with exporters to take another 15 percent of his produce. This was sold both to the European and Arabian markets. From the outset a firm policy was taken on prices to save management time and disputes. Supermarkets were charged 10 percent over the wholesale price and exporters 15 percent.

Finally, he arranged a contract with a supermarket in Kuwait to supply Iceberg lettuce for nine months. The contract guaranteed a minimum payment which would cover his growing costs, so the financial risk of growing this new crop was removed. This crop accounted for about 5 percent of his planned production.

The remaining 40 percent was sold to the traditional wholesale markets.

Result

Sales income increased so much that the business has paid off its capital investment in two years rather than the planned three. The success of the marketing venture has encouraged the company to establish its own marketing operation. The business has

further diversified into supplying planting material to the surrounding small growers. The long-term aim will be to use the supply of elite planting material coupled with the services of the marketing company to be able to programme the production and centrally market the produce of the surrounding small farms to both the local market and the export markets of the Gulf.

Important notes

1. The prices of off-season fruit and vegetables normally go through three phases. In the very first season when the produce arrives at the market outside the normal period it is treated with suspicion and often disappointing prices are obtained. Once this suspicion has been overcome prices improve dramatically. Excellent profits can be made by those who have invested early in the technology. However, as more growers start growing off-season crops, prices will fall. Sometimes over-production can occur and prices can drop below the cost of production. In this example we have seen how one grower has responded to this third phase (over-production) in the development of off-season technology.

2. The grower managed to sell direct to supermarkets by using his three special advantages. He could produce a quality product over an extended season and had the transport to deliver direct. Although this was more expensive for supermarkets than

buying from the wholesale market they were prepared to pay the extra money because of the convenience. Supply was guaranteed and the buyers only had to quote on the telephone what volume of crops they required.

3. Contract production for supermarkets is a highly advanced method of marketing and is particularly well developed in the USA. As this was a risky venture in the first year, the farmer negotiated a contract which would cover the production costs of lettuce, even if no produce was shipped. The risk was completely eliminated.

4. With his organized office, telephone and telex facilities he could successfully deal in these four different markets and thus spread his risk.

5. Large growers with a number of regular, wage-earning staff and a large investment in capital equipment carry high fixed costs or overheads (i.e. those costs which always have to be paid whatever crops are grown). In small farms most of the labour is carried out by members of the family. They generally have lower fixed costs and can therefore produce some crops cheaper than large farmers. The advantages are particularly noticeable in labour-intensive crops.

Case 5 - Starting a fresh fruit and vegetable export operation, Antigua

Perspective

Antigua is a small island in the West Indies. Three times a week a 747 jumbo jet lands enroute to London with spare cargo capacity. During the winter months, November to March, there was an oversupply of tomatoes and cucumbers owing to a government fixed-price buying scheme. These crops were being dumped at a high cost to the government. The country wanted to export the surplus production to the United Kingdom.

Action

A survey of the British market immediately revealed that Antiguan tomatoes and cucumbers could not compete in terms of either quality or price. However, the market research did indicate that there was a demand from the Asian and West Indian community for special tropical fruits and vegetables, many of which are grown in Antigua. Market opportunities were identified for green mangoes, okra, chill) peppers, scotch bonnet peppers (a specialist hot pepper) and even for a plant locally thought to be a weed, called bitter gourd or karella. A special airfreight rate was negotiated with the airline for regular shipments of over a tonne of horticultural produce. This was well below the normal cargo rate. Preliminary financial calculations suggested that these crops could be exported profitably. All the interested importers requested samples.

Examples of suitable cardboard cartons were taken from the British market for copying by a Caribbean packaging company. In order to impress on the farming community the quality of produce required by the export market, samples of competing products were airfreighted back to Antigua.

It was agreed that the next step was to carry out a test marketing programme. Independent advice was soughs to identify reputable importers amongst those which had expressed a keen interest in obtaining Antiguan produce. Sample consignments were sent to a panel of six importers:

- **to give them an opportunity to provide advice and feedback on how product quality and presentation could be improved;**
- **to see what actual prices would be obtained; and**
- **to select which importer was most suitable to handle Antiguan exports.**

At the end of the test marketing programme one wholesaler/importer was chosen because he specifically supplied the West Indian community and was well placed to market Antiguan horticultural produce. During negotiations he was persuaded to open an irrevocable letter of credit at a local bank for negotiated fixed prices. Although this price was less than the average wholesale price which might be resumed on a consignment basis it did guarantee a level of profit and thus minimized risk.

Working with the importer the requirements in terms of volume, quality and seasonality for the selected products were agreed on. This was translated into a production programme and each export farmer was provided with the correct seed, production notes and dates and areas for ploughing and planting. Contracts were signed with the farmers, setting out buying prices for stipulated quantities and qualities. Export cartons were manufactured and supplied in advance and a simple grading table made.

Result

During the first season about two tonnes a week, mainly of scotch bonnet peppers and okra, were exported. In the subsequent seasons exports continued with the bulk of sales being made direct to a retail chain. This has increased prices. As a result of the new markets the government reduced and finally stopped paying fixed prices for surplus vegetables. The high incomes of export farmers and the status they achieved by being seen to export successfully resulted in a number of young men resuming to farming. In the mid 1980s a refrigerated container shipping service bringing meat for the tourist trade from North America started to visit Antigua. The empty containers on the return voyage are now being used to export cucumbers. This is an even bigger export operation but it has been built on the experiences and successes of the airfreighted horticultural exports.

Important notes

1. **Cheap transport links were available.**
2. **The export crops were identified according to the market demand.**
3. **The wholesaler/importer was carefully selected on the basis of both reputation and his performance in the test marketing programme.**
4. **The test marketing programme enabled farmers and staff to learn by experience how to undertake all the necessary production and post-harvest operations on a small scale. Test marketing also enabled confidence to be built based on actual prices obtained in the market before any major investments were made.**
5. **Once selected, the export operation was planned in partnership with the importer.**
6. **The initial season's fixed prices, although not the highest obtainable, did guarantee a small profit and therefore minimized the project's risk.**
7. **The farmers were given a contract which made a commitment on both sides. The exporter was committed to buying the produce while the grower was committed to planting according to the production programme. He was also given seed of the correct variety as well as agronomic advice.**
8. **The staff of the export operation were highly motivated and worked overtime to make sure shipments were prepared on time.**
9. **A financial recording system was designed to demonstrate exactly how the export operation was performing.**

10. The export programme evolved from research through decision making into an action programme. This started on a trial basis and expanded into commercial production. The young project officer-acting as a marketing extension agentgained credibility early in the project by negotiating the significantly lower cargo rates for horticultural produce. As a result his advice and guidance on the major issues of the project were more readily accepted.

Case 6 - Improving horticultural exports, Kenya

Perspective

Kenya has been successfully exporting fruit and vegetables to Europe by air for over a decade. The volumes sold now exceed 40 000 tonnes. In 1983 the European importers commented that improvements were needed in the quality of produce, particularly in view of increased competition from other suppliers. The main crops sold are fine and extra fine french beans, a range of Asian vegetables, avocadoes, strawberries, passion fruit, extra large pineapples and cut flowers. Export production is carried out by small farmers, large farmers and cooperatives. Most exports are made by private Kenyan companies. The Horticultural Crops Development Agency (HCDA) is a government-backed organization which carries out some exports on its own account to fund its role as the representative of the private exporters. The HCDA decided to act on improving

quality standards.

Action

Discussions with the government crop inspectors and importers in Europe showed that most of the grading problems occurred at the beginning of the season. A frequent complaint was that mixed sizes were being packed together. Field observation showed that:

- **even very perishable crops like french beans were being left out in the sun;**
- **new field workers had difficulty grading correctly into fine and extra fine beans;**
- **tree and vine crops like avocadoes and passion fruit were picked into sacks and subsequently graded into export quality. Significant skin scuffing occurred.**

Field trials were undertaken whereby pickers covered their beans with a damp cloth in the field and field storage was in a tent clad in dampened material. This enabled the latent heat of evaporation, i.e. the cooling effect of water evaporating, combined with the shade, to prevent heat build up in the produce. Slide photographs were taken after one, three and five days to show the differences between the various post-harvest handling systems (see colour insert).

Strict sizing specifications differentiate fine and extra fine beans. Extra fine beans must

be longer than 100 mm but thinner than 6 mm while a fine bean must be thinner than 9 mm. In order to enable new graders to check these sizes at the start of the season a stick was made 100 mm long tapering from 9 mm width at one end to 6 mm. This could be made out of tin, wood or cardboard and was provided to new pickers to help them measure beans into the correct sizes.

A bean measuring stick for checking grades

For harvesting above the waist a picking bag was required. This could be made out of a kanga--a shawl universally available in Kenya. Two comers were tied over the neck and the other two corners were tied up to the shoulders to make a bag. Into the bag were placed two three-kg cardboard boxes. Pickers picked and graded as they worked. The skin damage to the harvested crop was reduced and high work rates were possible because the bag was comfortable to work with (see colour insert).

Result

Having established that there were some relatively simple and inexpensive steps that the export industry could take to improve its performance, the HCDA decided to communicate these findings and recommendations in the form of a conference before the start of the export season. The exporters passed on the improved post-harvest handling techniques to their growers. Importers in Europe reported a significant

improvement in Kenyan export qualities.

Important notes

1. **The general problems were known but the specific problems were only identified from field research, observation and discussions.**
2. **The recommendations were all simple and inexpensive and were of benefit to all in the industry.**
3. **The improved post-harvest methods were communicated to the exporters rather than directly to growers as growers were more prepared to accept advice from the buyers of their crop. 4. Improving the reputation of Kenyan produce was seen to be a benefit to all the individual exporters.**

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