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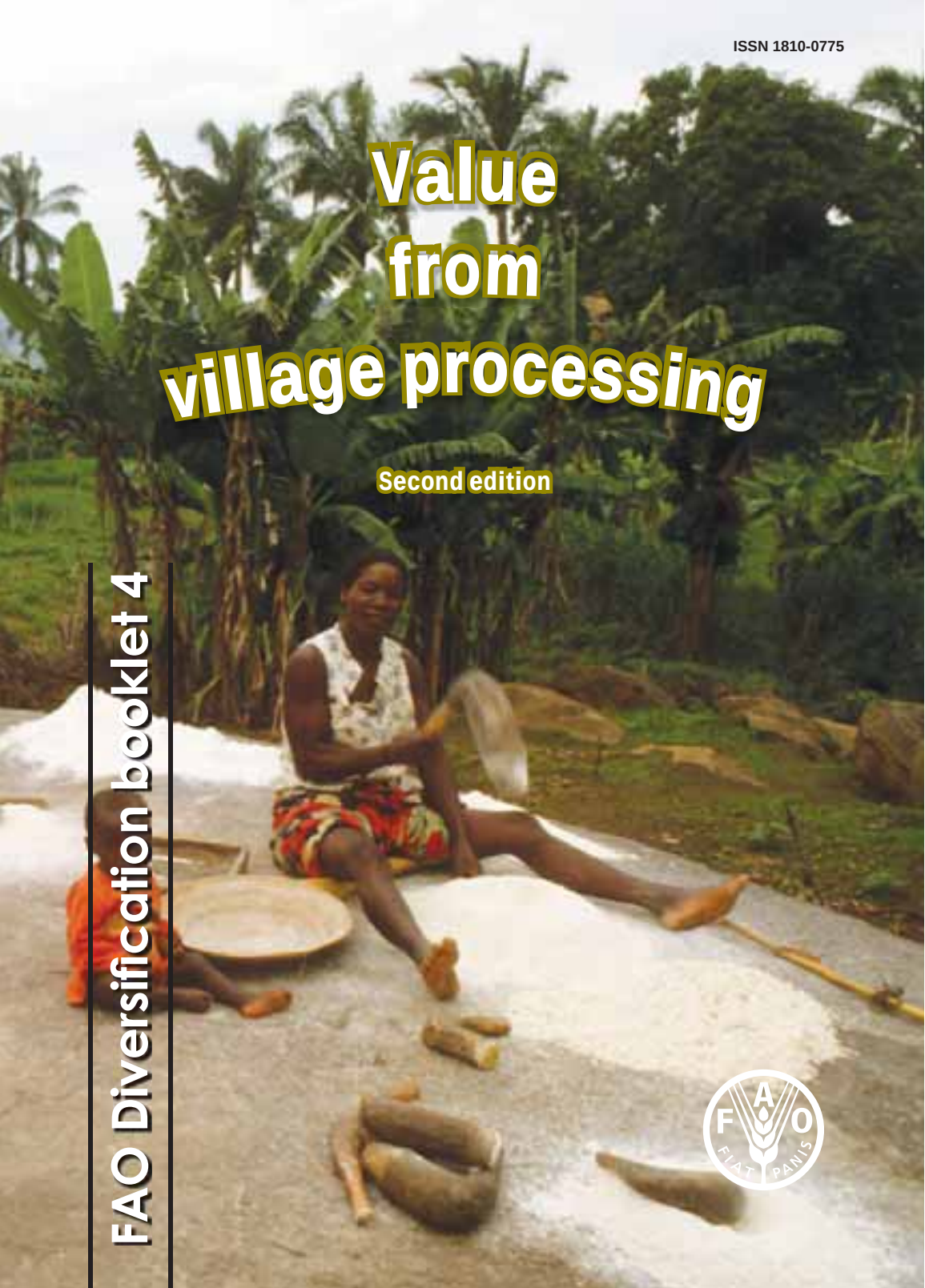
Value from village processing

Second edition

FAO Diversification booklet 4



Diversification booklet number 4
Second edition

Value from village processing

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Food and Agriculture Organization of the United Nations
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Preface

The purpose of the FAO Diversification booklets is to raise awareness and provide decision support information about opportunities at farm and local community level to increase the incomes of small-scale farmers.

Each booklet focuses on a farm or non-farm enterprise that can be integrated into small farms to increase incomes and enhance livelihoods. The enterprises profiled in the FAO Diversification booklets are suitable for smallholder farmers in terms of resource requirements, additional costs, exposure to risk and complexity. The products or services generated by the enterprises are suitable for meeting demand on a growing, or already strong, local market and are not dependent on an export market. However in this particular booklet, export markets are also considered as international trade in primary processed farm products can affect local markets.

The main target audience for these booklets are people and organizations that provide advisory, business and technical support services to resource-poor small-scale farmers and local communities in low- and middle-income countries. It is hoped that enough information is given to help these support service providers to consider new income-generating opportunities and how these might enable small-scale farmers to take action. What are the potential benefits? What are farmer requirements and constraints? What are critical 'success factors'?

The FAO Diversification booklets are also targeted to policy-makers and programme managers in government and non-governmental organizations. What actions might policy-makers take to create enabling environments for small-scale farmers to diversify into new income-generating activities?

The FAO Diversification booklets are not intended to be technical 'how to do it' guidelines. Readers will need to seek more information or technical support, so as to provide farmer advisory and support activities relating to the introduction of new income-generating activities. To assist in this respect,

each booklet identifies additional sources of information, technical support and website addresses.

A CD has been prepared with a full series of FAO Diversification booklets and FAO technical guides, together with complementary guides on market research, financing, business planning, etc. Copies of the CD are available on request from FAO. FAO Diversification booklets can also be downloaded from the FAO Internet site.

If you find this booklet of value, we would like to hear from you. Tell your colleagues and friends about it. FAO would welcome suggestions about possible changes for enhancing our next edition or regarding relevant topics for other booklets. By sharing your views and ideas with us we can provide better services to you.

Acknowledgements

I would like to thank the large number of small-scale food processing entrepreneurs in Africa, Asia and the Caribbean who have freely given their time and expertise over the years, sharing with me their experiences of the problems and successes of operating their processing enterprises, and in doing so, contributing to the success of others.

Peter Fellows

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Introduction

Primary processing on farm as a livelihood activity

On-farm primary processing has the potential to improve farmers' livelihoods by both increasing the amount and quality of food available to feed the family, and offering improved opportunities for income generation. Primary processing of crops can provide financial, social and nutritional benefits to individual smallholder families; it can provide opportunities for women to become more involved in commercial activities and more generally contribute towards the development process; and these benefits in turn can have an overall positive effect on local communities.

However, improving smallholder livelihoods by introducing on-farm processing also requires improvements in local infrastructure, training and support, and adequate marketing activities: for example improved utility provision and road infrastructure is needed to enable processing to take place and to transport processed crops to secondary processors and village markets; support and training may be needed to ensure that processed crops have the required quality and shelf-life to be able to compete effectively; and there must be a local demand for processed crops from buyers who are willing to pay adequate prices to give farmers the required income.

Policy-makers and advisors therefore need to integrate on-farm primary processing into integrated development programmes that address these issues and provide training and support for such initiatives. The successful inclusion of improved primary processing in development programmes therefore requires not only technical expertise to assist smallholders to process crops correctly, but also an appraisal of the diverse and often location-specific economic, cultural and environmental conditions found in farming and food marketing systems. This will enable farmers to adopt the most cost-effective sales and marketing systems and optimise their incomes.

On-farm primary processing is commonly used to prepare crops for storage or for further processing. Examples include preparation procedures such as washing, peeling, sorting and slicing crops; preserving

crops by drying; adding value by milling to produce flours; extracting a component such as cooking oil from oilseeds; or fermenting (see FAO Diversification booklet No. 21 *Traditional fermented food and beverages for improved livelihoods*). Further processing of these crops to produce a wide variety of processed foods is known as 'secondary processing'. Further details on 'secondary processing' are given in FAO Diversification Booklet No. 5 *Processing for prosperity* and FAO Diversification Booklet No.18 *Selling street and snack foods*.

Purpose of the booklet

This booklet describes opportunities for primary processing as a livelihood activity for smallholder farmers who produce roots and tubers, cereals, legumes, oilseeds, fruits and vegetables and sell them at village markets. The aim is to create awareness and demonstrate to policy-makers and development personnel the opportunities that are available for on-farm processing, and how improvements in commodity primary processing and marketing at village level can contribute to sustainable and improved livelihoods for smallholder farmers and their communities.

Advantages of the livelihood activity

Primary processing has been seen by many development agencies and government institutions as an important method to improve the livelihoods of rural communities. It has the potential to improve nutritional status and food security, and also to improve incomes to individual smallholders and/or the wider village community. These benefits may include:

- Improved short-term storage of fresh produce without excessive losses.
- Preservation of seasonal gluts of crops that would otherwise be wasted.
- Improved health and nutritional status through consumption of crops for a larger part of the year.
- Increased incomes from:
  -sales of processed crops out of season when prices are higher, or
  -adding value to crops by processing them (e.g. milling flours or extracting vegetable oils).

FIGURE 1 Rice Miller: Rice milling is a common type of primary crop processing in many countries
(Photo: FAO/ 63682/INPHO)

Primary processing and the farm household

Primary crop processing provides numerous benefits to farming households: for example, some types of processing can be easily integrated into normal household activities, particularly at a small (kitchen) scale of operation, where existing equipment, knowledge and skills of household members can be used; processing provides nutritional benefits to the household by preserving foods for periods of shortage; income from sales of processed commodities can be used to directly improve livelihoods, or to expand to other types of crop processing that may require investment in different equipment or training, but give higher returns and greater opportunities for long-term improvement to farmers' livelihoods.

Enhancing local knowledge, know-how and technology

Many farming households have the knowledge and skills to preserve their crops, often handed down through the generations. However, the introduction of primary processing can build on and enhance local knowledge and skills by integrating new ways of processing or new types of simple technologies that provide for better preservation techniques, greater processing efficiencies and yields, and less wastage. New skills and expertise to operate new types of equipment that are learned in order to undertake primary processing are also transferable, and may open up job opportunities for members of farming families (for example providing repair and maintenance services).

Food preservation and decreased food losses

In most countries, the majority of crops grow in one or two defined seasons each year and, depending on the type of crop, they are likely to spoil within a few days or weeks unless they are preserved (see Table 1). Losses can occur at all stages during crop production and processing: during cultivation (e.g. damage caused by cassava mosaic virus); during harvesting and handling; spillage during transport; and also post-harvest damage caused by moulds, bacterial blight or rotting, or consumption by birds, rodents and insects (e.g. grain borers, mealy bugs, weevils, termites and mites). Losses can be up to 30-50 percent or even higher with some crops (see Table 2) or on poorly-managed farms. Smallholders who operate good farming, post-harvest, primary processing and storage practices can reduce these losses substantially.

TABLE 1 **Rate of spoilage of different parts of fruit and vegetable plants**

Part of plant	Time before spoilage starts (days)
Fast growing shoots	1-2
Leaves	2-3
Stems	5-50
Fruits	5-50
Roots and tubers	15-50
Seeds and oilseeds	50+
Bulbs	30-100

Source: FAO.1997. Guidelines for small-scale fruit and vegetable processors, FAO Agricultural Services Bulletin No. 127, Rome

TABLE 2 **Post-harvest losses of selected crops**

Crop	Post-harvest losses (%)	Crop	Post-harvest losses (%)
Cereals/legumes		**Fruits**	
Barley	9	Apples	14
Groundnuts	10	Apricots	28
Maize	16-18	Avocado	43
Millet	12-13	Bananas	20-80
Oats	14.4	Citrus	20-95
Pulses	10	Papaya	40-100
Rice	8-11		

TABLE 2 **Post-harvest losses of selected crops** *(Cont.)*

Crop	Post-harvest losses (%)	Crop	Post-harvest losses (%)
Cereals/legumes		**Vegetables**	
Sorghum	12-13	Cabbage	37
Soybean	10	Cauliflower	49
Teff	11	Lettuce	62
Wheat	11-17	Onions	16-35
		Plantains	35-100
Roots/tubers		Tomatoes	5-50
Carrots	44		
Cassava	30		
Irish potato	5-40		
Sweet potato	15-95		

Source: Adapted from Aphils, 2011, Sandifolo, 2003 and FAO, 1981

Important reasons for processing are to reduce losses and to preserve foods so that they are available out of season. This is especially important during 'lean seasons' (i.e. prolonged dry seasons or winters) when there are few fresh crops available. Primary processing is therefore intended to preserve crops to enable them to be stored between harvests. In countries that have a suitable climate at harvest time, drying is the most common form of primary processing of staple crops, including cereals, legumes, roots and tubers. This must be carried out in such a way that the crop does not spoil before it is adequately dried, which can be a challenge to farmers if the harvest period does not correspond with dry weather. The dried crop must also be stored correctly to prevent losses arising from damage or consumption by insects, birds and rodents or spoilage by micro-organisms - especially moulds.

Fruits and vegetables may also be preserved by drying as slices or chips, or powdered (e.g. leaves), but there are many other methods of processing that can be used by smallholders to preserve them and prevent losses (see Caste Study 1). Many of these are traditionally done in smallholders' homes: for example fruit pastes, chutneys, and fermented vegetable and fruit products, including pickles and wine (see FAO Diversification booklet No. 21 *Traditional fermented food and beverages for improved livelihoods*). Each of these products can be stored for future use, either for home consumption or for sale.

CASE STUDY 1 **Tomatoes in Nigeria**

Tomato is a very important source of vitamins and minerals that are essential for a healthy diet. In many countries, tomato has become an important cash and industrial crop, and in Nigeria it represents about 18 percent of the average daily consumption of vegetable food in the country.

The quality and nutritional value of fresh produce like tomato, is affected by post-harvest handling and storage conditions. Tomatoes are usually harvested when the plant is fresh and has a high moisture content. This high moisture content though increases the risk of spoilage and reduced nutritional content of tomatoes during post-harvest operations of handling, transport and marketing.

An extension programme by the local government in Imeko-Afon, Ogun State, in collaboration with the Agriculture Media Resources and Extension Centre of the University of Agriculture, Abeokuta, was conducted to train tomato farmers in preservation methods for their produce, reduce losses in a cost effective manner, and provide new and improved marketing options for their produce at local level. The various methods highlighted included:

1. Making the tomatoes into paste, juice and ketchup.
2. Preserving the tomatoes by cutting them into slices and drying them.
3. Preserving tomatoes by boiling them, removing the skins and rinsing them. After rinsing, they are put in bottles with water and a teaspoon of preservative.

Overall, the establishment of such on-farm primary processing enterprises should be encouraged as clear advantages pertain not only to the preservation of precious nutrients for the farm family, but also the advantages that small-scale farmers can gain in marketing such processed products at local and village level.

Source: Adapted from Babalola, D.A., Makinde, Y.O., Omonona, B.T. & Oyekanmi, M.O. 2010. Determinants of post harvest losses in tomato production: a case study of Imeko-Afon local government area of Ogun state, Journal of Life and Physical Sciences 3 (2) pp. 14-18

Nutrition, health and safety

A balanced diet throughout the year is needed to maintain health, and two of the main reasons for primary processing are to maintain a secure supply of food for seasons of shortage (i.e. to provide food security) and to maintain health through an adequate supply of different nutrients in the diet. Cereals, roots and tubers are primarily sources of carbohydrate, and oilseeds are sources of fats, both of which provide energy in the diet. Excepting oilseeds, all crops also supply dietary fibre and varying amounts of proteins, minerals and vitamins that are needed for health. For example, vegetables are often eaten daily as an accompaniment to staple foods in a main meal and fruits are eaten as appetisers, side dishes to main meals, snacks, juices and desserts.

In general, crops have the highest nutritional value when eaten fresh, although minerals, fibre and many vitamins are retained in preserved foods. Some vitamins are lost during processing (especially Vitamin C) but processing by fermentation can increase the vitamin content of foods because of vitamins produced in the food by the fermenting micro-organisms (see Table 3). Correct processing methods help to retain more vitamins and other nutrients, so making the stored foods more nutritious than foods that are improperly processed. This, together with the larger amount of food available to a family if it has been correctly processed and stored (because of smaller losses through spoilage), can enable family members to have an adequate diet and maintain their health throughout the year.

Drying is one of the main methods of processing crops and when crops are dried quickly to low moisture contents (see Table 4) they are much less likely to suffer damage from mould growth. Proper drying not only reduces food losses (above) but also substantially reduces the risk of ill health or even death from poisons released into foods by some types of moulds. These are collectively known as 'mycotoxins', the most common of which is 'aflatoxin' that is produced by certain types of moulds that can grow on cereals, legumes, oilseeds or tubers, to cause potentially fatal liver damage and cancer. A second risk to health can arise from incorrectly processing moist 'low-acid' foods, including vegetables and root crops. Food poisoning bacteria are able to grow on these foods if they are not properly handled, processed and stored. Fruits, on the other hand, are mostly 'acidic' foods, and although yeasts and moulds can spoil them, the acidity prevents food poisoning bacteria from growing.

TABLE 3 **Summary of nutrient changes in foods after drying and fermentation**

Process/ product	Change (%) Carotene	Thiamin	Riboflavin	Niacin	Vitamin C	Pantothenic acid	Vitamin B_6
Fermentation:							
Cabbage/pickled	—	—	43	33	—	—	—
Soybean/Tempeh		41	(+817)	(+488)	73	57	19
Soybean/soysauce		(+400)	(+616)	(+667)	—	—	(+437)
Drying							
Fruits (average for apple, apricot, peach and grape)	6	55	0	10	56	—	—
Vegetables (average for peas, maize, cabbage and beans)	5	<10	<10	—	—	—	—

Source: FAO.1997. Guidelines for small-scale fruit and vegetable processors, FAO Agricultural Services Bulletin No. 127, Rome

TABLE 4 **Moisture contents of crops for safe storage**

Crop	Moisture content (%)	
	Short Term (less than 6 months)	Long term (more than 6 months)
Barley	14	12
Beans	16	13
Maize	15.5	13
Millet	10	9
Oats	14	12
Peas	14	13
Rye	13	12
Sorghum	13.5	13
Soybean	13	11
Sunflower seed	10	8
Wheat	14	13
Wheat (Durum)	13.5	12.5

Source: Adapted from Hellevang.1995. Grain moisture contents effects and management, NDSU

Diverse products

Primary processing offers the opportunity for farmers to make a diverse range of products that can both increase incomes by having more products to sell, and also spread the income over a longer period than just harvest time. Examples of the types of products that can be made on-farm by primary processing are shown in Table 5, together with an indication of their importance around the world or their potential for becoming important. By-products from many processes can also have value as an additional source of income (see Figure 2).

TABLE 5 **Examples of products that can be made on-farm by primary processing**

Type of crop	Products from primary crop processing	Importance and potential of products from primary processing
Roots and tubers	Dried slices and chips from yam, cassava, sweet potato	Very important in most tropical and sub-tropical countries as staple foods for the general population
	Fresh or dried slices of Irish potato, yam, cassava or sweet potato	Sold to secondary processors to make fried crisps or other snackfoods, or processed on farm for local sales. Important in some areas with good potential in most areas
	Grated cassava	Important for production of gari and other fermented products, especially in West Africa and parts of Latin America - either processed on the farm or sold to secondary processors
	Flours made from dried yam, cassava, potato, sweet potato	Very important as staple foods in the diet. Raw material for production of many products by secondary processors
Cereals and grains	Parboiled rice	Important in Asian countries because of improved taste and keeping quality, where there is high demand for domestic consumption.
	Dried maize, wheat, oats, millet, sorghum, barley or rice grains	Preserved for later consumption or for milling to flours - both of which are very important as staple foods worldwide
	Dried maize, sorghum or rice grains	Raw material sold to brewers for beer production - important in Africa, parts of Asia and Latin America

TABLE 5 **Examples of products that can be made on-farm by primary processing** *(Cont.)*

Type of crop	Products from primary crop processing	Importance and potential of products from primary processing
Cereals and grains	Rolled/crushed grains, especially oats and maize	Of less importance worldwide as raw materials for secondary processors making breakfast cereals, porridges or some types of animal feeds
	Flours made by milling maize, rice, sorghum, millet	Flours very important for domestic consumption worldwide and as raw materials for a large range of products made by secondary processors. By-products for animal feeds.
Oilseeds	Dried oilseeds	Extraction of cooking oil on-farm or by other processors - very important worldwide
		Preparation of feeds for poultry, dairy or meat animals, important in many countries
Legumes	Dried beans, peas, soybeans, groundnuts and many other legumes	Important worldwide when preserved for later consumption or sales as staple foods. Raw materials for a variety of foods produced by secondary processors
	Flours made from beans and peas	Important in Africa and South Asia either milled on-farm or sold to millers for production of flours used for domestic consumption or as raw materials for secondary processors
	Fermented soybeans	Important in parts of Asia for production of wide range of foods (e.g. tempeh, soy sauce, etc.)

TABLE 5 **Examples of products that can be made on-farm by primary processing** *(Cont.)*

Type of crop	Products from primary crop processing	Importance and potential of products from primary processing
Legumes	Dried groundnuts or groundnut flour	Used for extracting cooking oil, especially in Africa, either on-farm or sold as raw material to oil processors; as an ingredient for bakers or other secondary processors worldwide. Presscake by-product has value as food or animal feed.
Fruits and vegetables	Dried whole or sliced/ diced/chopped vegetables (e.g. cabbage, carrot, onion)	Important for consumption when cooked as part of meals worldwide. Opportunities for use as raw materials by secondary processors to produce dried soup mixes, etc., in some countries
	Dried whole or sliced/ diced/chopped fruits (e.g. mango, apricot, apple, banana)	Important for direct consumption as snackfoods or accompaniment to meals in many countries. Opportunities for use as ingredients by bakers and other secondary processors in some countries
	Fruit pulps and juices	Important as raw materials for secondary processors making fruit chutneys, jams, wines, tomato purée or sauce, etc. Some chutneys may be processed on-farm if there is local demand. By-products can be composted for fertilizer.
	Oil-bearing fruits - fresh or dried (e.g. palm, palm kernel, coconut)	Cooking oil extracted on-farm or by secondary oil processors. A wide variety of by-products can be sold (e.g. products from coconut in Figure 2 or fuel from palm processing in Figure 3)

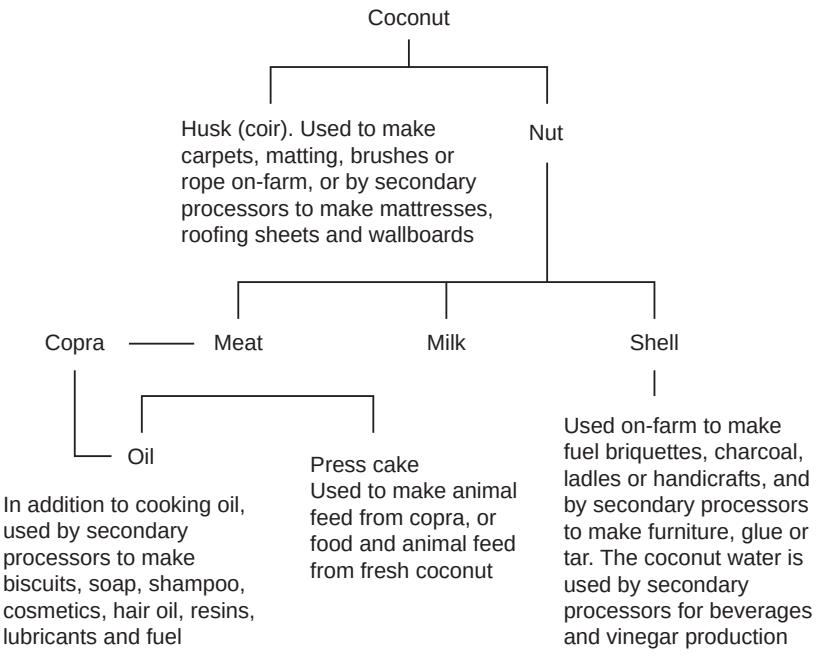


FIGURE 2 Uses for coconut by-products
Source: Adapted from Fellows, P.J. & Axtell, B. 2011. Opportunities in oil processing, CTA, Wageningen, the Netherlands (Unpublished)

Improved income

The benefit of primary processing is not only for improved food security, but also for income generation. Processed crops can be produced without high investment costs; they can be sold locally with minimum packaging and transport costs; and smallholders are likely to understand the local community's tastes and preferences. In this situation, farmers may see the income from sales of processed crops as an additional bonus that can be used to meet family requirements. As production grows in scale and mechanization, the requirements for different skills and levels of investment increase, but the potential financial rewards are also greater. However, markets may be more distant and diverse, which requires additional investment in packaging, transport, marketing methods and improved communications with buyers.

FIGURE 3 Fuel briquettes made from palm oil by-products
(Photo by .J. Houhounigan)

FIGURE 4 Selling dried crops processed on farm at market
(Photo: FAO/63746/ INPHO)

The financial rewards from successful crop processing and marketing depend on the skills of the farmer and the types of buyers being targeted (see Table 6). To achieve a good selling price, all processed crops should have a uniform high quality, and have the characteristics (colour, flavour, shelf-life, etc) that are expected by the buyers. In very small scale (subsistence) production, the level of mechanization and productivity are likely to be low, and local buyers are likely to be unable to afford high prices.

TABLE 6 **Potential buyers and uses for smallholders' crops**

Type of crop	Potential buyers	Uses for the crop
Roots and tubers	Local consumers	Direct consumption in meals
	Secondary processors	Raw material for production of crisps, gari, flours
	Schools and other government institutions	For institutional meals
Cereals and grains	Local consumers	Direct consumption in meals
	Millers	Production of flour for retail or wholesale markets
	Brewers	Raw material for beer production
	Animal feed suppliers	Preparation of feeds for poultry, dairy or meat animals
Oilseeds	Cooking oil processors	Extraction of cooking oil
	Animal feed suppliers	Preparation of feeds for poultry, dairy or meat animals
Legumes	Local consumers	Direct consumption in meals
	Millers	Production of flour for retail or wholesale markets

TABLE 6 **Potential buyers and uses for smallholders' crops** *(Cont.)*

Type of crop	Potential buyers	Uses for the crop
Legumes	Schools and other government institutions	For institutional meals
Fruits and vegetables	Local consumers	Direct consumption as accompaniment to meals or as snacks/drinks
	Secondary processors	Raw material for fruit wines, chutneys, jams, juices, tomato purée or sauce, etc.
	Schools and other government institutions	Direct consumption as accompaniment to meals or as snacks/drinks

Primary processing can also bring about other improvements and benefits to smallholders: these include better linkages to commercial food processors and other buyers (especially in integrated development programmes) which may improve the amount, quality and varieties of crops that are grown and result in higher prices for the farmer (see Case Study 2). Because the crops are preserved, the income can be generated over a larger part of the year. Improved incomes from sales to secondary processors, or secure supply contracts with institutions or other buyers, reduce both farmers' dependency on middlemen and seasonal price fluctuations. Increased planting of some types of crops in response to the demand from buyers may also improve the rural environment (e.g. soil regeneration and rainwater retention as a result of orchard or vegetable planting). Successful on-farm primary processing may lead to an increase in demand for equipment and packaging materials that stimulates the development of local suppliers and/or engineering workshops.

CASE STUDY 2 **Smallholder links to a food processing company - rice producers in Zambia**

In 2007, the Dutch development agency, SNV, contracted Cinci wa Babili, a local Zambian NGO and capacity builder, to provide services to rice farmers and assist them to form an association in an area with a capacity to provide services to 2 000 farmers, 30 percent of whom are women. Chambeshi Rice Farmers Association is now in the process of registering Savings and Credit Cooperatives (SACCOs) to support its farming and marketing activities. The SACCOs have so far raised US$2 000 to begin their lending operations.

The association's vision is 'To empower rice farmers in the district to operate as profitable businesses by providing them with business development services'. To achieve this, the association has provided its members with the following services: input provision, access to markets through contract farming arrangements, bulking and storage services and access to finance via SACCOs.

In 2008, SNV contracted a rice processor, Frontier Grinding and Packaging Ltd., to create a formal trade relationship with farmers, and the company offered Chambeshi Rice Farmers Association a contract at a fixed price. SNV linked Frontier to Zambia Agricultural Technical Assistance Company Ltd. (ZATAC) who in turn arranged financing for Frontier from Woord en Daad of the Netherlands. In 2009, Frontier signed a memorandum of understanding with the Association to purchase 250 MT of paddy at ZMK 50 000 (US$10) per 50 kg bag. This was a 100 percent price improvement since farmers normally sell paddy at US$4-5 per 50 kg bag to traders. In preparation for the purchase, Frontier distributed 5 000 grain bags and arranged collection of the grain. Traders are the main competitors to the Frontier-Chambeshi purchase arrangement as they are offering better prices to the farmers because of the global food crisis and resulting price increases for rice. Thus, this arrangement has both improved the bargaining capacity of farmers and increased the prices offered to rice farmers by attracting more buyers in the market.

Source: Adapted from Mufara, P. 2011 Living the dream-The Chambeshi rice farmers association story, Netherlands Development Organisation (SNV)

There may also be community benefits from improved linkages between smallholder farmers and retailers or other customers, including: lower cost and increased availability of locally preserved foods; improved food quality as a result of greater competition between smallholder processors; increased diversification in the varieties of preserved food that are available in the diet; and improved relationships and trust between on-farm processors, retailers and customers in a community.

The creation of trade in on-farm processed foods presents an opportunity for even the poorest members of a community to significantly improve their livelihoods. This can contribute to raising incomes, improving living standards and giving an incentive for rural inhabitants to remain in rural areas and not migrate to urban centres in search of employment and provide greater financial security to the whole rural community. Improved infrastructure and the creation of links to urban centres, together with the establishment of improved services and supplies, results in an increased standard of living for rural populations.

Opportunities for women

In many countries, women, children as well as the elderly have a major role in crop processing, especially preparation procedures such as washing, sorting and peeling crops. Primary processing for sales at markets means that they also have an opportunity to participate in deciding the best places to sell the crops and choosing suitable methods for marketing processed produce. This also offers the opportunity for them to be involved in other aspects of processing, such as helping to maintain quality standards and thus enhance their knowledge.

FIGURE 5 Women milling at their cooperative premises
(Photo :FAO/63301/INPHO)

BOX 1 **Women and commodity processing**

Agriculture and its related activities are commonly perceived to be male-based. This cannot be more far from the truth as, for example, in sub-Saharan Africa about 60 percent of households are headed by females. This is particularly true in farming and especially in primary processing operations. However women have considerable barriers to be able to operate such enterprises successfully. They have restrictions in property rights, limiting their role as land owners and also to own other productive assets, like machinery. They have difficulties in accessing credit and this results in having a minor role in enterprise activities and in particular in the management of its revenues. Women also have problems in access to education, training and extension services as well as to improved primary processing technology that can reduce their drudgery. Commonly, they are excluded from decision-making in the enterprise and this also hampers economic opportunities and employment conditions. This is anomalous as women have much of the required know-how and skills of primary processing methods 'embedded' from traditional community cultural and social background. Moreover women who trade their processed products have difficulties in accessing markets, obtaining fair prices and can be subjected to male-dominated trade harassment at local and village level.

Importantly women can share the benefits of their labour, as they can be involved in deciding how the family uses the money that they earn. This may require introduction of ways to strengthen women's control over their income, such as introducing and promoting group savings and credit schemes. This not only allows women to be more independent and increase their options to provide for the family, but it also improves their social status in their communities. In some communities, it may be necessary to undertake gender sensitisation activities to ensure that community leaders and male heads of farming households understand why it is important that women and young people are rewarded for their efforts.

Farmer organization

When operating above subsistence level, smallholders can often increase their incomes and efficiency by joining together with other farmers in some form of association. Typically, these organizations can assist in obtaining farming inputs; sharing information about buyers, especially about different village markets in an area and large-scale secondary processors; organizing transport; and/or negotiating collectively to market their processed foods. Such associations may be informal to

begin with and later become more formal, such as a legally registered producers' association or a marketing cooperative. Among the many advantages of organized smallholders, the following are significant:

- Economies of scale, both in production, marketing and in buying inputs.
- Combining local resources, skills, communal equipment and services to benefit the group.
- Efficient use of trainers' time when holding training courses, by training all members in a group. Higher quality and safety as a result of training and uniform product quality among all group members.
- Larger amounts of processed crops to sell and therefore increased capacity to take advantage of market opportunities. Improved bargaining power with buyers.
- Opportunities to supply Fair Trade organizations.
- Lower transaction costs, and lower unit costs for transport, processing and storage.
- Improved access to credit from financial institutions.
- Increases the likelihood of smallholders' sustainability, leading to improved community cohesion.
- Larger organizations can hire professional staff to undertake key activities.
- Enables better opportunities for farmers' voices to be heard in local and national forums.

It is important that an association is created to fulfil specific goals and that it does not have too many functions (e.g. an association can be formed to obtain credit or farming inputs, to transport crops; or to find new customers and negotiate prices on behalf of members). Associations also need to be professionally managed to be successful in the long term: checks and balances should be put in place, especially in the management of finances and stock; there should be clearly defined responsibilities for members who are elected to manage the association; members' rights and responsibilities should be clearly defined when the group is formed and there should be open access and transparency in all decisions made on behalf of the association; all members must be free to communicate with each other and participate in association decisions. This may require support and training in group formation and leadership skills in order to get an association operational and running successfully.

FIGURE 6 Extension officer training members of a farmers' association in rural China
(Photo:FAO/23173/C. Shanghua)

Feasibility of the activity

The primary resource in most villages is its crops, and adding value to crops makes it possible to generate additional income. However, it is essential that farmers be provided with sufficient information to properly evaluate primary processing as a livelihood activity before any investment takes place in setting up on-farm processing units. Farmers and their families should make an evaluation of on-farm processing as a potential livelihood activity and take the decision whether to go ahead or not. Advisors can support them in making decisions with information on for example markets and equipment options. The decision to start on-farm processing is likely to be influenced by the additional profits, but it may also include other factors, including extra work required by family members; their confidence to process foods to the required quality and sell them in new markets; and other social and cultural factors. It is important that farmers decide on their own, and decisions not taken for them, whether they want to take on the added responsibilities involved in processing in order to become more prosperous and food-secure.

What commodities to process?

The choice of which commodities to process depends mostly on i) the types of crops that farmers already grow (the supply) and ii) the types of processed commodities that buyers need (for example, demand at village level and/or from medium and large scale processing enterprises in an area). This means that the expected amount and value of sales should be assessed before a farmer decides to go ahead with any investment in the processing activity. This type of market assessment (or survey) does not need to be a complex or expensive activity, but it is likely that smallholders will require assistance from support organizations to design and conduct the survey. Farmers will need to survey demand for processed commodities and make estimates on which are most popular and provide for good prices.

How much to process?

When smallholders wish to process a crop on the farm, one of the most important questions is how much should be processed and how much should be sold immediately. If they set aside all of the crop for processing

FIGURE 7 Parboiling rice before it is sold
(Photo: FAO/PH00130/INPHO)

there is no immediate income, which might be an important constraint on family finances. The decision on how much to sell at harvest time and how much should be processed depends on a number of different factors: for example, the need for cash at harvest time to pay bills; the amount of processed food needed by the family until the next harvest; the amount of crop that is available for processing in relation to the demand for the processed commodity. This last factor depends on market demand estimates made and if the farmer has the capacity to meet this demand with his or her own crops, or whether to team-up with other farmers and share crops to meet the demand for the processed commodity.

What equipment, technology and packaging to use?

Once the likely amounts of crops to be processed have been estimated, based on expected sales and family requirements, the farmer will need to make estimates if any new equipment and packaging may be required. This may consider new equipment to upgrade a process from manual to mechanical operation, or larger or different equipment needed to expand the level of production and meet a greater demand for the processed food. It is essential that any new equipment is matched to the demand for the processed commodity: if it is too large, the farmer is wasting money by buying processing capacity that is not required; if it is too small, the farmer will not be able to process the intended amounts of crops.

Frequently, farmers do not have access to information about the types and sizes of equipment that are available in a country, the costs of different options, the requirement for spare parts, or availability of people who can maintain and repair the equipment. There may also be constraints on how the equipment can be powered: this depends on the local infrastructure (e.g. for electricity or fuel supplies) and natural resources (e.g. for water or solar powered equipment). Frequently farmers are faced with choices to invest in cheaper equipment that is manually operated or driven by animal power, but may have a lower throughput; or investment in more expensive equipment that is driven by a diesel or petrol engine, but has a higher output.

All of these are important considerations that farmers should take into making estimations about equipment and a role of advisors and support organizations is to assist farmers in obtaining the necessary information. In particular, it is often beneficial to source equipment from local fabricators or engineering workshops: they will then have staff available with the necessary skills to maintain and repair equipment; they are likely to charge less than workshops in large towns; and they are sufficiently local to make the repairs quickly and prevent long periods when the equipment is not operational (which would result in financial losses to farmers if the crops spoil before they can be processed). However, rural engineers and mechanics frequently have fewer skills than better-trained city equivalents - both in designing and constructing reliable and hygienic equipment, and being able to respond efficiently if there is a breakdown. Farmers should therefore find out

if local workshops are capable of meeting their requirements for after sales support before purchasing equipment from them.

Similarly, there is a very wide range of packaging materials that can be used for processed foods, each with different properties and prices. Some can be made locally from natural resources (e.g. sisal bags, wooden boxes or crates) whereas others, such as plastic trays, sacks, barrels, etc., have to be obtained from city-based traders. Farmers need to estimate the various packaging typologies that can be found locally and their costs. In many countries there are also small-scale industries that recycle and re-use packaging materials, and farmers may need information to locate these sellers. Some type of packaging are more effective and efficient than others for a particular processed food and farmers will need advice on making the most cost-effective choices.

Scale of operation

There are several potential scales of operation that smallholders can estimate. At the smallest scale, commodities that are processed for home consumption may also be sold to neighbours or at local markets when additional income is needed. This does not have many barriers that would impede entry by smallholders: the requirements for investment and training are small and post-harvest and marketing costs are minimal.

FIGURE 8 Reused packaging materials for sale at a market
(Photo: FAO/19856)

FIGURE 9 Pounding cassava to make flour at home-based enterprise level
(Photo: FAO/23343/A.Proto)

More commercial on-farm processing provides an opportunity to move away from subsistence farming towards cash crop farming, where smallholders produce commodities that have a wider market demand. At these higher scales of operation, processing has a number of additional requirements: perhaps the most important is to ensure that potential sales opportunities are identified and confirmed before a new processing venture begins - it is of little use to process crops that do not have a profitable market. Typically at this

FIGURE 10 A milling machine for a more commercially-oriented small-scale enterprise (Photo: FAO/17680/A. Conti)

scale, buyers can be consumers in local village markets, secondary processing businesses that buy crops as ingredients for their products, or wholesale merchants or institutions that buy crops for re-sale or use in meals. Examples of potential markets are given in Table 6 for the crops considered in this booklet.

Estimates on the scale of an on-farm processing operation should be demand-led, assuming that there are sufficient amounts of crops available to process.

■ ***How to organize the activity?***

Farmers should also review and estimate whether the necessary skills are available within the family to process crops to the quality standards required by buyers. Again this is an area where support agencies can assist, and provide information on training costs, times and conditions. Estimates will also have to be made on whether to operate alone as a single farming family, or whether to join with other families or form a farmers'

association in order to both afford the investment required and meet the demand for products.

Once an estimate has been made on who will do the processing, there is a need to estimate other facotrs. This involves the types of work that are involved in primary processing of crops and can be broadly divided into the following areas:

1. Harvesting crops and any preparation that takes place in the fields (see Figure 11a)
2. Transporting the crops to the processing unit (see Figure 11b).
3. Preparing the crops for processing (e.g. washing, peeling, slicing etc.) and processing operations (e.g. drying, extracting oils or juices) (see Figure 11c).
4. Packaging and storage (see Figure 11d).
5. Transporting processed commodities to market (see Figure10e).

FIGURE 11a Harvesting maize and barley
(Photo: FAO/21560/G. Bizzarri)

FIGURE 11b Men and boys transporting maize following its harvest
(Photo: FAO/22041/G. Bizzarri)

FIGURE 11c Women preparing maize for processing and/or storage
(Photo: FAO/15696/P.Gigli)

FIGURE 11d Maize in Storage
(Photo: FAO/11186/F.Matioli)

FIGURE 11e Transporting to market
(Photo: FAO/63662/INPHO)

Depending on the extent of mechanization, each of these stages can be time-consuming and may involve a number of people working together to achieve the necessary production rate. Estiamtes therefore need to be made on who will do the work, how long it is expected to take, what are the quality standards required for each type of work, and who will monitor the work to make sure that it is being done effectively.

Transport and sales in particular can be very time-consuming if the smallholder or family member takes their produce to market and is therefore away from the farm and not employed in other farming activities. Estimates therefore are needed on the relative cost-effectiveness of employing family members or hiring a haulier and/or salesperson to sell the processed foods. This in turn depends on the distance to market from the farm, and is part of the considerations that are taken when conducting a feasibility study.

Credit availability and access

A major consideration is availability and access to credit: farmers operating alone are much less likely to be able to get credit from financial institutions to invest in a micro or small-scale on-farm processing operation; whereas those who join a farmers' association may be more successful. Advice may be needed from support organizations on the different forms of credit that best meet farmers' needs (e.g. in terms of interest rates, payback times and any conditions imposed by the lenders).

Nearly all formal lenders require an assessment of the likely profitability of a processing enterprise in order to make a judgement on the creditworthiness of the farmers. As a minimum, they require figures for the projected amounts of sales and profits, as well as the expected costs of production, which are found using a feasibility study. With a little research, these figures are not difficult to estimate, but many farmers will require assistance to do this.

Costs and profits

There are a number of different costs that are associated with primary processing that a farmer should take into account when estimating the likelihood of an operation being feasible for a smallholding family: typically, the costs of production are very low at subsistence-level processing, when farmers use manual methods or home-made equipment and require little additional fuel and packaging materials. At higher scales of operation, production costs include processing inputs such as

fuel or power and packaging; any ingredients that they need to buy; whether they need to hire transport to take processed commodities to market; repayment of loans used to buy equipment; payments for temporary staff; and the costs associated with business registration and taxes. There are also other costs that may arise if they buy equipment, such as repayments of loans and depreciation.

When all the costs are added together, they need to be compared against market prices, so as to estimate a farmer's potential. Sales prices of processed crops should exceed the total cost of producing, processing and marketing such products for the venture to be profitable.

Evaluation of the livelihood activity

Primary crop processing may at first seem quite straightforward and offer many benefits to smallholder farmers, and indeed for many this may be true. However, there are a number of different factors to take into account and each should be assessed before a farmer makes any investment of family funds or takes out a loan. If this is not done, the farmer may find that the costs involved in processing are higher than the income that they can achieve; the demand for processed products does not exist in the amounts that are expected; the price that customers are willing to pay for the processed commodities is less than expected; or the quality of the processed commodities does not match the expectations of customers.

If one or more of these factors is unfavourable, the farmer risks making a loss, and for many resource-poor families this could have lifelong effects through paying off the debts that are incurred. It is therefore essential that advisers give farmers accurate and up-to-date information and that they properly train farmers to assess these different aspects of the proposed primary processing operation. This should be done in a systematic way, examining each of the factors that affect not only profitability, but also the capacity of the farming family to undertake primary processing (i.e. conducting a feasibility study). While it is the farmers' responsibility to make the final decision, it is the advisers' role to ensure that the decision is properly informed.

The livelihood activity

Essential elements of the activity

Buildings

On-farm processing requires a covered structure to allow processing to take place in the shade and out of the rain. For some types of processes, especially those that involve heating or use petrol or diesel engines, such as dryers, threshers, mills and roasters, this can be an open-sided structure to allow fumes and smoke to escape. For others, such as fruit juice extraction, it is desirable to have a fully enclosed building to reduce the risk of product contamination. In contrast to some types of secondary processing,

FIGURE 12 An open-sided structure for grinding operations on-farm
(Photo: FAO/63674/INPHO)

where hygienic finishes are required for internal walls, floors and ceilings (see FAO Diversification booklet No. 5 *Processing for prosperity*), on-farm primary processing requirements are less strict. Where they are available, concrete blocks may be used for walls but wooden or plastered dried mud structures with a waterproof roof are also acceptable, provided that they are kept clean. Ideally, the floors of processing rooms and storerooms should be constructed of good quality concrete, smooth finished and without cracks that would harbour insects and cause a build-up of dirt.

The location of the building should be away from any swamp land that would be a source of smells and insects, and the land around the building should be cleared to reduce problems caused by insects and birds (preferably short grass that also traps airborne dust). There should also be a site available for waste disposal away from the building

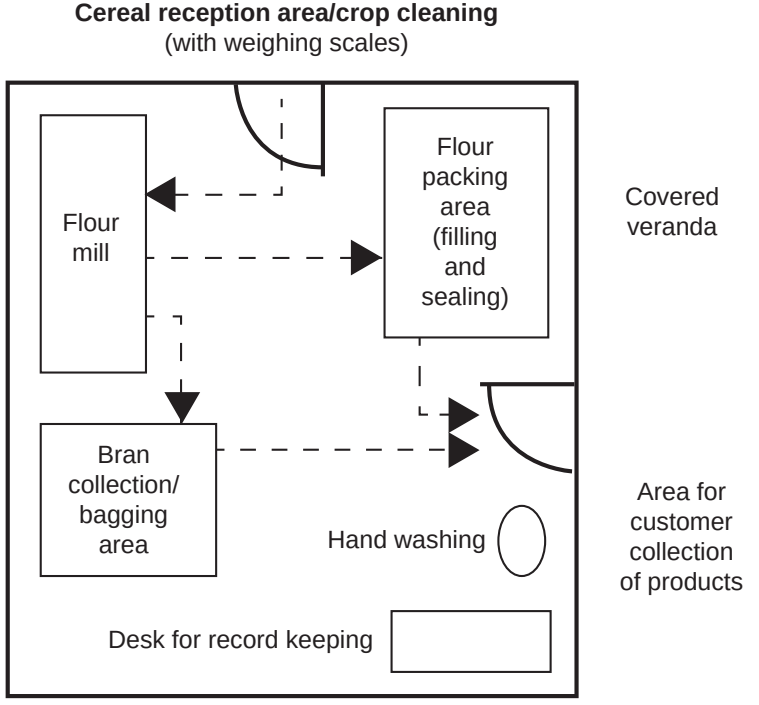


FIGURE 13 Layout of a building for cereal milling

that will not contaminate water supplies. The layout of equipment in a processing unit should ensure that there is a flow of materials around the building to reduce the risk of clean finished products becoming contaminated by incoming, often dirty raw materials (see Figure13).

Water

Safe (or potable) water is required for some types of crop processing to clean crops or to wash equipment. If products require water as an ingredient, this should be treated to make sure that it is safe. Underground water from a well is preferable to river or lake water because it is much less likely to be contaminated. If there is a risk that water is likely to be dirty, some form of filtration is required. The simplest method is to use a filter made from sand (Figure 14) and the purified water can then be used as required in the processing area.

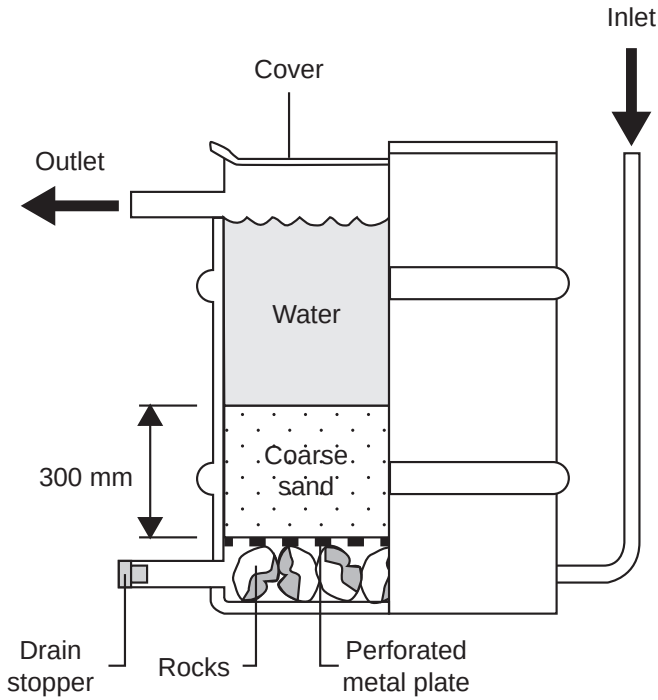


FIGURE 14 Treatment of water using a sand filter
(Source: Courtesy of Doulton water filters and adapted by Michael Breece)

Energy

Many types of processing require power to operate equipment or energy for heating and drying and there are a number of options that are available to most rural communities. Many rural communities do not have access to mains power, or it is not sufficiently reliable, and costs of electricity generation are too high. In these places, energy can be supplied by water, wind, animal power, the sun or by manual operation.

Water power is only an option where the supply has a sufficient fall in height and quantity of water to drive machines powered by turbines or waterwheels (e.g. in mountainous areas). Wind power has been used successfully in some countries to drive grain milling equipment in windmills, but wind is often unreliable and unless a region is known to have reliable steady winds at a sufficient wind speed, it is rarely a viable option. Animal power, using horses, donkeys, buffaloes, camels and oxen, is an option for driving processing equipment (e.g. threshing crops, oil extraction, fruit pulping or cereal grinding) in communities where animals are traditionally used for work. Where sunshine is abundant at harvest time, it is suitable for drying crops, provided there is protection against rain, insects, birds and rodents. Simple solar collectors, with or without fans to increase air flow, can greatly increase the rate of drying and produce reliable and efficient operation with little investment.

Biomass by-products from crops such as oil palm (see Figure 3), rice, maize and sugarcane can be used as a fuel for drying if they are available in sufficient quantities. Methane (biogas) is a natural gas that is produced from by-products of fruit and vegetable processing in enclosed containers and makes a suitable fuel for heating or for some types of engines. If the farm has livestock, such as pigs, this can also be used to produce methane (see FAO Diversification Booklet No. 15 *Pigs for prosperity*). Manual- or animal-driven machines can be used for a wide range of crop processing machines at a small scale of operation and may be a suitable choice when starting a processing operation before investing in electric or engine-driven machines. Diesel and petrol engines are available in different sizes for village-scale processing

operations to drive equipment or generate electricity to power electric motors. Diesel engines are more reliable and although they are more expensive to buy, they are usually cheaper to operate, provided that there is a reliable source of fuel and the means to transport it to the village in the amounts required.

If mains electricity or a generator is available, electric power is the preferred choice for processing because it is convenient to use, clean in operation and often cheaper than other energy options. In a processing room full use should be made of natural daylight to reduce costs. Where lighting is needed, florescent tubes are cheaper to operate than incandescent bulbs, but care is needed if there is machinery with fast moving exposed parts, because fluorescent tubes can make a rotating machine appear to stand still - with obvious dangers to operators. All electric power points should be placed high enough above the floor to prevent a risk of water entering them during washing the floor or equipment. Each power point should only be used for one machine to avoid overloading a circuit and causing a fire, and ideally the mains supply should have an earth leakage trip switch. If three-phase power is needed for larger machines, such as flour mills, the wiring should be installed by a qualified electrician to balance the load across the three phases.

Basic equipment

All types of crop processing require basic equipment such as tables, buckets, knives, and scales to handle, weigh and prepare raw materials. In most countries, wooden work tables are cheaper than metal ones, but they are more difficult to keep clean. If wood is used, it should be covered in a sheet of thick plastic, aluminium or other impervious surface for easier cleaning. Scales are expensive to buy in most countries and a cheaper alternative is to calibrate scoops or other measures, so that they contain the correct amount of material when filled level with the top (see Figures 15a & b) - provided operators are carefully trained to ensure that the weights are consistent. Other utensils, such as knives, peelers, etc., should be made from stainless steel and containers and buckets should be food-grade plastic, stainless steel or aluminium.

FIGURES 15a and 15b Calibrated scoops and jug
(Photos by P. Fellows)

Steel is most commonly used to construct equipment that is used for processing cereals, legumes, oilseeds, root crops and vegetables because these foods do not react quickly with the metal. Because of the acidic nature of fruits, the parts of fruit processing equipment that are in contact with food should be made from food grade plastic, aluminium or stainless steel. Other metals, such as iron, steel, brass and copper should not be used because they react with the fruit and cause off-flavours or colour changes in the product. However, because of the high cost of stainless steel and the inability of local workshops to fabricate stainless steel equipment, it is often only used for cutting blades or boiling pans for fruits.

Labour organization

For most smallholders, at least initially, the labour for primary processing is likely to come from family members. There are many types of processing activities that require skills which can be acquired by practice and are suitable for all family members, including older children, such as washing and peeling crops, turning crops when they are drying in the sun, etc. However, depending on other work that is required on the farm during harvest periods, family members may already be fully employed and it may be necessary to hire labour. Alternatively, members of farmers' associations may be available to assist with processing if this is part of the arrangement or agreement when joining the association, so that all members benefit from each other's labour.

In each case, it is desirable to have a plan of work so that the best use can be made of peoples' time. This need not be written down but the farmer should at least have an idea of what needs doing, where and when, and how long it is expected to take. In this way all of the crops can be processed and placed into safe storage before they begin to deteriorate. Depending on the type of crop (see Table 1), there may be a few weeks to organise the labour needed to complete the processing of cereals or oilseeds, but for other crops such as fruits and vegetables, the work must be completed within a few days to prevent unacceptable levels of losses, and this requires more careful work organization. Normally, the work will follow the sequence of processing activities, starting with people working to harvest the crop, then moving on to preparation of crops for processing (e.g. winnowing,

sorting, washing, etc.), followed by processing, packaging where necessary, and moving processed crops into storage. This is an over-simplification, because it may also be necessary to decide specific work for individuals (e.g. those who have the skills and/or experience to operate particular equipment, such as a cereal mill or oil extractor) and some types of work may be too heavy for children or women, and it is reserved for stronger family members or hired labour.

Roots and tubers

Products from primary processing of root crops include dried chips and flours made from yam, sweet potato or cassava, and fermented products such as 'gari' from cassava. All root crops require washing to remove soil after harvesting, followed by inspection to separate the roots or tubers that are infected with mould growth, diseased or excessively damaged by insects, rodents, etc. A simple wash tank can be constructed from concrete or metal and fitted with a drain valve so that the water can be changed regularly. This avoids a build-up of micro-organisms in the wash water that could then infect other healthy crops.

Inspection and sorting are best done using a table so that crops can be kept clean once washed. After washing and sorting, crops are peeled to remove the skin, either manually using sharp knives or peelers, or using a small peeling machine. Chips can be produced manually using a knife, but only at household level production. At all other scales of operation, chips are made using a chipping machine (see Figure 16), which consists of a vertical metal disc with coarse serrations or blades on the surface. The roots or tubers are held against the rotating disc to cut off suitably sized pieces. Similar designs of machines are also available for grating root crops (e.g. cassava for gari production). Alternatively, strips of root crops may be made by forcing the food past sharp blades. These types of equipment can often be made by a local workshop, and can be operated by hand, pedal or motor.

Other types of equipment are also available to grate root crops, including locally made drum graters or manual graters (see Figure 17). At larger scales of operation a motor-driven hammer mill can be used if pulped root crops are required.

FIGURE 16 Chipping machine for root crops
(Photo by P. Fellows)

FIGURE 17 Grater for root crops
(Photo: Courtesy of IITA at www.flickr.com/photos/iita-media-library/5126248578/)

In processing cassava to produce gari, the washed, peeled and grated crop is fermented for three to five days in non-corroding containers such as polypropylene sacks, fibreglass or plastic drums, wooden boxes or concrete tanks, depending on the level of investment and the required scale of operation. It is then pressed in cloth bags to remove much of the water, roasted, sieved and packaged. Simple presses (see Figure 18) can be made from wooden beams, weighted down with stones or metal, or using a screw or hydraulic press. The latter are usually lorry jacks and are therefore readily available and cheap to buy.

After pressing, the meal is removed from the bag and sieved. Roasting is usually a manual operation done using a shallow pan mounted on concrete blocks over a fire, and the dry roasted gari is then sieved using a manual sieve. It can be either packed into sacks and dispensed into customers' own containers or packed into plastic or paper bags for sale (see Figure 19).

Cereals and legumes

Primary processing of cereal and legume grains involves threshing, winnowing, husking, shelling, drying, and for some grains, milling. In many countries women are largely responsible for this and in almost all cultures they control grain storage. Depending on the type of cereal or legume, crops may be partly dried in the field after harvest, which helps to separate the grains during threshing. Threshing cereals such as millet, sorghum, barley and rice, and legumes (soybean, groundnut, lentils, cowpea and different varieties of beans) is either done manually using flails or similar tools, or using a mechanized threshing machine. The crops may be winnowed (see Figure 20) to remove contaminants such as dust, chaff, insects and stones.

FIGURE 18 Press used in gari production from cassava
(Photo: Courtesy of IITA, available at www.flickr.com/photos/iita-media-library/5135322212/)

FIGURE 19 Preparing processed cassava for sales
(Photo: FAO/12898/G.Tartagni)

FIGURE 20 Winnowing using a battery-powered fan
(Photo: FAO/63657/ INPHO)

FIGURE 21 Traditional maize cribs
(Photo by P. Fellows)

Maize is harvested on the cob and dried without the surrounding leaves in maize cribs (see Figure 21). The kernels are then removed from the cobs when the maize is dried, either using a manual sheller, or a motorized sheller at larger scales.

When processing cereal and legumes to sell as dried whole grains, the next stage is to inspect the crop to remove damaged or mouldy pieces. This is done manually using an inspection table that can be locally constructed. It consists of a mesh that retains the grain stretched over a wooden frame. Damaged/mouldy seeds and contaminants such as straw and chaff can be picked out by hand, and soil or sand fall through the mesh. Then it is necessary to clean the crop to remove any remaining stones, weed seeds, insects and other contaminants. Crops can be cleaned more easily by machines than by hand: crop cleaners contain perforated plates or wire-mesh sieves and may incorporate a winnowing fan (see Figure 20) to separate light material such as chaff or dust. The output of even a small motorized crop cleaner is about five tonnes per hour. Correct inspection, cleaning and sorting is one of the most cost-effective ways of adding value to crops, making investment in crop cleaners very worthwhile. After drying, crops can achieve a higher sale price if

FIGURE 22 Sun-drying cereal crops
(Photo by P. Fellows)

they are marketed as 'free from stones' or similar.

Crops are dried by sun-drying (see Figure 22) in areas that have a suitable climate at harvest time. This is because solar dryers or fuel-fired drying equipment that are large enough to dry the large quantities involved are likely to have a capital cost and/or running costs that are too high for smallholder levels of investment. Sun drying should take place on clean surfaces, such as concrete or plastic sheeting that are located away from sources of contamination. Crops may also be raised off the ground on woven matting or wooden drying frames. Crops need to be turned regularly and collected if there is a risk of wetting by rain or dew, and if possible, covered with mosquito netting to minimise damage to, or consumption of the grains by birds, insects or rodents.

Once dried to the correct moisture content (see Table 4), crops should either be packaged for sale or stored for later sales. Typically, dried crops are packed into either bulk (50 kg) sacks made from Hessian, cotton, multi-walled paper or woven polypropylene, or in smaller amounts in paper or plastic bags. Sacks may be hand-stitched, or if electricity is available, using an electric sack-stitcher. Paper bags may be folded and stapled to seal them and plastic bags may be tied using a plastic strip (see Figure 23), or heat sealed using a flame or an electric heat sealer.

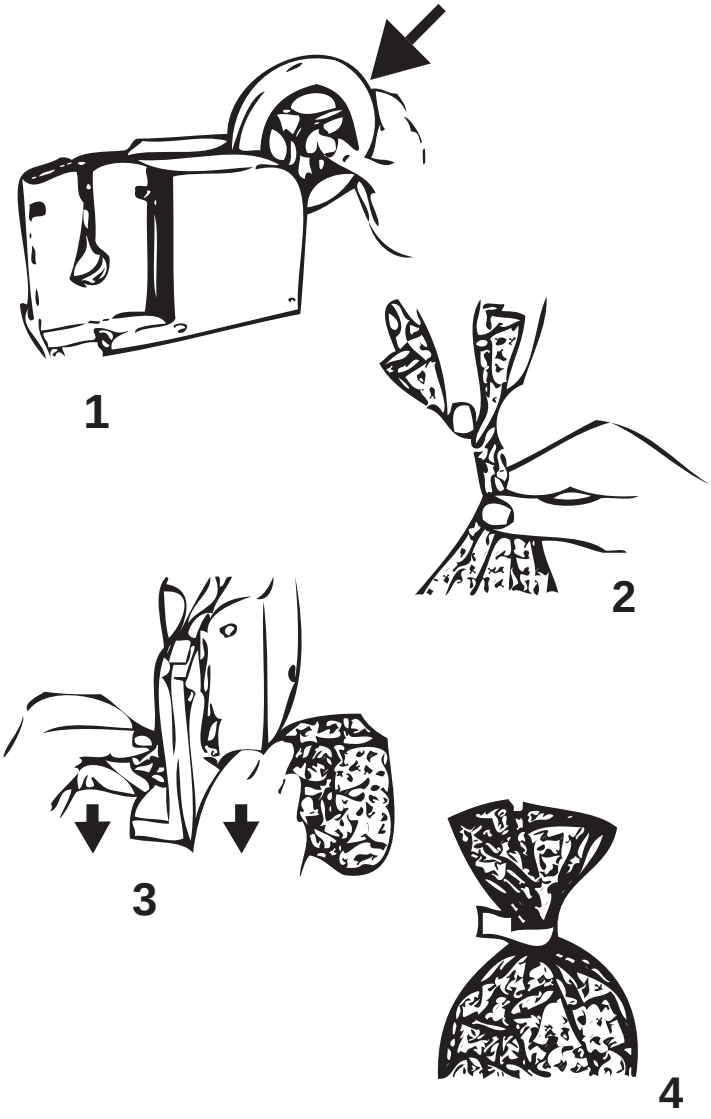
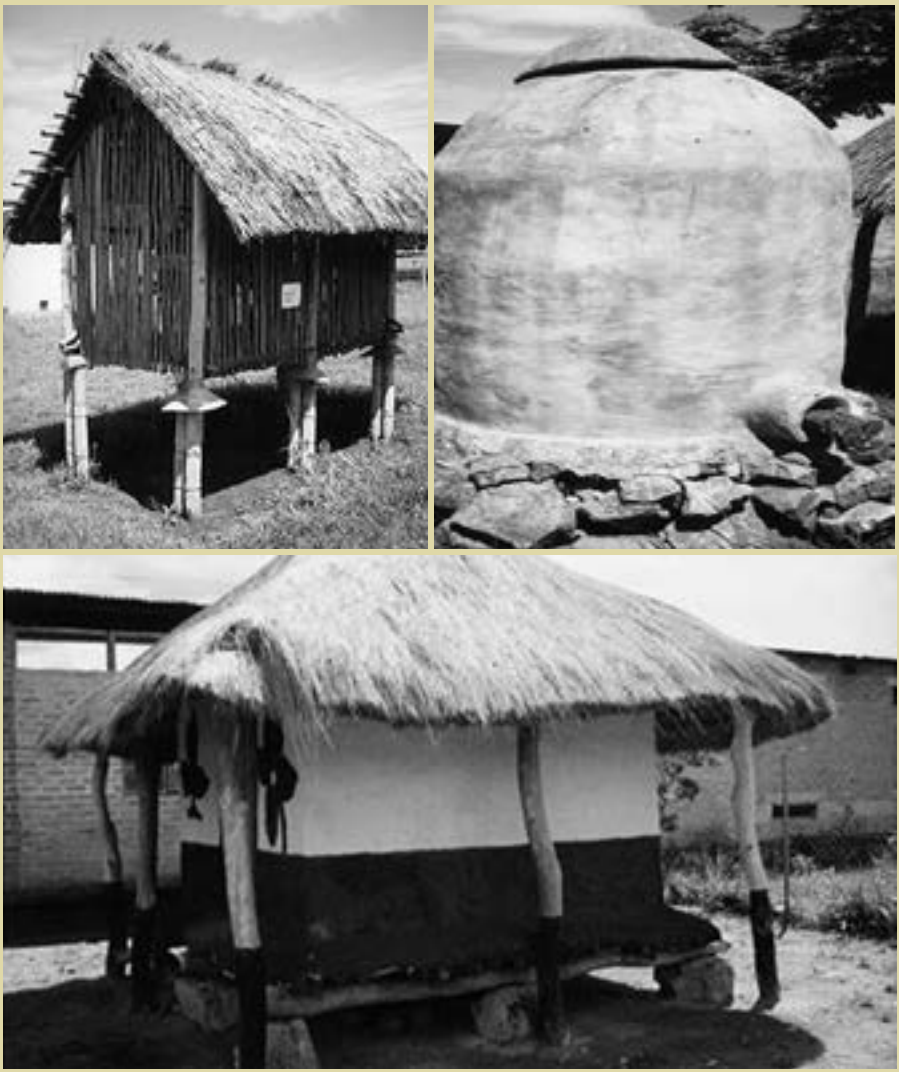


FIGURE 23 Manual sealer for plastic bags
(Source: Fellows, P.J. & Axtell, B. 2003. Appropriate food packaging, 2nd edition, TOOL/ILO Publications, Practical Action Publishing, Bourton on Dunsmore, Rugby, United Kingdom. Adapted by Michael Breece)

If crops are stored in bulk for later sales, it is important that the storeroom, silo or storage containers are watertight, rodent-proof, insect-proof, and offer some insulation against temperature fluctuations. Locally-made stores constructed from woven pliable sticks or chicken wire plastered with sun-baked mud, or preferably concrete, may be suitable if they are correctly designed and constructed (see Figure 24). Small stores can also be made from 200-litre oil drums with tight-fitting lids, provided that they are kept in the shade to avoid severe temperature fluctuations. If storerooms or containers are made airtight, the air inside can be removed by placing a lighted candle inside before the store is sealed. The burning candle uses up the oxygen, which kills any insects in the store and also extends the storage life of the grain.

It is important that the temperature in a store is kept as constant as possible, because any fluctuations can lead to moisture condensing from the air and creating dampness in the grain that can lead to mould growth. Overhanging roofs and thick walls are used to insulate the store and help prevent significant temperature changes. Groundnuts should not be stored in their shells or maize cobs stored with the outer leaves in place to reduce the risk of moulds growing underneath where they cannot be seen.

Value is added to cereals and legumes by milling them to flours. Whole grains store better than ground flour, so many rural women grind or pound small amounts of grain every day for immediate family consumption. If flour is prepared as part of on-farm primary processing, the traditional methods of grinding the whole grain use manual stone mills (or 'querns') or pounding the grain using a pestle and mortar, followed by winnowing and re-pounding. These methods are not only tiring and time consuming, but output is low at one to five kilograms flour per person per hour. Powered dehusking or milling machines are therefore the preferred option. Different types of equipment are available for different crops: for example dehusking of paddy (which is sometimes referred to as 'milling') removes the outer husk. Dehusked paddy is referred to as brown rice and further milling (or 'polishing') produces white rice. Different types of rice mills are available, including an 'under-runner disc mill', a 'rubber-roll mill' or an 'Engelberg mill'. The choice often depends on the local availability of equipment and existing knowledge, skills and experience of their operation, maintenance and repair. For example, the under-runner



FIGURES 24a-c Examples of locally made storage structures for grains
(Photos by P. Fellows)

disc mill is popular on the Indian subcontinent, but not in Africa. The Engelberg mill (see Figure 25) is relatively inexpensive, robust and easily repaired. It has few moving parts to wear out and the skills required to operate and maintain it can be quickly learned.

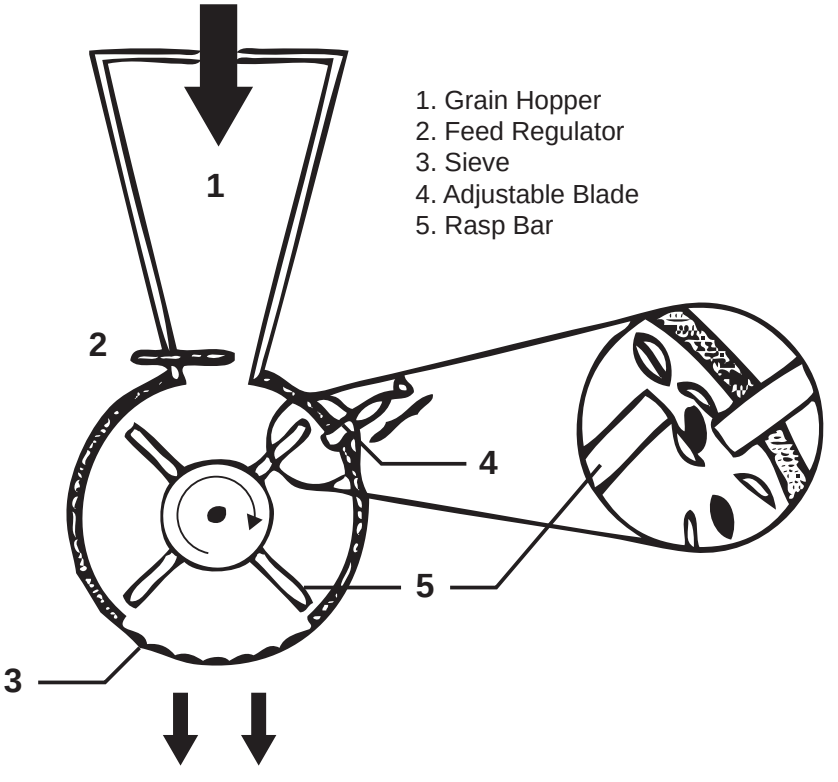


FIGURE 25 Engelberg mill for rice milling
(Source: Courtesy of Dippon, 1990. Adapted by Michael Breece)

Before it is dehusked, paddy may be parboiled (partial cooking which toughens the kernel). The process makes the seed more resistant to insect attack and to shattering during dehusking. Paddy that has been parboiled can be stored for longer after drying and it has a better nutritional quality because nutrients in the bran move into the grain so they are not lost during dehusking. The outer layers of millet and sorghum seed are also removed by dehulling because they contain chemicals named 'tannins' that are slightly toxic, have a bitter taste and inhibit protein digestion when consumed.

FIGURE 26 Parboiling rice
(Photo : FAO/PH00128 /INPHO)

Maize may be milled either wet or dry: in dry-milling, the dried maize is ground between stones or in a plate mill or hammer mill; in wet-milling, the grain is milled after it has been soaked in water, or in Latin America, after it has been partially cooked in an alkaline solution made using lime to help remove the bran before it is milled. Mills that grind maize and legumes to produce fine flours are widely used because of their advantages over manual pounding or rubbing stones. They can be hand-operated, but are more often motorized to reduce the physical effort required: for example a manual plate mill or stone quern yields about 5 kg of coarse flour or 1 kg of fine flour per hour, whereas a small hammer mill with a 3 kW diesel engine produces about 150 kg of coarse flour or 50 kg of fine flour per hour. Also manually ground flour can have variable particle sizes, whereas powered mills have sieves that produce uniform particle sizes and flour quality. Hammer mills can be supplied different sizes, are relatively inexpensive, and can be made locally so that spare parts are easily available. Plate mills are usually only available if imported and spare parts may be difficult to make locally. However,

FIGURE 27 Maize mill
(Photo: FAO/18933/G.Bizzarri)

plate mills can grind wet and dry products, whereas hammer mills are restricted to only dry products. Flours are usually packaged in similar containers to grains described above.

Oilseeds

Post-harvest sorting and cleaning of oilseeds uses similar methods to those described for cereal and legume grains. Additional care is needed when storing oilseeds to ensure that they are fully dried and stored away from sunlight at the lowest achievable temperature to prevent them becoming rancid. Cooking oil may be extracted on-farm from oilseeds such as sunflower, mustard and sesame.

The traditional methods of processing oilseeds are pounding, roasting and then either pressing or kneading to extract the oil, or separating the oil by mixing the ground material with hot water. However, these methods are time consuming, inefficient and produce a low yield of oil. There are a number of designs of manual or motorized batch oil presses, including the cage (or bridge) press (see Figure 28) and the Bielenberg press (see Figure 29). The oilseeds are coarsely ground and the 'meal' is moistened

and heated in a shallow pan over a fire. The hot meal is then pressed to extract the oil. Manual or motorised expellers operate continuously to extract oil from whole seeds (see Figure 30). Manual machines produce around 2-3 litres of oil per hour, whereas motorized presses or small expellers can produce around 50 litres per hour. Presses may be

FIGURE 28 Cage press for cooking oil extraction
(Photo by P. Fellows)

constructed in local workshops, but in most countries expellers have to be imported. The 'ghani' is a type of pestle and mortar that can be powered by animals or a motor, which is popular on the Indian subcontinent for extracting oil from mustard seed and other crops.

FIGURE 29 Bielenberg press
(Photo: FAO/PHO1635/ INPHO)

FIGURE 30 Oil expeller
(Photo: FAO/17878/A. Conti)

Oil should be packaged in lightproof, moistureproof and airtight containers to prevent it going rancid during storage. Ideally, special 10-20 litre oil cans should be used as these offer the best protection, but where these are not available coloured glass bottles that are sealed with cork or plastic stoppers are a suitable alternative. For bulk storage, oil should be stored in 200 litre oil drums that have been thoroughly cleaned and dried before re-use.

Fruit and vegetables

There are a number of products that can be made on-farm from fruits and vegetables, including dried products, chutneys, pickles, jams, sauces and juices. Whichever products are made, the crops should be cooled as soon as possible after harvesting to prevent deterioration in quality. This can be achieved by harvesting in the early morning when ambient temperatures are low and then covering the crops in wet sacking, so that evaporating water keeps them cool. Alternatively, soaking them in a water tank may be used to cool crops. After harvest fruits and vegetables are washed, sorted to remove infected, diseased or damaged items and then prepared for further processing. Peeling and

slicing are usually done by hand in the household, but at larger scales of operation, there are peelers (see Figure 31), cutters and slicing or dicing equipment that can be used.

Most vegetables require blanching before they are dried to prevent the development of off-flavours or loss of colour during storage (an exception is mucilaginous vegetables, such as okra, which is not blanched). Blanching involves placing the vegetables in a wire basket and dipping it into a pan of boiling water for a few minutes. To prevent browning during storage, fresh fruit slices are either dipped in a solution of sodium sulphite or citric acid, or exposed to burning sulphur in wooden sulphuring cabinets fitted

FIGURE 31 Small peeling machine for fruits
(Photo by P. Fellows)

with mesh trays. Crystallised fruits are made by soaking the sliced fruits in syrup for three to four days before drying. The sugar syrup removes part of the water from the fruits and also produces a sweeter, more succulent dried product.

In contrast to cereals, root crops, oilseeds and legumes, fruits should not be sun-dried. This is because their sweetness and aroma attracts insects and risks contamination. Also they are usually processed in smaller amounts than the other staple crops, which makes solar dryers (see Figure 32) suitable for on-farm processing. Solar dryers have advantages over sun drying when they are correctly designed: they give faster drying, which reduces the risk of spoilage, improves the product quality and gives a higher throughput, so reducing the drying area that is needed; and they protect the fruit against rain, insects, dust, birds and animals while it is drying. However, care is needed to prevent too rapid drying, which would result in 'case hardening' and subsequent mould growth on the fruits. Solar dryers can be constructed from locally available materials at a relatively low capital cost and there are no fuel costs.

FIGURE 32 Solar dryer
(Photo by P. Fellows)

If the local climate is not suitable for solar drying, or if a very high quality dried fruit is required, it is then necessary to use a fuel-fired dryer. There are a large number of different types of dryer and the selection depends on the amount of production required, the types and costs of fuel and level of investment that are available. It is unlikely that many individual smallholder farmers will be able to afford the higher capital and operating costs of fuel-fired dryers, or have the skilled labour needed for operation and maintenance, but they may be an option for farmers' associations. Details are given in the further reading section of this booklet.

Dried fruits and vegetables should be packed in moistureproof, airtight containers (e.g. sealed plastic bags, ceramic jars or metal tins) and stored in a cool dry place away from sunlight. Some are fragile and also need protection against breakage by packing them in boxes for transport to market.

Preservation of fruits and vegetables to produce pickles is common in some regions, using fruits such as lime, papaya and mango and a range of vegetables, including chillies, onions, cucumbers and cabbage. In all products, the prepared fruit or vegetable is mixed with salt and spices and held in a closed container such as glazed pottery. The salt extracts water from the fruit or vegetable to form a pickling brine. In some products a natural sequence of bacteria ferment sugars in the raw materials to produce lactic acid. This prevents spoilage and the product can be kept for several months. In unfermented pickles the brine acts as the preservative chemical or alternatively vinegar may be added to the vegetables and spices. These products can be kept in sealed pots for several months, during which time there may be a degree of fermentation that improves the flavour, but preservation is a result of the salt or vinegar used. The pots should be stored off the floor in a cool dark place, away from sunlight and dampness. Processors may sell pickles from these containers into customers' own pots, or package them in small plastic bags that are sealed to prevent leakage.

Other products, including juices, sauces, chutneys and jams, can be made by separating the pulp from fruits. Soft fruits, such as berries, tomatoes, grapes, etc., are processed by pressing the whole fruit using a fruit press, similar in design to the oil press. An alternative is to steam some types of cut soft fruits such as melon, tomato and papaya that 'dissolve' and

form a pulp. Citrus fruits are 'reamed' to extract the juice without the bitter pith or skin. Passionfruits and harder fruits, such as apple, pineapple, etc., are peeled and then pulped. Although it is possible to use a pestle and mortar or an animal-powered pulper that uses a heavy circular stone to crush the fruit, in most on-farm operations an electric liquidiser, or at large scales of operation a motorized pulper-finisher (see Figure 33) are required.

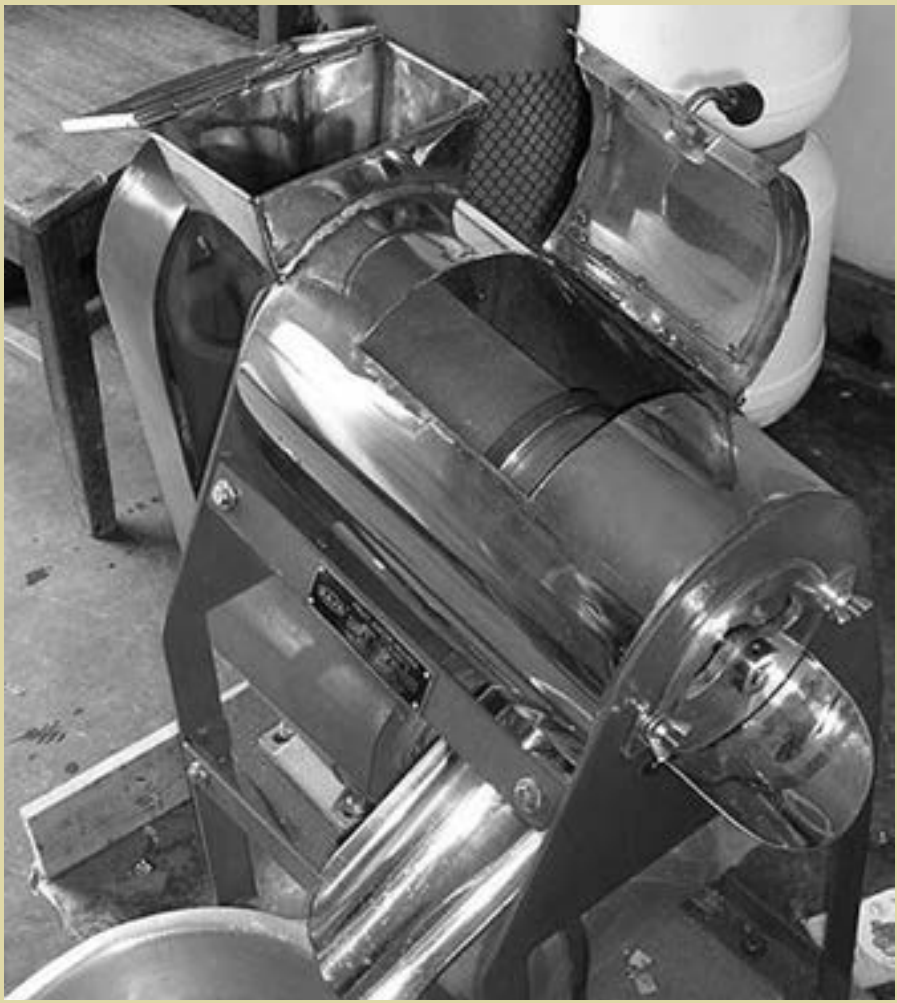


FIGURE 33 Pulper-finisher for fruit processing
(Photo by P. Fellows)

When clear juice is required, the pulp is filtered through a fine muslin cloth. Fruit juices may be sold within a day or two without further treatment, but if a longer shelf-life is required, they must be pasteurized, which increases the cost and complexity of the process. There are different methods of pasteurization, but the method that is likely to be most suitable for on-farm processing is to fill juices into re-used glass bottles that are sealed with new caps. These are then pasteurized by submerging them in a large pot or tank of water and gradually heating the water to just below boiling point. The bottles should remain in the hot water for 10-15 minutes and are then cooled.

The pulp from tomato or chillies can be concentrated by heating it gently with spices, salt and sugar to make a sauce. Chutneys and jams are made by heating fruit pulp (and

FIGURE 34 Fruit and vegetable preserves on sale
(Photo by P. Fellows)

sometimes fruit pieces) with sugar to form a thick, viscous product. Depending on the type of fruit, jams may require added pectin and citric acid (or added citrus peel that contains citric acid and pectin) in order to form a gel. Because of the acidity, a stainless steel boiling pan is needed for heating sauces, chutneys and jams. These pans are expensive but there are no alternatives and a producer should regard this as a necessary investment to be able to produce these products. For household operation, a stainless steel saucepan can be heated directly over a heat source, whereas at larger scales of production, a 'double jacketed' pan is used to give more uniform heating and avoid localised burning of the product. This is a significant investment, and farmers should therefore carefully evaluate potential sales to make sure that the process can be profitable. Sauces, jams and chutneys may be sold locally in small plastic bags that are tied or sealed to prevent leakage, but for more distant sales these products should be packed into glass or plastic jars that have screw-on lids (see Figure 34). Obtaining these containers may also be a significant constraint for on-farm processing.

Initiatives for successful market participation

Market research

One of the most important aspects of on-farm processing of any crop and at any scale of operation is to be market-led: investments should only be made when a farmer is sure that there is a market for the processed crops and selling them will be profitable. To do this requires market research. Farmers need to investigate aspects such as the types of processed crops that consumers or other buyers (medium and large-scale processors, schools, etc.) want to buy; how much do they want to buy each week or month; what price they are willing to pay; where the buyers are located; how to transport products to these locations; and how much it will cost to make the sales. Market research helps farmers to understand the likely demand for their products and helps to assist in calculating the expected profitability of on-farm processing. This information reduces the risk of taking the wrong decisions.

The type of market research that is needed depends in part on the types of buyers at village level and also on where they are located: at the simplest, a farmer who is selling processed crops to neighbours in a village or at a village market can ask customers the above mentioned questions and get a good idea of their needs and how much they are willing to buy, and at what price. The customers can also give farmers information about the quality of the processed crops that they require (e.g. no stones in cereal flours, clear groundnut oil with a good flavour, etc.). Market research becomes more complex and expensive if other buyers are selected and/or they are located further away: for example, a farmer who is intending to supply shops or wholesalers in larger towns will incur travel costs to visit these potential buyers, and they may each have detailed specifications on the quality of products that must be met before they will consider buying. This type of market research may be beyond the capacity of many individual rural farmers, but it may be possible with assistance from support agencies, or by forming farmers' associations that can fund the research or join together to do it as a group.

FIGURE 35 Collecting price data for market research
(Photo: FAO/17816/A. Conti)

Farmers also need to consider competitors. This is an area where support from advisors may be needed to carry out assessments to see if crop processing activities are viable and provide feasibility studies to confirm this. Advisors should be able to both train farmers and/or members of associations in market research techniques and also guide them to sources of market information. It is important to realise that although market research is a prerequisite for starting an on-farm processing business, it is not a guarantee of success. It can reduce risks and uncertainties, but it cannot fully eliminate them. Further information on market research can be found in the *Selected further reading* section of this booklet.

Once farmers have an estimate of the likely demand, quality and sale prices for processed crops, they should examine the levels of production and likely production costs involved in meeting the demand (i.e. what to process, when, how much, to what quality standard, how much it will cost). Again, farmers

who work through an association may have opportunities for sharing resources and costs of production to meet the expected demand.

Continuity of supply: seasonal processing

Most cereal, legume, oilseed and root crops have a single harvest season each year. On-farm processing therefore has important benefits for farmers in being able to preserve crops for an extended period to ensure continuity in supply to consumers and other buyers. This also ensures that their income is also spread over the year, rather than payment at a single harvest and the risk of indebtedness for much of the year.

However, this also means that a large amount of crop has to be processed in a relatively short time after harvest in order to ensure that it is stabilised against deterioration before it is stored. Seasonality also affects the cashflow in an on-farm enterprise if packaging materials, fuel, etc., have to be bought during a relatively short harvest period. Many fruits and vegetables also have a single harvest season, although some crops (e.g. tomatoes, plantains and onions) can often be cultivated for a much larger part of the year (see Figure 36). This puts less strain on farmers' resources and workloads because processing can take place at a smaller scale for a larger proportion of the year. Where fruits and vegetables are highly seasonal, crops can be part-processed for intermediate storage so that a succession of crops can be processed throughout the year (see Figure 37). By careful selection of the crops that are grown, farmers can spread their workload over a larger part of the year, and reduce 'peak' periods of work and ensure constant supplies to their processing operation.

Commodities and adding value

Many staple crops, especially cereals, have a relatively low value at harvest time, which is one of the reasons for rural poverty in many countries. Processing to extend the storage life of crops allows farmers to sell them out of season when prices increase, and thus increase farm incomes. Higher value is added if the crops are transformed into different products: cooking oils, gari, fruit juices, chutneys and pickles each have a considerably higher value than the raw materials from which they are made. Provided that farmers have a good market for these products that gives them high prices without incurring high costs, this enables them to successfully participate in these markets and increase overall farm incomes.

FIGURE 36 Example of a seasonality chart for fruits and vegetables

Marketing channels: local networks

The cost of selling processed crops is an important consideration for farmers, especially if profit margins are small. One of the main costs is transporting crops to more distant markets because, without their own vehicles, farmers normally have to rely on contracted hauliers or public transport. These costs may be reduced if a farmers' association is

FIGURE 37 Drums for storing part-processed fruits and vegetables
(Photo by P. Fellows)

able to contract hauliers on behalf of a number of farmers and thus share the costs more widely. However, hauliers have no requirement to safeguard the quality of the foods that they transport, and careless handling can seriously damage processed commodities and lead to a reduction in income for farmers. Local markets are often therefore a better option: farmers may be able to transport crops the shorter distances to market using

their own animal carts or bicycles (see Figure 38). This means that the time spent away from the farm is less; and they retain control over the way that foods are handled and their quality when displayed in the market. The main potential disadvantage of local markets is the likelihood of lower prices compared to those available from both urban markets and other types of buyers (e.g. institutional buyers or food processing companies). One of the purposes of market research and feasibility studies is to evaluate the differences in costs of selling and likely income, so that farmers can choose the most profitable options available in their local circumstances.

FIGURE 38 Women preparing crops for transport
(Photo: FAO/21671/K.Pratt)

CASE STUDY 3 **Marketing of edible oils in Myanmar**

Approximately 16 percent of the cultivated land area in Myanmar is sown with oil crops, which is the third most important crop group after cereals and pulses. However since the liberalization of the pulse trade in the early 1990s, the area cultivated in pulses has overtaken oilseed crops. The most extensive and traditional oilseed crop is sesame, which is 44 percent of all oil crops cultivated; followed by groundnut. As it has a much greater yield of oil per unit area, groundnut contributes the largest share (33 percent) of edible oil produced in Myanmar. Sunflower is the third oil crop cultivated and represents

CASE STUDY 3 **Marketing of edible oils in Myanmar** *(Cont.)*

12 percent of edible oil produced, while palm oil production represents 7.5 percent of the domestic edible oil consumption and this share is expected to increase to above 30 percent. Minor oilseed crops are niger and mustard seed, which contribute 4 percent each to overall edible production.

In Myanmar, the bulk of oil goes to the consumer as crude filtered oil and groundnut, sesame, niger and mustard oils are not refined. There are five well identified marketing channels in existence:

1. Farmers producing the oil themselves using traditional wooden mills, for their own consumption or village markets.
2. Farmers renting a mill for their own consumption and/or to supply village markets.
3. Small and medium sized oil millers supplying local wholesale markets and/or retailing themselves.
4. Larger oil millers supplying wholesalers in larger urban centres.
5. Large oil millers marketing branded oil to supermarkets, showrooms or door to door sales.

Source: Adapted from FAO. 2009. An analysis of the Myanmar edible oil crops sub-sector, by R. Favre & U Kyaw Myint, Rome

Packaging

A second important cost involved in selling is packaging: bulk packaging of processed crops incurs lower costs than retail-sized containers; and selling unpackaged crops into customers' own containers incurs no packaging costs for the farmer. Therefore a low-cost method of entry into the market is for farmers to store processed crops in bulk containers or storerooms on the farm and remove the required amount to take to market each week or month in boxes or sacks. They can then sell the foods and re-use the packaging. Provided that storage conditions are satisfactory to maintain the quality of foods, the relatively short time taken to transport and display them is not likely to affect their quality before they are sold. Examples of this approach include selling cooking oil by the jug-full from large oil drums or selling chutneys and pickles by the spoonful.

Alternatively, retail-sized containers offer the potential for higher added-value, but at a higher production cost: cooking oil can be sold in re-used bottles or pickles can be packed into re-used jars or sealed plastic bags.

FIGURE 39 Packaged products in a storeroom
(Photo by P. Fellows)

Producer organizations

Selling foods is a time-consuming activity and although it is possible for farmers to delegate this to a family member, this means that the person is taken away from other duties on the farm. For some farming families it may be preferable to join a farmers' marketing association, where they can sell their produce from the farm gate to the organization and the association's staff then take produce from all families to sell in different markets. This approach is not very different to that of traders and middlemen, but the important differences are that farmers have control over the activities of the association, and more importantly, they should receive a higher price for their products. However, the association has to be professionally managed to keep marketing and other operational costs to a minimum, otherwise it cannot compete effectively against traders for farmers' produce.

Supporting the livelihood activity

Institutional role

Two important roles for government policy-makers and other non-government advisers are to create policy frameworks that assist farmers to process and sell their foods, rather than hindering them, and to create the infrastructure that is needed for farmers to operate in food markets. Examples of interventions at policy level that help farmers to connect to markets include; creating a stable environment that facilitates private sector market operation such as price stabilization schemes with transparent rules of operation. Policies that improve rural infrastructure include building feeder roads to connect with main roads to population centres, creating rural trading centres, and routinely maintaining the surfaces of existing roads to reduce the time and cost of getting foods to market.

Food quality standards are another area in which governments can create a 'level playing field' to benefit both producers and consumers: the development and enforcement of food standards enables processors who aim to produce genuinely high quality foods to compete against others who may use sub-standard materials to create lower selling prices or increase their profitability. This requires public sector organizations such as a Bureau of Standards to not only devise and set the standards, but also to encourage their widespread adoption by providing information, training technicians to run short training programmes for processors, assisting processors with advice on how to improve their operations and only resorting to prosecution as a last resort for persistent offenders.

Another role for government and non-government institutions is to provide farmers with market information on different types of buyers, the quality they require and the prices they are willing to pay. Although private sector organizations may provide this type of information in some countries, it is usually too expensive for most smallholder farmers. Farmers find it difficult to access market information themselves because of a combination of lack of resources or time, and lack of confidence or skills to gather the information. If farmers had better market information, they could bargain for higher prices from buyers.

FIGURE 40 Training in upholding quality standards in drying tomatoes
(Photo:FAO/22143/ H. Wagner)

CASE STUDY 4 **Support for primary processing in smallholder agriculture in sub-Saharan Africa**

Agriculture in sub-Saharan Africa employs more than 70 percent of the workforce, and is the primary source of income for rural populations. It is important that smallholder farmers are supported to modernise their operations and grow viable business enterprises that can generate enough income to sustain the needs of their households. There is a need for concerted action to increase the potential found in agro-processing and advocate policy changes that will expand markets and attract investment.

Some of the critical areas requiring support in sub-Saharan Africa are:
a) Reduction in taxes/duties on processing equipment: the cost and availability of agro-processing equipment is a key challenge and as a result of the lack of local expertise, processors are forced to import equipment. This increases the cost as a result of transport and the high import duties imposed by governments. Reduction of import duties would facilitate access to processing equipment and encourage investors to set up processing plants.
b) Establishment of investment funds: lack of finance for investment in small-scale processing facilities is a major drawback to the development of agro-processing. The establishment of a fund targeting the development of agro-processing industries would assist many small-scale farmers and other rural entrepreneurs.

Source: Adapted from Sibale, E. 2010. Strategies for commercialising smallholder agriculture, (Available at www.howwemadeitinafrica.com/strategies-for-commercialising-smallholder-agriculture/5676/)

Governments, support agencies and farmers' organizations can have an important role in both collecting and disseminating prices and other marketing information and also providing advisors who are skilled in training farmers and smallholders' associations in marketing techniques and preparation of feasibility studies. The management of contracts by farmers' organizations under different types of contract farming arrangements with buyers can also help small-scale farmers to access more lucrative markets and reduce the constraints they face in diversifying into high added-value foods and connecting to these markets.

Sustainable support services

One of the reasons why on-farm processing may be underdeveloped is the high cost of providing support services to large numbers of widely-dispersed farmers in rural areas that are difficult to access. Although, government and non-government extension staff may visit particular areas to establish new support schemes, continued visits over a number of years may be prohibitively expensive. It is therefore necessary to design interventions and support programmes with cost in mind as an important factor for sustainability. Two ways in which this can be done are first to organise farmers into associations that can act as a single point of contact for external assistance for farmers in an area. This type of assistance may be to introduce new ideas and information, for example:

- To gain a better understanding of the processed crop industry and how it operates in the country and the particular geographical area of interest.
- The main processing competitors and their distribution, prices, sales volumes and methods.
- Short- and long-term market opportunities and potential challenges.
- Demand trends for different processed crops, which new products might be introduced and their potential profitability.
- Information on equipment suppliers and repair service providers.
- Determining available credit and how farmers can finance the inputs needed for processing and marketing.

There is also a role for support agencies to assist with advice on the formation and management of associations for production and sharing of raw materials, processing, transport, marketing and selling.

Secondly, a group of local farmers or employees at an association can be trained from the outset of a support intervention to provide additional training and support for farmers in an area (the 'training of trainers' approach). Trainers may need to receive occasional refresher training and updating, which can be either done on their farms or in village buildings or they can be asked to travel to the support organization's centre. The types of training and support that can be offered by local trainers include:

- Advice and training on improved post-harvest methods to prevent loss of crop quality and quantity and the cost of improved methods.
- Improved quality control and standardization of products.
- Processing to produce new, higher added-value products.
- Development of existing facilities for storage and processing.
- Skills improvement in marketing methods, marketing research, finding opportunities for new

FIGURE 41 Farmers being trained by extension officers
(Photo: FAO/23287/A. Proto)

markets and new methods of selling.
- Costing production, setting prices and calculating profitability.
- Promoting the use of record keeping.

Where necessary, farmers' associations may need to develop a fund to pay for support and training by placing a small levy on processed foods that they sell on behalf of farmers. This will ensure that support services can be accessed continually when they are required, in a sustainable way that does not depend on government or donor assistance.

Training should be focussed on the actual needs of farmers to improve their processing activities (rather than the needs perceived by support organizations). In particular, this means using demonstrations of processing techniques and more generally adopting a 'learning by seeing' and 'learning by doing' approach, rather than talks and lectures. This requires particular sets of training skills by trainers, and provision of these skills by support agencies can have important long-term benefits to both successful outcomes and the sustainability of the support that is provided. Training of trainers systems use experienced processing staff as trainers and they in turn train a group of educated local extension staff or farmers who have the required abilities to undertake advice and group training for farmers' groups. Further information on training is given in the *Selected further reading* section of this booklet.

Knowledge and skills

Where the main aim of primary processing is to improve health and nutritional status, smallholders may need nutrition education to advise them on how to achieve balanced diets, as well as advice on hygiene and maintaining health. This may be achieved by establishing farmers' or women's groups to enable training and support to be given in a cost-effective way to whole communities. Primary crop processing also requires a wide range of skills: some, such as harvesting at the correct stage of maturity, appear to be simple but often require lengthy experience and/or training. There may also be a need for advice on different types of crops that have higher nutritional value and/or varieties of crops that are able to be stored for longer periods without deterioration. Advice and skills training on improved methods of harvesting, post-harvest processing and crop storage can have significant effects in reducing crop losses and improving people's diets, health and food security.

When the aim of primary processing is to increase farmers' incomes from sales of crops, a different range of skills and knowledge is required: one of the most important areas is to ensure that farmers are able to sell their crops for an adequate price without excessive costs incurred in selling. This requires confidence and communication skills to be able to negotiate with buyers, and awareness of the market requirements and buyer preferences for quality and price. Each of these areas can be improved by training, confidence building exercises and provision of market information. Farmers need to be able to supply their crops at the required quality and in the amounts needed by buyers at a price that is acceptable. This requires skills in processing, storage and quality control, as well as business and financial skills to ensure that the enterprise is profitable. A summary of the types of skills and knowledge that need to be considered when introducing programmes to support commercial village crop processing is given in Table 7.

When promoting primary food processing, each programme should have a clearly defined set of objectives. Different approaches are needed when promoting processing to increase food security or nutritional status, compared to those that are used to establish or support small on-farm processing enterprises for income generation. Different types of knowledge and skills are required by government and support agency workers when introducing or promoting improved primary processing, depending on the main objectives of the assistance. The different objectives of a programme should therefore be clearly identified at the outset and appropriate methodologies developed to address each one. A summary of issues that should be addressed to meet differing objectives is shown in Table 7.

Financial services

There is often a need for smallholder farmers to access credit to purchase inputs, such as ingredients, packaging, etc. Where conventional banking systems are not appropriate, alternative sources of finance should be explored including non-governmental organizations that operate micro-finance initiatives, which have more favourable interest rates and payback periods. Farmers should also be encouraged to save money and use this to finance processing initiatives, and more generally, to promote savings as a feasible part of good business practices that are sustainable in the long term.

TABLE 7 **Some considerations in addressing different programme objectives to improve primary food processing**

Considerations for programmes to improve food security and nutrition	Considerations for programmes to develop on-farm crop processing enterprises
• Nutrition education • Health and hygiene training • Development of farmers' groups, producer cooperatives or other types of farmers' associations	• Market awareness and buyer preferences • Improved communication skills and confidence building to develop trusting relationships with buyers • Strategies to improve marketing of crops • Improved transport and road infrastructure • Quality assurance, hygiene and sanitation during processing and storage • Training in management and business planning • Methods of financial control • Finance and credit suppliers. Credit support systems • Taxation and business regulations • Suppliers of equipment and packaging materials
• Seed banks and other types of agricultural support • Skills training in primary processing and post-harvest storage • Improvements to crop processing techniques and equipment	

Technical support and information dissemination - food safety and quality

Most governments have a series of regulations that are designed to ensure the safety and quality of processed foods, which smallholder farmers need to comply with to avoid the risk of closure or prosecution. Buyers will reject any processed commodities that contain foreign materials, such as dirt, animal faeces, insects, human hair, or pieces of wood, metal, etc. Also, the presence of food poisoning bacteria like Salmonella, viruses, Hepatitis A, heavy metals such as mercury and lead, or pesticide residues can each be a serious threat

to health. There are many ways that foods can become contaminated: during harvest, handling by people with poor personal hygiene, equipment that is not properly cleaned and dirty processing rooms. Prevention requires Good Hygiene Practices (GHP), which includes proper cleaning of buildings and equipment, regular health checks and hand washing by production operators, wearing suitable work clothing and keeping foods under hygienic conditions that prevent contamination by foreign materials or the development of micro-organisms.

One of the methods that can be used to ensure that safe, wholesome foods are produced is known as 'Good Manufacturing Practice' (GMP). This is a collection of management principles that apply to each step in a production process, from harvesting crops to sales of processed foods to consumers. The details differ for each processing system, but the principles are to first understand the process and possible ways in which food safety or quality might be compromised; then planning to ensure that the correct processing conditions are used; measuring and monitoring conditions in the process to make sure it is on track; and keeping records of the process conditions. Then if there is a problem with the processed food, the producer can prove that everything has been done correctly during its production. GMP requires smallholder farmers to be trained in its principles and methods, and is an area where technical support is often most required. GMP also reduces post-harvest crop losses and increases the amount of food available for sale, so increasing farmers' incomes. There are also similar management principles to ensure sustainable production systems and environmental protection, and workers' health and safety.

Drying is one of the most important methods of post-harvest processing by smallholders and the risks to food safety and quality arise from poor harvesting and handling methods, and poor drying and storage conditions. The main risk is from growth of moulds or bacteria on crops that are inadequately dried or stored in damp conditions. Damage caused to crops, especially fruits, vegetables and root crops, by poor harvesting and handling can accelerate this mould or bacterial growth. Bacteria can cause rotting of root crops, which makes them unsaleable, and mould growth on root crops, cereals, legumes and dried fruits and vegetables is not only unsightly, but can also lead to the production of aflatoxins (invisible poisons that can cause liver damage

and cancer). Other changes that are caused by bacteria and moulds, or by improper processing, can affect the quality of all processed foods without causing a safety hazard. Loss of quality reduces consumer acceptability and puts serious constraints on the marketability of processed crops. Legal or buyers' quality standards and the preferences of consumers vary in different countries and processors need to be fully aware of these in order to sell processed foods at a high price. Training and provision of information on correct post-harvest methods is therefore essential for the production of safe, high quality processed crops.

`An important component of GMP is sorting crops into uniform categories according to physical and quality characteristics that are important to buyers: for example a uniform size and shape may be important for some crops, whereas for others it may be the colour or overall appearance that buyers look for. The different categories of crop quality can then be sold to different buyers, thus maximising the income to the processor and reducing wastage to a minimum. When smallholder processors are known to employ these types of quality standards, it creates confidence among buyers: for example, wholesalers, other processors and retailers are more likely to buy from trusted farmers without the need for rigorous inspection of every batch.

- ***Technical support and information dissemination - processing, packaging and storage equipment***

When farmers know the types and quantities of crops that are available for processing, as well as the quality required by buyers, they then need to decide which tools and machines are needed to process the foods at the planned capacity, which equipment is available locally and at what price. Other important considerations are what maintenance is required for machines, what spare parts are required and where to source them and what skills are needed for the processing operation. Each of these aspects can be a problem for smallholders and the provision of information by support agencies on the availability and costs of equipment is a valuable type of support, as well as training in the correct methods of processing.

Depending on the product and the required length of storage, processed foods can be stored in earthen pots, baskets, jute or plastic sacks, cribs, clamps, silos, ventilated rooms or huts, or underground pits. Electrically

powered cold stores for fruits and vegetables are also an option, but these are likely to be too expensive for smallholder operations, even where electricity is available and has a regular supply. In many instances, locally developed storage methods can be very effective and may only need slight modifications to improve them. For some types of processed commodities, it is necessary to have controlled storage conditions, or as a minimum, stores that prevent losses or damage caused by rodents, insects and birds. This type of storage structure that is large enough to hold a year's harvest of crops can be very expensive. Support agencies can assist with the design of the store and information on low-cost methods and materials for construction. Agencies may also facilitate setting up production and storage facilities that can be used by a number of smallholders to share costs, allow higher quantities of products to be processed, and hence increase the throughput of the operation and enable larger buyers to be targeted, possibly enabling a better bargaining position.

Similarly, packaging may be required for easier handling, transport and storage of processed commodities, or to protect them against loss of quality during storage. Transporting foods can also be a source of contamination and/or loss of quality. Technical staff at support agencies may be able to offer advice on containers that protect foods during transportation, assist in developing hygiene and sanitation rules for hauliers, or assist farmers' associations to contract or own their own vehicles and hence retain control over the transportation conditions. Further information on transport is given in FAO Diversification booklet No. 10 *Rural transport and traction enterprises for improved livelihoods*.

Packaging may also assist marketing for some types of processed commodities in some types of markets. A wide range of materials can be used for packaging, from locally made baskets and clay pots, to reusable plastic crates, drums and barrels. Each type of packaging has its advantages and disadvantages, and the availability and cost varies in each country or area within a country. Smallholder farmers often do not know which types of packaging may be suitable, where they can be obtained and their costs, and again provision of this information by support agencies is very valuable. Further information on processing and packaging is given in FAO Diversification booklet No. 5 *Processing for prosperity*.

CASE STUDY 5 **Using radio to disseminate information: Radio Benue, Nigeria**

A study was conducted to determine the relevance of radio programmes for fulfilling information needs of farmers and to ascertain the agricultural knowledge gained by such farmers. Radio Benue was established in 1978 by the government of Benue State in Nigeria and empowered to disseminate information aimed at informing, educating and entertaining the people of the State. Agricultural programmes 'Profitable Agriculture' sponsored by the Cooperative Extension Centre of the University of Agriculture, Makurdi and 'Farming World' sponsored by Benue Agricultural and Rural Development Authority were designed as an attempt to increase and improve agricultural information dissemination to farmers. They were presented in English and in two indigenous languages, Tiv and Idoma.

The results of the study showed that the majority of the respondents (66 percent) listened to agricultural programmes on Radio Benue. The remaining respondents (34 percent) did not listen to the programmes because of inaccessibility to radio sets, non-awareness of the programmes or unsuitable time of presentation. Generally, the listeners found the messages relevant to their information needs. The major determining factor for listening frequency among the respondents was time of presentation of the programmes. The respondents complained that the programmes were aired mostly in the mornings and afternoons when they were on their farms and too busy to listen to radio. They also complained that the programmes were aired more often in English than in the local languages that they understood better. Similarly, there are some ethnic groups in the state that do not understand any of the three languages of the programme presentation. They include Igede, Etulo and Hausa.

Radio Benue agricultural programmes made a good impact on the listeners in terms of knowledge gained in several areas of improved agricultural practices. Most of the respondents (81.8 percent) gained some new knowledge on timely crop planting. The majority of the listeners also gained some knowledge on correct application of fertilizer (68.2 percent), appropriate type of fertilizers to apply (78.8 percent), proper management of growing crops (66.7 percent) and disease, insect and pest control (56.1 percent). Relatively fewer listeners gained knowledge through the programmes about improved crop/livestock varieties (42.4 percent) and proper methods of processing farm produce (39.4 percent). Only very few respondents (18.2 percent) indicated some knowledge-gain about access to agricultural credit.

Source: Adapted from Okwu, O.J., Kuku, A.A. & Aba, J.I. 2007. An assessment of use in agricultural information dissemination: a case study of radio Benue in Nigeria, African Journal of Agricultural research, Vol 2(1),pp. 14-18

Business skills training and advice

Many smallholder processors do not have experience of calculating their costs of production, working out the prices that they need to charge for their processed commodities, or

FIGURE 42 Using weekly radio broadcasts of prices to assist farmers
(Photo: FAO/17819/A. Conti)

the profitability of their operations. Even fewer will have the expertise to decide a marketing strategy or the confidence to negotiate terms of sales with buyers, or to deal with the actions of competing processors so that their processing business can grow and develop. Each of these is an area that advisors from support agencies can help to address.

There are a number of different costs of crop processing and marketing, which include inputs such as ingredients, packaging, fuel or power, hiring transport, product losses, labour costs for employees

or family members, costs of buying equipment and repayments of loans, depreciation, renting storage space, fees and government taxes. Calculating these costs is a fundamental requirement for any crop processing that operates in a commercial way. Knowing the costs helps the farmer to understand how the business operates, where savings can be made, and to make decisions on future production and marketing to make the operation more efficient or profitable. Training in cost calculations and more generally record keeping is an area where advisors can have a large impact. Farmers need to keep written records of all their costs and sales income to help them understand the amounts of money flowing into and out of the processing business each week or month. Records help farmers to assess how the processing business is performing, where losses are occurring, which products sell the most and which are most profitable.

When pricing their products, farmers may initially have to use the existing market price for their processed crops, but as their reputation for quality and reliability increases, they may be able to influence the market price. This is particularly the case for high-value products that are produced for 'niche' markets where consumers demand high quality and are willing to pay premium prices. The profitability of smallholder processing depends mainly on the price that they received for the processed crops, and hence on the types of markets that foods are sold into and the quality of the foods. There are also advantages in having larger scales of production, with farmers joining together to process crops under a single brand name and/or share processing equipment, transport etc., which give economies that can reduce production costs. However, it is important that any increases in production are only considered when farmers are confident that the additional processed crops can be sold. It is important that farmers are able to calculate income and production costs, and hence their profits, whether they are working alone or as part of a larger group.

Training and support may be required to enable farmers to make these calculations accurately. If they are done incorrectly, farmers may over-estimate how much processed crops they can sell, or buy equipment using a loan based on guesswork. If this is under-utilized because of low market demand, the loan interest and repayments may erode any profit that is made. For these and many

other reasons, it is strongly advised that a feasibility study be conducted before any investments are made. A feasibility study should address the most important aspects of the enterprise, including:

- Market feasibility (types of processed foods in demand, types of customers, quality required customers, selling prices, amounts sold, competition).
- Technical feasibility (preparation and processing methods, hygiene and safety requirements, equipment, ingredients and labour required).
- Financial feasibility (investment costs, operating costs, cash flow, profitability, any loans required).

The provision of marketing information and help with calculating marketing costs can also help smallholders decide where to sell the processed foods - either locally or further afield - and which types of buyers to aim for. Smallholders may also need advice and assistance to decide how to sell their products, whether to sell directly to consumers or to other buyers, such as traders, institutions, other processors, retailers, etc. Farmers therefore have many options; each with its advantages and disadvantages, and advisers can create an enabling environment to assist farmers to market their processed crops. This is based on marketing opportunities rather than the commercial power of buyers in the supply chain. Similarly, decisions on when to sell their processed crops should be made to benefit farmers: for example, they should usually sell when prices are highest out of season, not when buyers want them to sell. This requires bargaining power and market information, which individual smallholders may not have. Advisers can either supply this information or assist in establishing smallholder associations to increase bargaining power and access to market information. However, unless farmers sell their processed crops themselves, either from the farm gate or in local marketplaces, it is important that their prices allow all members of the supply chain, including wholesalers, retailers, etc., to have opportunities to make a profit. These participants in marketing channels are important because they may pay for transport and sometimes packaging to collect farmers' processed crops from the farm, and they organise distribution and find different markets in which to sell the crops. Income from sales in more distant markets is introduced to rural areas, rather than having the same amount of money from local

sales being recirculated within an area. This additional income from outside an area can be used for development of communities (in addition to benefits of improved food security and nutrition from having an improved supply of processed foods available).

Role of the adviser

Advisory and field staff who work for government departments (e.g. agriculture, rural development, etc.) or national and international development organizations/NGOs, as well as other 'third sector' organizations such as manufacturers associations, each have a role to support smallholder farmers to develop processing activities. It is important that they assess the needs of farmers and design programmes that meet these needs before providing support services. Farmers may wish to receive advice on market research, training in processing and quality management, improved business management, or provision of technical information and technical support. A summary of aspects that advisors can address to promote and support smallholder processing to improve livelihoods includes:

- Background information on how the processed food sector functions in a country or a particular area, including the main players, the likely demand and existing supply of processed foods, and the potential of the sector for new smallholder processors.
- Advice and support for farmers to conduct feasibility studies, to cost the business operation and estimate incomes and profitability before they make any investments.
- Advice on how smallholders can access processed food markets.
- Helping farmers to obtain estimates of the costs involved in constructing or modifying buildings for processing operations and provide information on suppliers of equipment, packaging materials and ingredients.
- Providing farmers with information on regulations concerning food hygiene, food safety and composition, labelling, etc.
- Providing support and training in food handling, processing, packaging, quality assurance, storage and distribution of processed crops.
- Promoting associations or farmers' groups for farmers who wish to undertake crop

processing. This requires managerial support for extension workers, and adequate funding to allow field staff to regularly visit associations, support meetings, provide information on rules and legal status for the association, and train members to properly manage the organization. When operated correctly, associations can have many benefits, such as representing farmers in meetings with public authorities; and acting as a vehicle for support institutions to communicate efficiently with large numbers of farmers or to deliver training.

Advisors can support smallholder farmers in many of these ways, but ultimately it must be the farmers who decide whether or not to start processing activities and how to run their businesses, based on their evaluations of the suitability of the livelihood activity.

Challenges

Starting with the crop supply and harvest, and moving through processing and storage to selling the processed crops, the following are some of the more important challenges that are within the control of farmers:

- **Raw material supply:** using varieties of crops that are less suitable for processing; lack of facilities for storage or part-processing crops to stabilise them before processing; growing inadequate volumes of crops to meet demand for processed foods; harvesting crops when they are immature or over-ripe; causing damage to crops as a result of poor handling; not sorting crops into different quality grades.
- **Processing:** lack of technical knowledge and skills to operate processing correctly; not being able to meet quality standards required by consumers; lack of access to capital or credit and high interest charges for loans resulting in inability to afford post-harvest technologies/ equipment to store and process crops.
- **Management:** lack of skills or knowledge about how commercial enterprises operate; limited knowledge of business opportunities and realities; under-developed planning, business and financial management skills.
- **Marketing:** poor marketing knowledge; little recognition of opportunities for product diversification; poor negotiating and selling skills; lack of trusting relationships and formalized agreements with buyers.

External constraints that challenge development of smallholder crop processing include:

- **Economic conditions:** business development may be hindered by high taxes, poor tax administration, high levels of corruption; excessive rules and regulations that are inconsistent and/or not transparent; monetary policies that result in high inflation/high interest rates, high cost of finance and/or limited access to credit that make

loans unaffordable; reduced government expenditure on agro-industrial support; lack of coherent agricultural and business/industrial development strategies or problems with implementation.

- **Markets:** limited purchasing power by consumers resulting in low demand for processed foods; excessive competition from larger scale processors or imported processed foods; little or no publicly available information on markets, prices, trends, or key market players; high cost/limited access to commercial market research services.
- **Suppliers:** absence of, inadequate, or unaffordable local supplies of ingredients, packaging materials and equipment; inadequate equipment production by local workshops and inadequate knowledge by workshops of hygienic and safe equipment design.
- **Support:** under-funded education sectors or extension services leading to lack of skilled advisors; support institutions having insufficient understanding of farmers' needs and lacking resources and commercial awareness to implement practical support; government policies that do not coordinate agricultural and industrial development policies, or conflict with each other; poor coordination or cooperation between government institutions and NGOs or the private sector; breakdown of governmental extension services/absence of direct farm business support services; extension agents that lack marketing/business skills or organizational skills required to help farmers' organizations.
- **Infrastructure:** inadequate roads, absence of/erratic supply and high cost of water and electricity supplies, and poor telecommunications.

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- Technical Centre for Agricultural and Rural Cooperation ACP-EU (CTA), Postbus 380, 6700 AJ Wageningen, The Netherlands, Tel: 00 31 317 467100, Fax: 31 317 460067, E-mail: cta@cta.nl, Web: www.agricta.org.
- United Nations Industrial Development Organisation (UNIDO), Vienna International Centre, P.O. Box 300, A-1400 Vienna, Austria, Tel: 43 1 26026, Fax: 43 1 2692669, E-mail: unido@unido.org, Web: www.unido.org.

Fair Trading Organizations in Europe

- Claro fair trade plc., P.O. Box 129, Byfangstr. 19, CH-2552 Orpund, Switzerland, Tel: +41 32 356 07 00, Fax: +41 32 356 07 01, e-mail: mail@claro.ch, Web: www.claro.ch

- Ctm Altromercato, Via Francia 1/ C 37135 Verona, Italy, Tel: 39 045 800 8081, Fax: 39 045 8008020. e-mail: info@altromercato.it, Web: www.altromercato.it
- European Fair Trade Association (efta) Head Office, Kerkewegje 1, NL-6305 BC Schin op Geul, Tel (+31) 43 3256917, Fax (+31) 43 3258433, email efta@antenna.nl, Web: eftafairtrade.org.
- EZA Dritte Welt, 8, Plainbachstr., 5101 Bergheim, Austria, Tel: +43 662 452 178, Fax: +43 662 452 586, E-Mail: office@eza3welt.at, Web: http://www.eza3welt.at
- Fair Trade Organisatie, P.O.Box 115, (Beesdseweg 5) 4100 AC Culemborg, The Netherlands, Tel: +31 345 54 51 51, Fax: +31 345 52 14 23, E-Mail: post@fairtrade.nl, Web: www.fairtrade.nlinfo@fairtrade.nl.
- GEPA, P.O. Box 260147, 42273 Wuppertal, Gewerbepark Wagner, Bruch 4, 42279 Wuppertal, Germany, Tel: +49 202 26 68 30, Fax: +49 202 266 83 10, E-Mail: gf@gepa.org, Web: www.gepa.de
- Ideas, Avda. Amargancena, Pacela 9 – Nave 7, Polígono Amargacena, 14013 Córdoba, Spain, Tel: +34 957 429080, e-mail: info@ideas.coop, web: www.ideas.coop
- Intermon Oxfam, Departamento de artesanía y comercio, Calle Louis Pasteur, 6 (Parque Tecnológico), 46980 Paterna, Valencia, Spain, Tel: +34 961 366 275, Fax: +34 961 318177, e-mail: rsanchis@IntermonOxfam.org, Web: www.IntermonOxfam.org
- Magasins du Monde-Oxfam, 7a, Rue Michiels, 1180 Bruxelles, Belgium, Tel: +32 2 332 0110, Fax: +32 2 332 1888. E-Mail: mdm.oxfam@mdmoxfam.be, Web: www.madeindignity.be
- Oxfam Market Access Team, 274, Banbury Road, Oxford OX2 7DZ, UK, Tel: +44 1865 315 900, Fax: +44 1865 313243, E-Mail: oxfam@oxfam.org.uk.Tradecraft Plc, Kingsway, Gateshead NE11 0NE, UK, Tel: +44 191 491 0591, Fax: +44 191 482 2690, E-mail: comms@traidcraft.co.uk.
- Oxfam Wereldwinkels VZW, **Oxfam World Shops vzw,** Ververijstraat 17, B-9000 Gent, Belgium, Tel: +32 9 218 88 99, Fax: +32 9 218 88 77, E-Mail: oxfam.wereldwinkels @ oww.be, Web:www.oxfamwereldwinkels.be
- Traidcraft. Plc, Kingsway, Gateshead, Tyne & Ware, NE11 ONE, UK, Tel: +44 191 491 0591, Fax: +44 191 4976 562, e-mail: comms@traidcraft.co.uk, Web: www.traidcraft.co.uk

Website sources of information

- Practical Action has Technical Briefs on different aspects of agro-processing http://practicalaction.org/?id=agroprocessing, followed by a search for the topic

The FAO has a number of links to information websites.

- Free information, including equipment suppliers at www.fao.org/inpho/equipment, and publications at www.fao.org/CATALOG/GIPHOME.HTM or www.fao.org/docrep.
- Agricultural Research Information System (AGRIS) www.fao.org/agris.
- Agricultural Network Information Center. Includes AGRICOLA (AGRICultural On-Line Access) www.agnic.org.
- FAO Catalogue on-line. Some with links to full text. www.4.fao.org/faobib.
- CAB International Abstracts CDs; www.cabi.org.
- International Network for the Availability of Scientific Publications. www.inasp.org.uk.
- FAO World Agricultural Information Centre (WAICENT). www.fao.org/waicent.

The following provides direct links to pages within the WAICENT site:

- FAOSTAT, statistical data on agro-related topics. www.apps.fao.org. Information Network on Postharvest Operations (INPHO). www.fao.org/inpho. SCIRUS scientific information. www.scirus.com.
- Network of European Tropically and Subtropically Oriented Agricultural Universities (NATURA) www.wau.nl/natura/. Association of African Universities www.aau.org.
- ***Publishers of books on small-scale food processing***
- Food and Agriculture Organisation (FAO). Publications, Viale delle Terme di Caracalla, 00100 Rome, Italy, Tel: 39(06)5705.1, Fax: 39(06)5705.4593, E-mail: fao@fao.org., Web: www.fao.org. A CD-ROM of current titles is available by post.

- IDRC Books, International Development Research Centre (IDRC). PO Box 8500, Ottawa, Ontario, Canada K1G 3H9, Tel: 1 613 236-6163, Fax: 1 613 563-2476, Email: pub@idrc.ca, Web: www.idrc.ca/books.
- Practical Action Publishing, Bourton on Dunsmore, Rugby CV23 9QZ, UK, Tel: +44 (0) 1926 634501, Fax**:** +44 (0) 1926 634502, **e-mail:** publishinginfo@practicalaction.org.uk, Web: http://developmentbookshop.com/
- Royal Tropical Institute (KIT) Publishers, P.O. Box 95001, Mauritskade 63, 1092 AD Amsterdam, The Netherlands, Tel: 31 20 5688 272, Fax 31 20 5688 286, Email publishers@kit.nl, Web: www.kit.nl.
- Technical Centre for Agricultural and Rural Co-operation ACP-EU (CTA), Postbus 380, 6700 AJ Wageningen, the Netherlands, Tel: 00 31 317 467100, Fax: 31 317 460067, E-mail: cta@cta.nl, Web: www.agricta.org.
- International Labour Office Publications, Tel: 41 22 799 7866, Fax: 41.22.799.6117, E-mail: publns@ilo.org., Library and Information Services, Tel: 41 22799 8675, Fax: 41.22.799.6516, E-mail: bibl@ilo.org, InFocus Programme on Boosting Employment through Small Enterprise Development (IFP/SEED), Tel: 41 22 799 6862, Fax: 41.22.799.7978, E-mail: ifp-sed@ilo.org, Web: www.ilo.org/global/What_we_do/Publications/ILOBookstore/lang--en/index.htm

Notes

Primary crop processing can create diversified incomes and employment for farmers in rural villages. Processing brings many different benefits to communities: it allows foods to be preserved and stored as a reserve against times of shortage; it helps to avoid the effects of lowered prices when seasonal gluts occur at harvest time; and it enables farmers to add value to crops that diversify and increase sources of income.

The booklet is intended to create awareness among advisers, government officials, community leaders and development agency staff; on the opportunities and benefits that primary processing can bring to small-scale farmers. The booklet addresses the actions that can be taken by policy-makers and programme managers in government and non-governmental organizations to create enabling environments for smallholder farmers to diversify into primary processing.

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