Processed foods for improved livelihoods

FAO Diversification booklet 5

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Peter Fellows

Agricultural Support Systems Division
Food and Agriculture Organization of the United Nations
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Dr Peter Fellows
Midway Technology Ltd

Preface

FAO Diversification booklets aim to raise awareness and provide information about opportunities at the farm and local community level to increase small-scale farmer income. Each booklet will focus on a specific farm or non-farm enterprise or technology that experience has shown can be integrated successfully into small farms or at a local community level. We explore the potential benefits associated with new activities and technologies, as well as appropriateness and viability in differing circumstances.

The main target audience for FAO Diversification 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. We hope to provide enough information to help these support service providers consider new income-generating opportunities, and how they might enable small-scale farmers to take action. What are farmer requirements and constraints? What are critical "success factors"?

FAO Diversification booklets are also targeted to policy level people 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?

It is important to point out that the Diversification booklets are not intended to be technical "how to do it" guidelines. In order to provide farmer advisory and support activities relating to introduction of new income-generating activities, most organizations will find it necessary to seek more information or technical support. For these organizations, each booklet identifies complementary sources of information and technical support.

If you find this booklet of value we would like to hear from you. Tell your

colleagues and friends about it. If you have any suggestions where we can make changes for the better in our next edition, or topics for other booklets – this is equally important. By sharing your views and ideas with us we can eventually provide better services to you.

Director, Agricultural Support Systems Division
Food and Agriculture Organization of the United Nations
Rome, Italy

Introduction

Food has been processed since communities first came together thousands of years ago. Most foods need some form of preparation and processing to make them more attractive to eat. Grains, vegetables, meats and fish are each unpalatable in their raw state, and some foods, such as cassava, are dangerous if eaten without processing. Even nuts, milk and fruits that are eaten raw can benefit from processing into a wide variety of other products.

Different types of processing have been developed over generations into the range of methods that we have today. In every region, country and even in individual villages, there are distinctive traditional processed foods that are well suited to the local climatic and socio-economic conditions (for example, the 2 000 different cheeses throughout the world, each with its own distinctive flavour and texture). In villages throughout the world, families inherit or develop specialist skills and become for example the village baker, brewer or fish smoker. Traditional products have a high local demand and are often sought by people in other areas, so establishing trade and the development of local food businesses. In Sri Lanka, for example, some communities are known throughout the island for the quality of their buffalo curd (yoghurt), which is bought by traders and distributed over wide areas. Food preparation and processing therefore benefit communities by:

- increasing the variety of foods in the diet;
- creating special foods for cultural or religious occasions, thus reinforcing cultural identities;
- creating opportunities for sales and income generation.

However, processing does more than change the eating quality of raw foods. All foods are biological materials that begin to decay as soon as they are harvested or slaughtered. Processing slows down or stops this deterioration and thus allows foods to be preserved for extended periods. This benefits village communities in a number of ways.

- It enables food to be stored as a reserve against times of shortage to increase food security (to ensure that sufficient food is available and that essential nutrients are eaten throughout the year).
- It enables crops to be sold out of season when prices are higher.

Processing offers opportunities for villagers to diversify their sources of income. When farmers in an area grow similar crops, processing helps to avoid the effects of lowered prices and incomes when seasonal gluts occur at harvest time. Processing also enables farmers who grow low-value staple crops to add value and increase household incomes. For example, in many African countries processing sorghum into beer or processing cassava into gari or snack foods can form very successful small-scale businesses. In many Asian countries, value is similarly added to fruits and vegetables by processing them into a wide range of pickles, chutneys and other relishes. These small-scale operations are a major source of employment in rural villages, estimated at up to 60 percent of employment in some countries.

Many governments and international development agencies promote food processing as a means of alleviating poverty in rural areas. There are many advantages in choosing food processing over other income-generating activities.

- Food processing is accessible - everyone is familiar with the food that they grow and eat and, compared with some other types of business, there are fewer aspects to learn when getting started. Small-scale food processing is also particularly suitable for women, who may be the specific intended beneficiaries of development programmes.
- If chosen correctly, processed foods can have a good demand and offer the opportunity to generate good profits by adding value to raw materials.
- Crops or animals that are the raw materials for processing are usually readily available (and sometimes in surplus).
- Of the many different types of processing technologies, most are suitable for small-scale operation with an affordable level of investment by rural people.
- Domestic utensils can be used in many processes when starting up. When production expands, many types of processing equipment can be manufactured locally by metal workshops or carpenters, thus creating further employment.
- Most types of processing have few negative environmental effects.

There are two broad categories of food preparation and processing:

1. **Primary processing**, in which foods are stabilized after harvest and sometimes converted into a more convenient form for storage. Examples include drying crops, milling cereals and extracting cooking oils from oilseeds or nuts. These types of processing are

described in more detail in the accompanying booklet in this series *High hopes for post-harvest*.

2. **Secondary processing,** in which fresh foods or the products of primary processing are made into a wide range of processed foods. These are the subject of this booklet.

In the following sections, the booklet describes some of the opportunities and constraints that face communities in developing countries who wish to introduce or improve food processing. It is intended to assist:

- advisers, government officials or development agency staff who wish to promote food processing;
- development workers who wish to set up or improve a food processing unit;
- community leaders and entrepreneurs who are involved in food processing.

Food preparation and processing are important to rural communities to ensure their food security, to increase variety in people's diets, and as a means of generating diversified income and employment. When successful, processing at village level can create an enhanced quality of life for villagers because of greater prosperity and improved health and nutrition.

Basic facts about food preparation and processing

People process foods every day when preparing meals to feed their families. However, the term "food processing" is broader than preparing and cooking foods. It involves applying scientific and technological principles to preserve foods by slowing down or stopping the natural processes of decay. It also allows changes to the eating quality of foods to be made in a predictable and controlled way. Food processing uses the creative potential of the processor to change basic raw materials into a range of tasty attractive products that provide interesting variety in the diets of consumers.

Food preparation and processing can be defined as "any change that is made to a food to alter its eating quality or shelf life".

All food manufacturers should make safe foods so that consumers are not at risk. This is not only microbiological risks, but also glass splinters, pesticides or other harmful materials that can get into the food and lower its quality. Consumers consider *eating quality* as the main factor when buying foods, and a food should fit in with traditional eating habits and cultural expectations of texture, flavour, taste colour and appearance. For some foods, *nutritional quality* (e.g. protein content, vitamins and minerals, etc.) is an important consideration. Product quality is affected by the raw materials, the processing conditions and the storage and handling that a food is subjected to after processing. Food processors should understand the composition of their foods because it enables them to predict the changes that take place during processing, the expected shelf life of the product and the types of micro-organisms that can grow in it. This information is used to prevent food spoilage or food poisoning. Details of the composition of raw materials or products can be obtained from university food science departments, bureaux of standards or food research institutes.

Types of processing

Without processing, as much as 50 to 60 percent of fresh food can be lost between harvest and consumption. This may be due to inadequate storage facilities, which allow micro-organisms or pests to spoil the stored food. Improved storage can greatly reduce

these losses (Clark, 2002). Processing methods that are suitable for village scale processing can be grouped into six categories (Table 1). A number of other preparation methods (such as mixing, coating with batter, grinding, cutting, etc.) alter the eating quality of foods, but do not preserve them. It is important to note that the production of most food processed foods uses more than one of the categories in Table 1. For example, jam making involves heating, removing water, increasing the levels of acidity and sugar, and packaging. Smoking fish or meat involves heating, removing water and coating the surface with preservative smoke chemicals.

Effect of processing on the quality of foods

In addition to preserving foods, secondary processing alters their eating quality. (See Glossary in Annex C). A good example is cereal grains, where primary processing by drying and milling produces flour, which remains inedible. Secondary processing is used to produce a wide range of bakery products, snack foods, beers and porridges, each having an attractive flavour, texture and/or colour. Eating quality is the main influence on whether customers buy a product. Foods that have an attractive appearance or colour are more likely to sell well and at a higher price. It is therefore in the interests of processing businesses to find out what it is that consumers like about a product using market assessments and ensure that the products meet their requirements. This is described below.

Scales of operation

When operating as a business, food processing can take place at any scale from a single person upwards (Table 2). The focus of this booklet is on the smaller scales of operation from "home-scale" to "small-scale".

Home-scale processing

Foods that are intended for household consumption are usually processed by individual families or small groups of people working together. Many of the world's multinational food conglomerates started from a single person or family working from home (Table 3). In developing countries, home-scale processors aim to generate extra income to meet family needs such as clothing or school fees. Where this is successful, many later expand production and develop first into a micro- or small-scale business (Case study 1), and later into larger scale operations.

Characteristically, home-scale processors cannot afford specialized food processing equipment and rely on domestic utensils, such as cooking pans and stoves for their production.

TABLE 1 **Types of village food processing**

Category of process	Examples of types of processes
Heating to destroy enzymes and micro-organisms.	Boiling, blanching, roasting, grilling, pasteurization, baking, smoking
Removing water from the food	Drying, concentrating by boiling, filtering, pressing
Removing heat from the food	Cooling, chilling, freezing
Increasing acidity of foods	Fermentation, adding citric acid or vinegar
Using chemicals to prevent enzyme and microbial activity	Salting, syruping, smoking, adding chemical preservatives such as sodium metabisulphite or sodium benzoate
Excluding air, light, moisture, micro-organisms and pests	Packaging

TABLE 2 **Scales of commercial food processing**

Scale of operation	Characteristics
Home- (or household-) scale	No employees, little or no capital investment
Micro- (or cottage-) scale	Less than 5 employees, capital investment less than US$1 000
Small-scale	5-15 employees, capital investment US$1 000-US$50 000
Medium-scale	16-50 employees, capital investment US$50 000–US$1 000 000
Large-scale	More than 50 employees, capital investment over US$1 000 000

Adapted from Trager, 1996

They may work part-time as the need for money arises and use part of the house, or an outbuilding for processing. However, in many situations the lack of dedicated production facilities means that there is a risk of contamination and product quality may be variable. This may reduce the value of the processed foods and the potential family income. A role of extension agents and training programmes is to upgrade facilities and hygiene, to introduce simple quality assurance techniques and improved packaging, to enable products to compete more effectively with those from larger processors.

Where families generate sufficient income from sales, some choose to invest in specialist equipment (such as a bakery oven, or a press for dewatering cassava or making cooking oil). In most cases, such equipment can be made by a competent local carpenter, bricklayer or blacksmith. This allows home-scale businesses to expand and become micro- or small-scale enterprises.

Micro-scale processing

Whereas home processors may sell their products to neighbours or in village marketplaces, the move up to micro-scale processing requires additional skills and confidence to compete with other processors and to negotiate with professional buyers, such as retailers or middlemen. Similarly, although the quality of their products may be suitable for rural consumers, it may not be sufficient to compete with products from larger companies in other markets. To successfully expand to micro-scale production, village processors need technical skills to make consistently high quality products, and financial and marketing skills to make the business grow and become successful. They may require assistance to gain these skills and confidence, and short training programmes or technical extension workers can help them to establish improved production methods, quality assurance and selling techniques.

Small-scale processing

The expansion to a small-scale processing operation requires additional investment to produce larger amounts of product in a dedicated production room. It is likely to require specialist equipment that is either made by a metal workshop in a nearby town or imported, because most rural blacksmiths do not have the necessary skills, equipment or materials to make such equipment. At this level of production, village processors are likely to be in competition with other small-scale businesses, larger companies and imported products. They need to develop attractive packaging,

TABLE 3 **Origins of some of the world's major food-processing companies**

Year	Food company
1200	Bock beer was invented in the German town of Einbeck, and is still manufactured there
1383	Lowenbrau brewery opened in Munich, Bavaria and remains in production there today
1715	French distiller, Jean Martell, began brandy production in Cognac, France
1725	The chocolate company, Rowntree, had its beginnings in a grocery store in York, UK
1871	The first margarine factory was opened by Jan and Anton Jurgens at Oss in Holland
1876	H J Heinz joined his brother and cousin to produce tomato ketchup and pickles
1877	A cream separator was invented by Swedish engineer, Carl Laval, whose company is *now Alfa-Laval*
1884	Swiss miller, Julius Maggi introduced powdered pea and beet soups, later to become "Maggi" Maggi cubes
1899	Coca-Cola was bottled under contract for the first time by Benjamin Thomas and Joseph Whitehead in Tennessee, USA, instead of syrup being mixed with carbonated water at the point of sale

(Adapted from Trager 1996)

CASE STUDY 1 **Confectionery production in Sri Lanka**

Mr and Mrs Chandradasa live in rural southern Sri Lanka. After a short training programme in 1994, they started to produce a range of confectionery products in their kitchen using simple domestic equipment. They make approximately 1 800 sweets per week and sell them in local shops. All ingredients and packaging materials are available locally, but they are unhappy with the quality of the labels, and are seeking better ones to improve their marketing. Their main problem is that shopkeepers have the upper hand and will not pay them until the products are sold. Despite these problems, they have increased their turnover to such an extent that Mr Chandradasa has been able to leave his regular job, and they have saved enough money for a purpose-built building for confectionery production. They have also built a 6-loaf bread oven and are baking two batches of bread per day. They hope to expand this new venture if there is sufficient demand. (Source: Edirisinghe, 1998).

FIGURE 1 Small-scale processing. (Photo by the author)

quality assurance techniques, and the financial and managerial skills needed to run a successful small business.

If the level of investment at this scale is too high for individual families, an alternative approach is for a group of people, such as a farmers' group, or a women's group, or a producer co-operative to operate the food processing business together (Case study 2). They invest jointly in the equipment and facilities, and market their products under a single brand name. There are many advantages to this approach including a greater willingness by lenders to make a loan if a group is sharing responsibility for the

CASE STUDY 2 **Forest fruit processing**

The Kalahan Educational Foundation (KEF) is a people's organization set up by tribal elders, which operates an income-generating project in the Philippine Cordillera Mountains on the island of Luzon. Traditional slash and burn farming practices have been under threat from logging companies for many years, and pressure to maintain income levels has caused many farmers to live and work outside the area. KEF took over the management of 15 000 hectares of forest reserve. They planted fruit trees and employed guards to protect the ancient forest from illegal clearances. They also set up a food processing centre to process forest fruits such as wild guava, wild grape, passion fruit and tamarind into high quality jams, fruit butters and jellies. Over 25 percent of the 540 families living in the reserve area gain significant cash income from bringing forest fruits to the factory. They are processed and packaged into glass jars bought from Manila. Fruit wastes are fed to pigs and their waste is converted to biogas to fuel the factory. The unit produces 40 000 jars of product per year and sells 85 percent of it in Manila through high-class supermarkets. They currently have 2 to 3 percent of the market and aim for 10 to 12 percent. Their customers are typically professional people who appreciate the higher quality compared to competitors' products, and for whom price is not a major issue. They are also exporting their products to Europe via a fair trading organization. (Source: Good 1997).

repayments, new employment opportunities for those without land, discouraging migration to larger towns or cities, and providing greater financial security and an improved standard of living to larger numbers of people.

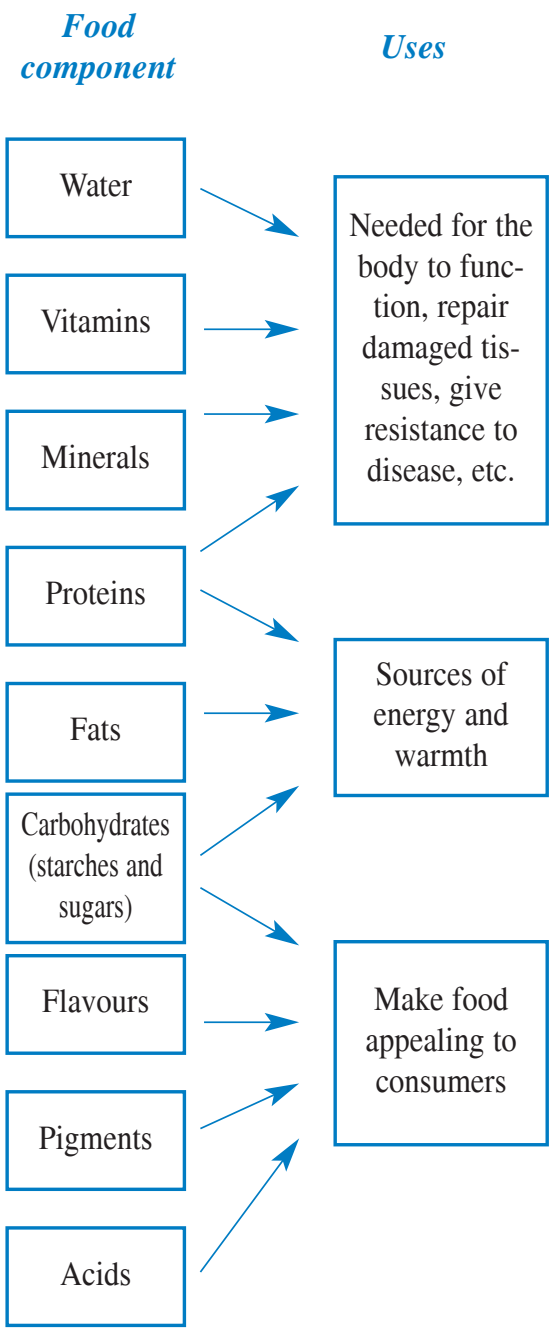
Many governments promote the development of small-scale food processing enterprises because they:

- have the potential to create significant levels of employment;
- increase food security for growing urban populations as well as rural families;
- produce products that can substitute for imported foods or have export potential, and thus help reduce balance of payments problems and improve the overall prosperity of the country.

Benefits of food preparation and processing for creating healthy families and sustainable livelihoods

FIGURE 2

The uses of nutrients from foods in the body



The normal diets of people in village communities throughout most of the world consist of a cereal or root crop staple food, which provides starchy carbohydrates, together with a source of animal or plant protein, such as meat, milk, fish, beans etc. Vitamins and minerals are provided by leafy vegetables, fruits or nuts, which are often made into a strong-tasting relish to accompany the relatively bland starchy staples. To remain healthy, people need to eat an adequate amount of food, but also ensure that the food contains sufficient amounts of specific nutrients (Figure 2).

Because most crops are seasonal, there are times of the year when either gluts can result in high levels of wastage or shortages can arise if adequate measures are not taken to preserve and store the foods. This is particularly important in areas that have a dry season or winter period when crops cannot be grown and animals are slaughtered because of a lack of fodder. In these situations stored dry grains or root crops provide energy; dried, salted or smoked meats, or cheeses provide a source of protein, vitamins and minerals; and processed

fruits and vegetables such as pickles, chutneys or dried fruits or leaves provide vitamins and minerals. A few crops, including cassava and some types of beans also contain poisons or anti-nutritional components, which must be removed by processing to make the food safe to eat.

Food processing is able to maintain the health of the family throughout the year by increasing its food security.

Where a household processes some of its crops or animals for sale, the additional diversified sources of income provide a greater degree of economic security (Case studies 3 and 4). Other social and economic benefits that can arise from processing include: more efficient use of time and, labour when equipment is used to process crops; and enhanced social standing within the community for groups who run a successful processing operation. Programmes that promote food processing in rural communities can also be used to introduce a wide range of skills that are needed to improve the livelihoods of people in rural communities. Examples include greater confidence

CASE STUDY 3 **Rural production of an African condiment**

The leguminous tree *Parkia biglobosa* is found throughout West Africa. Its seeds are made into a fermented condiment (netetou) that is sold in most local markets and it is a main ingredient in cooking, where it strengthens the flavour of sauces eaten with rice and sorghum dishes. The condiment faces competition from bouillon cubes made by large manufacturers, which are sold for US$0.03. Despite the competition, netetou remains the "local cube" that is anchored in traditional food habits and is popular with all classes of people. It can be divided into small pieces and sold for US$0.01, which is affordable by all. The production is mostly done by women, which allows them to diversify their income from cultivation of rice and peanuts, where prices are falling. A woman can expect to earn up to US$25 per production period, which allows her to buy rice and other family essentials. Between December and June groups of up to 30 women meet to rent a building for processing, with some groups processing up to 15 tonnes per season. A market survey revealed consumer concerns over hygiene during production and selling of netetou and, as a result, the product is now packaged in plastic bags, which allowed a relaunch of the product and the possibility of higher incomes to the women. A second problem was that the women were dependent on merchants for sales. A separate marketing channel was established to 80 sellers in Dakar, which is also expected to increase the incomes to the producers. (Source: Ferre, 1993).

CASE STUDY 4 **Benefiting from underutilized crops in Ecuador**

A decline in prices for traditional crops such as coffee, banana and cocoa caused farmers in the Amazonian Sucumbos Region of Ecuador to opt for livestock farming and they started to clear large expanses of forest. The PROFORS/GTZ-INEFAN project was established to promote sustainable use of non-timber forest products to alleviate pressure on the remaining forest areas. Inchi trees are part of the natural forest, and their nuts are used by families, but not traded in markets. Traditionally they are eaten without processing, but the oil can also be extracted and used as high quality cooking oil or in cosmetics. In the project, nuts are collected by farmers and sold at collection points. They are transported to the Andes highlands where the temperature and humidity are more suitable for processing than in the Amazon basin. The nuts are shelled by women employed by a local organization named Movimentop maquita Cushunchic Commercializando como Hermanos. They are dried and used to make oil, roasted and salted, or coated with chocolate, each of which increases their value. Because the inchi nuts were not widely used in the past, processing has created a new source of income for farmers, and harvesting takes place at the time of year when families receive no income from coffee or other crops. The project has stimulated smallholders to launch their own initiatives to commercialize the nut, by planting trees on their farms or by buying grafted inchi trees in local plant nurseries. Profits depend on the number of trees on a farm and their productivity, but an average farm with two trees makes a profit of US$28 to US$56 per season. (Source: Kircher, 2000)

and negotiating skills, improved skills in managing income and expenditure, improved understanding of quality requirements of consumers and changes to crop production methods to meet consumer needs. Establishing a processing unit can offer alternative employment opportunities to young people who suffer from lack of access to land. It can also be used to introduce nutrition concepts to mothers' groups, or widen the career horizons of schoolchildren through operating a small food business. As the community is strengthened management skills, machinery repair workshops, market information networks, etc., can each be introduced. The village becomes more financially secure and improvements to schools, medical facilities and other services can follow.

Food processing is a route to creating sustainable livelihoods and economic development for rural communities.

Making choices and factors influencing choices

Before introducing food processing into a village community, it is necessary to decide the overall purpose of the new initiative. Is the primary aim to improve the health and nutritional status of villagers, or is it to generate income, or both? This decision is important because it determines the types of support and resources that will be needed to make the introduction successful.

Processing for improved nutrition or food security

If the aim is to improve health and nutrition, an understanding of the current dietary problems is needed, together with any likely future

CASE STUDY 5 **Community weaning food production**

In Peru, a number of Andian communities faced high incidences of malnutrition among young children. There was insufficient family income to afford commercial weaning foods and project staff from the Lima office of the Intermediate Technology Development Group decided to assist villagers to produce their own products. The weaning foods were based on locally available raw materials and the project staff advised the communities on the correct proportions of crops to mix together to reach a correct nutritional balance of carbohydrate, protein, vitamins and minerals. Importantly, the communities decided that the mothers of all the young children in the village were the best people to produce the weaning food because they had an obvious interest in its success. They meet together for one day every two weeks and make sufficient weaning foods to meet their needs for this period. They were trained to mix the ingredients in a hygienic way so that they remained safe from food poisoning. The weaning foods were stored in the mothers' homes and used as needed. The main benefits of this approach were the low cost of production using local ingredients, the use of technologies that were appropriate for the communities, and control of production by the mothers themselves. The women viewed the fortnightly production sessions as social occasions, and there was a constant change of members as new mothers joined the group, stayed until their children reached five years old, and then left until their next child was born. The groups strengthened the confidence of their members and allowed exchange of information and informal training in a wide variety of topics. (Source: Axtell and Intermediate Technology, 2001, personal communication Peru)

TABLE 4 **Factors influencing choice when processing for food security/improved nutrition**

Choices	Factors that influence decisions
What foods to process?	Nature and extent of nutritional deficiencies, or causes of food insecurity, types of locally avail able foods.
What type of process to use?	The local acceptability of the processed food and required storage life, types of equipment required, availability of resources to establish production and maintain/repair of equipment, protection required by food from storage structures or packaging and local availability of suitable materials.
How to make sufficient amounts of processed food with the required quality?	Extent of knowledge and skills to process the food safely in sufficient quantities and make products of acceptable quality; amount of training and technical assistance required.
Who owns, manages and operates the facilities?	Degree of cohesion and cooperation between families in the community, and willingness to invest time and resources in community ventures or individual household production.

changes to food consumption. A nutritional survey is conducted to identify deficiencies, and this is then used to decide which foods should be preserved to meet those deficiencies, and how this can be done at the lowest cost. Using this information, the community should decide what is the best way to establish the processing facilities, how they should be owned and managed, and who will do the work (Case study 5).

If the intention is to increase the levels of food security in a village, the crops that are chosen for processing must be familiar to the community and the processed products should already form part of people's normal diet. The processing methods should cost as little as possible and be effective in preserving the foods for the required period. The choices that need to be considered and the factors that influence these choices are summarized in Table 4.

Processing for sale

If the purpose of introducing food processing is to generate income for families or a community, a number of decisions need to be taken before production starts (Table 5). The first set

TABLE 5 **Factors that influence choices when processing foods for sale**

Choices	Factors that influence decisions
What foods to process?	Types, amounts, cost and quality of locally grown foods, suitability of varieties for processing, estimated size of the current and future demand for the product.
What type of process to use?	Extent of knowledge and skills to operate a process, resources to establish production and maintain/repair equipment, local availability, sources and costs of equipment, ingredients, packaging and distribution vehicles, requirements of the process for energy and clean water supplies, any waste disposal or air/water pollution issues.
What facilities are needed and where should they be located?	Availability of a suitable production site near to raw material supply with access road and essential services (power, water, fuel, etc.); and production capacity required.
Who owns, manages and operates the facilities?	Degree of cohesion and cooperation between families in the community, willingness to invest time and resources in community ventures or individual family based production.
What scale of production to choose?	Size of demand for products and share of market (from market investigation), knowledge and skills to plan production and produce sufficient quantities of food, numbers of trained production and administration staff and skills required, availability and cost of processing equipment with the required throughput, and amount of technical assistance required.
How to make food with the required quality?	Extent of knowledge and skills to process the food safely to produce the quality required by customers; number of staff trained in quality assurance and, amount of training and technical assistance required.
What marketing and selling techniques to use?	Types of consumers, choice of advertising and promotion methods, distribution methods and sales outlets to be used, the main competitors and their marketing and selling techniques.
How much finance is needed?	Total investment costs, sources of finance, production costs, expected income, cash flow and profitability.

of decisions concern the type of product to make. In general, the products that are best suited for village processing have a relatively high value and low volume. Similarly, high-value products that are made from cheap raw materials offer the best opportunities to add value and generate good profits. Typically fresh fruits, vegetables, cereals and root crops cost little during the harvest season, but can be processed into a range of high-value juices, pickles, baked goods, snack foods, dried foods, etc. (Table 6). This added value means that for a given level of income, a relatively small amount of food must be processed, and hence the size of equipment and the required investment can be kept at affordable levels.

Product selection

The two most important considerations are as follows.

1. **Supply side.** The potential types of crops or animals that can be grown in an area, the likely amounts that can be produced, the cost of production, the quality of the raw materials in relation to those produced in other areas and their suitability for processing.
2. **Demand side.** The nature and size of the demand that exists (or could exist in the future) for products that can be made by processing these crops or animals, and the number of competitors.

Communities, planners and policy-makers need to balance supply and demand factors when making decisions on what type of processing to introduce.

A common falsehood: "Because there is an annual glut of a particular crop in an area, it should be processed to avoid wastage".
The reality: "Market requirements determine the choices of crops or livestock to be grown and processed for sale".

Access to information is a key factor in deciding which products to make and which markets to exploit. Most rural communities are isolated and have little access to information on the type and size of demand for products, quality requirements of consumers or the trading conditions imposed by retailers and other buyers. An important role of government extension services and international development organizations is to find and distribute this type of information to rural producers.

It is important to emphasize that people who have little experience of food processing should select products that have a low risk of causing food poisoning. Acidic foods (such as yoghurt, pickles, fruit juices, jams, etc.) and most types of dried foods are

considered safer than low-acid foods such as meats, milk, fish and vegetables. These latter foods are much more likely to cause food-borne illness if processing conditions are incorrect, or if there is poor hygiene by food handlers. Similarly, some types of process require higher levels of skill and expertise, or are more expensive to set up and operate than others. These factors should be taken into account when selecting a rural processing operation. The types of products that are usually suitable for village production are shown in Table 6.

TABLE 6 **Products that are likely to be suitable for village processing**

Products
Bakery products (cakes, breads, biscuits, buns, etc.)
Beverages (beers, wines, juices, squashes & cordials)
Confectionery products
Dried or smoked foods (fruits, root crops, vegetables, meat, fish, etc.)
Preserves (jams, pastes, pickles, chutneys, sauces, etc.)
Snack foods
Yoghurt

Flour milling, cooking oil extraction, cassava processing and crop drying are also suitable and are described in the accompaning booklet in this serie *High hopes for post harvest.*

Each of these products:

- is relatively safe from causing food-borne illness;
- requires equipment that can often be made and repaired locally;
- is not technologically complex to process;
- often has a high demand and a high added-value;
- does not have sophisticated packaging requirements.

Feasibility studies

As in all small business development, once the type of product has been decided, it is necessary to examine all of the factors that influence the likely success of the proposed enterprise, which is known as conducting a feasibility study. The types of questions in Table 5 form the basis of a feasibility study; refer to sources of information in Annex B for further details.

Problems and deterrents to growth of small-scale food processing

There are multiple constraints on small-scale food processors, but the three most important areas are: 1) raw material supplies and planning production; 2) packaging supplies; and, 3) distribution and sales.

Raw material supplies and planning production

There are special problems that make food processing different to most other types of manufacturing business. For example, the composition and yield of crops and animals vary according to the variety, the climatic and soil conditions, and the actions of weather, pests and diseases. Many raw materials spoil rapidly after harvest or slaughter unless they are quickly processed (Table 7). Some are also highly seasonal, and can only be processed for part of the year. Each of these factors can cause unpredictable supplies and large variations in the quality and cost of raw materials. This in turn makes financial planning and production planning more difficult.

Processors need to properly plan production to avoid delays in processing, which would result in spoilage of the raw material. Many processors lack the skills and knowledge to ensure that all inputs required

TABLE 7 **Spoilage of foods food**

Type of food	Spoilage rate and storage life
Animal products: meat, fish, milk.	Very rapid: a few hours.
Leafy vegetables: lettuce, some types of herbs or cabbage.	Rapid: 24 to 48 hours.
Soft fruit: raspberries, strawberries.	Rapid: 24 to 48 hours.
Hard fruit: apples, citrus, pineapples, bananas.	Slow: days or weeks.
Roots and tubers: yams, potatoes, cassava.	Slow: days or weeks.
Seeds: spices, grain, nuts, oilseed.	Very slow: months or years if dry.

Source: Fellows and Axtell, 2001

for production are in place each day. Lack of an ingredient, staff shortages or machinery breakdowns due to lack of maintenance are each causes of delays and lost production, which can lead to failure of the business. In some areas, shortages of fuel are a major constraint and, in others, there may be seasonal shortages of water that restrict processing activities. Some processed foods also have a seasonal demand (for example, foods used in festivals and ceremonies, or those that are consumed at specific times of the year) and this further complicates the planning and operation of a food processing business.

Packaging

Packaging is used to control the shelf life of some foods, but in most developing countries there are serious shortages of plastic films, pots, jars, bottles, cartons, etc., which make packaging one of the most important constraints on small-scale food processors. Traditional packages including leaves, clay pots, etc., do not perform technically as well as plastics, metal or glass containers and may be perceived by customers as less attractive or inferior. For marketing purposes, small-scale processors also need to use attractive packaging to compete with larger producers or imported products.

Distribution and sales

After processing, the shelf life of processed foods can vary from a few days to several months or years. This, together with the quality of feeder roads and the availability and cost of transport, determines the geographical area in which a processed food can be distributed. Products that require chilled or frozen transport and storage facilities are not suitable for village processing in countries where a cold distribution chain is difficult to set up and manage. Problems may also arise because processors have little influence over the activities of retailers and other buyers. Products may be poorly displayed or left on display after their "sell-by" date. They may be incorrectly stored, which leads to accelerated spoilage, or buyers may not pay for foods for many weeks, which causes cash flow problems for the processor. The processors therefore need to pay great attention to who distributes and sells their products, and influence them to protect and promote the products.

Other constraints on small-scale food processors can be grouped into those that are intrinsic or within the control of a business, including:

- lack of capital for expansion, inadequate management of finances;
- little market investigation or understanding of marketing concepts;

- under-developed entrepreneurial characteristics, selling or negotiating skills;
- lack of networks with suppliers and retailers;
- poor understanding of quality requirements by consumers, inadequate hygiene and quality assurance;
- poor understanding of opportunities for product diversification.

Those that are extrinsic, or beyond the control of the business include:

- little information on alternative technologies, lack of equipment production by local metal workshops;
- insufficient support from research institutions and inappropriate training courses at teaching institutions;
- little influence over services provided by support agencies or government field staff;

CASE STUDY 6 **Assistance from a development agency**

Bakery products are increasingly popular among the rural population of Malawi, where the market has been dominated by a few large bakeries in the main towns. However, their supplies to rural areas were intermittent and inadequate. Since 1989, the Development of Malawi Traders Trust (DEMATT) has introduced more organized progressive small-scale bakeries in rural areas throughout the country with encouraging results. It has provided training in baking buns, bread and cakes, production planning, quality assurance, costing and pricing, accounting, hygiene, business management, promotion and marketing. It also introduced fuel-efficient wood burning ovens that can be constructed from locally available materials using the expertise available in rural areas. The bakeries are able to produce between 80 and 100 loaves and 150 buns per day using a smaller oven, or between 800 and 1 000 loaves per day using a larger design. To date 33 individuals and a women's group have started new bakeries. Their main problems were shortages of flour and ingredients, and a controlled price for bread. Large bakeries have lower unit costs because they can buy bulk ingredients at a lower price. Rural bakers had higher costs because of transport charges and the need to buy smaller amounts, and these substantially reduced profit margins. DEMATT arranged with suppliers to sell ingredients to the bakers as a group rather than to individuals, thus reducing the price. The other main points that have led to the success of the rural bakeries are the small start-up investment of US$46-US$460 per bakery, the large demand for their products, and the use of efficient ovens that reduced fuel costs. (Source: Makoko, 1994).

- high cost of finance for small loans, land titles required for collateral on a loan;
- poor coordination between government institutions and non-governmental organizations and conflicting government policies (e.g. taxation vs promotion of small businesses).

In contrast to larger, formal companies and international conglomerates, most small-scale food processing enterprises have little political influence and do not receive government support (e.g. subsidies, foreign exchange allowances, price guarantees or access to specialist advice from government institutions). Some join associations to increase their economic or bargaining powers. Others seek external technical or financial assistance from development agencies, trade associations or government institutions to guide them to solutions for their individual problems (Case study 6). In South Asia and especially in India, small-scale food enterprises have been actively promoted by the central government for many years and there are many hundreds of thousands of successful rural enterprises.

Market investigations

The demand for processed foods depends largely on the economic situation in a particular country or region. Where economic activity is growing, there is sufficient disposable income and growing urban populations, who form the main markets for commercially processed foods (Case study 7). Examples include the rapidly expanding economies in South Asia, the "Pacific Rim" and some countries in Latin America and Africa, where there has been a corresponding upsurge in small-scale food processing enterprises.

In other areas, low incomes and conservative eating habits create situations in which there is little demand for processed products beyond the usual staples, and in these places the introduction of diversified food processing is more difficult. Similarly, in countries that have opened their markets as part of structural adjustment programmes, the competition from imported processed foods that can be produced more cheaply because of economies of scale or subsidies, may overwhelm small-scale local processors and cause them to fail.

When processing foods for sale, one of the most important activities is to assess the demand for products and the proportion of that demand could realistically be met by a processor who is in competition with other producers.

CASE STUDY 7 **Changing markets for processed foods**

In many large Asian cities, increases in the cost of rented property over the last few decades have had a profound effect on the demand for processed foods. Whereas previously, in professional families the income from one parent was sufficient to pay the rent and employ a housemaid, the increased cost of accommodation now means that both parents must work full-time and a housemaid may no longer be affordable. As a result, the parents must prepare meals, but they may have little time available for traditional food preparation methods when they return from work. The demand for convenient, pre-prepared foods has therefore increased dramatically. Products such as spice mixes, cooking sauces, prepared rice and ready-to-eat meals are now being supplied by many hundreds of small-scale processors, who previously had a limited local market for their products. (Source: Author's field work, 1998).

This not only guides the processor to which products to make, but also determines the size of the production facility and the level of investment required. The market investigation should include identification of the likely customers and consumers, and the types of promotion; marketing and selling techniques that are likely to be most effective for them. If a market assessment is not done, and re-done on a regular basis, a business is likely to eventually fail (Case study 8)

A simple market assessment can be done by the processors themselves, using the type of questions in Table 8, or they can employ an agency to do it for them.

Marketing plans

Consumers' perceptions are not just about price and quality, but may also

CASE STUDY 8 **The need to assess demand for a product**

In the 1980s, a government-supported factory was set up in a rural area of an African country. It purchased pineapples from farmers within a 20 km radius and transported them to the factory for processing into canned pineapple slices. The capacity of the factory was approximately 20 tonnes per day. However, the factory had never been profitable for several reasons. The demand for canned pineapple slices had not been properly assessed; they were not part of peoples' normal diet as most people preferred fresh fruit, and therefore sales were insignificant. Some retailers reported having stocks of rusty tins that were over five years old, and many said that they sold not more than one or two tins per year. Problems were also encountered with production. The farmers harvested their pineapples too early in order to receive an income as soon as possible for their crop. This meant that the pineapples were small, too acidic and had a pale colour. Their small size meant that peeling losses were proportionately very high (of the order of 60 percent instead of a more usual 25 percent), and the cost of the usable crop was therefore increased almost twofold. Additionally, the acidic flavour and pale colour were not attractive and the canned pineapple did not compete well with products made in other countries. As a result, there were limited export opportunities. The low sales meant that money was not available to invest in the business or pay farmers on time. As a result, fewer farmers were willing to supply the business, equipment was not repaired when it broke down, and the process was only able to operate at about 20 percent of its capacity. This increased the overhead costs, so that the product was sold at a loss. This spiral of decline continued until the factory was forced to close. (Source: Author's field work, 1989)

TABLE 8 **Typical questions for a market assessment**

1) Questions about potential customers and consumers:

- Who are the people who are most likely to buy your food (e.g. retailers, hotels, businesses and institutions)?
- Who are your expected consumers (e.g families, travellers, children, etc.)?
- What do consumers expect in terms of quality or other benefits?
- Where are your customers (urban, rural, which towns)?
- What are the average income levels of your consumers?
- What amounts of food do consumers buy each week or month, and how much are they willing pay for it?

2) Questions about competitors:

- Who and where are the important competitors, and how many are there?
- What are their successes and weaknesses?
- How will your product or your service to customers be better than theirs?

3) Questions about sales outlets:

- Where do your consumers usually buy their food?
- Who will sell your product and where are the sellers located?
- What are the terms of trade (discounts, payments, etc.)?
- How will your product be distributed?

4) Questions about your product promotion and marketing:

- What type of packaging do customers and consumers want?
- How will you use the package to promote the food?
- What types of promotion or advertising do your consumers see or hear (e.g. newspapers, radio and television, signboards, posters and leaflets, personal contacts, special promotions, and free samples in retailers' shops)?

FIGURE 3 **Examples of components of a marketing mix**

Product

High quality
Attractive appearance
Unusual packaging
Highly nutritious
Many varieties
Available in required amounts

Place

Long opening hours
Good decoration
Clean environment
Popular location
Delivery service
Fast and friendly service
Good range of stock

Promotion

Free samples
Competitions and shows
Articles in newspapers
Special promotions
In-shop displays

Price

Low price
Discounts for higher quantities
Special offers
Credit facilities

include status, enjoyment, attractiveness, convenience, health or nutrition. When this information is put together, a *marketing mix* (Figure 3) can be used to summarize the factors that are special for a particular product. Using the information from a market assessment, processors can identify groups of people who will provide the greatest sales, then refine their product to meet the needs of customers and consumers, and develop a strategy to market their products to these particular people. This involves developing an attractive package, negotiating with retailers, distributors or other buyers, and designing and distributing promotional materials.

For rural processors, there are five types of geographical markets that they can consider supplying.

1. **The home community**. The nearest market is customers who are neighbours and other members of the village. Processors can sell foods that other families cannot make because they require special skills and/or equipment, or because of lack of time or other reasons. The main outlets are sales from the home, sales in daily village markets or from local shops or kiosks.
2. **Local villages**. In many rural areas, people from neighbouring villagers meet in weekly markets that are held in one of the larger communities. Processors can rent a stall in the marketplace, set up roadside stalls for people who are

travelling to the market, or rent a shop in the neighbouring village. Similarly, in some countries farmers transport products to rural trading centres, where they are sold to traders or middlemen. Sales outside a village are more important than the sale of foods to neighbours, because for economic development "new" money must be brought into a village, rather than recirculating existing money within a community.

3. **Rural towns**. Larger daily markets in rural towns attract people from a wider area and have a larger range of income groups who are potential customers at retail shops. There may also be sales to small hotels, bus stations, cafes, etc.
4. **Large towns/capital city**. These have more limited opportunities for inhabitants to cultivate their own foods, higher disposable incomes and therefore large numbers of potential consumers. Urban residents may also be more willing to try out new or different foods. In some cities, expatriate and tourist populations also increase the demand for a wider range of processed foods. Sales can be made by processors from roadside stalls or rented stalls in daily markets or via retail shops, supermarkets, or wholesale traders/middlemen (Case study 9). There are also opportunities to sell processed food to hotels, institutions and other food processors (Table 9).
5. **Export markets**. Some types of products that can be produced by village processors are suitable for export. However, the administrative and legal complexities of exporting require assistance, either from local agents, from development agencies (Case study 10) or by creating well-organised producer associations (Case study 11). Large numbers of rural communities have benefited from sales of processed foods to fair trade organizations (Annex A), which buy

CASE STUDY 9 **Confectionery making in Peru**

Maria Canto Zanabria lives in a rural village near Huancayo and has run a food processing micro-enterprise for 10 years making jam and a traditional flour from a local root crop. In 1999, she read an article about chocolate making and started production using Peruvian ginseng. She produces between 200 and 300 packets of chocolates per week, which are sold to intermediaries for distribution to shops in Huancayo. She pays herself a wage and reinvests the rest of the profits in the business to buy better equipment, including different types of chocolate moulds. (Source: Anon., 2001).

TABLE 9 **Summary of different types of markets for small-scale food processors**

Type of market	Retail				Institutional			Food service/processing				Export agents	
Location	Sales directly from the processing unit	Market stalls	Small shops kiosks	Supermarkets	Schools	Hospitals	Barracks	Hotels	Cafes	Restaurants	Other food processing companies	Mainstream commercial agents	Fairtrade organizations
Home community	*	*	*										
Local villages	*	*	*		*								
Rural towns		*	*		*	*	*	*	*	*			
Large towns/ capital city		*	*	*	*	*	*	*	*	*	*		
Export markets												*	*

products such as dried fruits, nuts, cooking oils, shea butter and jams for sale in Europe and other industrialized regions. They assist communities to establish village development programmes and use the income from sales to fund improvements to community facilities.

The types of typical customers in each of these five market categories are shown in Table 9. There may also be specific types of consumers that can be identified for particular food

TABLE 10 **Tips for small-scale processors to increase sales in local markets**

- Produce products that have an attractive appearance.
- Package them attractively, with a catchy brand name that people will remember, or display them in an attractive way if they are not packaged.
- Make sure that products have the same quality every day.
- Make sure that the same weight of product is filled into each pack.
- Emphazise that the products are produced hygienically.
- Try to increase production to benefit from economies of scale, and pass on lower prices to customers.
- Create a reputation for high quality products and value-for-money.

CASE STUDY 10 **Cashew processing in Sri Lanka**

Traditionally in Sri Lanka, middlemen hire low-income women in rural areas to process cashews, and then package and sell the processed nuts to buyers and exporters. Although this is an important source of income to poor farming families, the women depend on middlemen to buy the processed kernels and to provide loans. In 1992 Intermediate Technology Sri Lanka (ITSL) received a request from a group of cashew farmers for a more affordable and efficient way to dry cashew nuts. ITSL modified and improved a tray dryer design that had been developed in Peru and adapted it for use in cashew processing. By 1999, eight villages had adopted the improved drying technology and had increased the quality and quantity of their products. As well as improving the technology, the project aimed to empower small-scale cashew processors by helping them to access information on markets for their products, and increase their status within the cashew industry. The groups now grade the kernels according to sizes required by the international market, and processors in four villages are now selling 100 percent of their produce (3 000-4 000 kg per month) to exporters. They are acknowledged as a reliable source of quality products. An indication of the improvements in quality is the percentage of broken nuts, which has fallen to between 4 and 10 percent in villages involved in the project, compared to more than 30 percent in those that have recently joined. The groups conduct their enterprises collectively in order to increase their access to credit and to market their products more effectively. One group has increased its credit from the Rural Development Bank from US$3 800 to US$10 000. These changes have increased women's incomes by more than 10 percent, and families now earn up to US$25-US$30 per month, which has had significant effects on their lives. Not only have they made improvements to their houses, better clothing and education for their children, etc., but the increased incomes have also enabled them to gain recognition and respect within their villages as successful, self-employed business people. On a wider scale, the Cashew Corporation and Export Development Board of Sri Lanka now recognize that small-scale rural processors are capable and reliable export suppliers. (Source: Hildellage, 1999)

products. For example some foods are more commonly eaten by children (weaning foods, confectionery), by men (meat snack foods sold in bars), by travellers or workers' lunchtime meals (fried fish, bakery products, prepared meals), by students (biscuits, yoghurt, snack foods) or by

CASE STUDY 11 **Making money from honey**

In a region of the United Republic of Tanzania that is economically depressed and where poverty is widespread, trade in honey is providing thousands of subsistence farmers with a rare opportunity to earn cash income. In the dry season when the ground is too hard to cultivate, many farmers travel up to 160 km and stay in temporary camps for 2 to 3 months working traditional hives made from hollowed-out logs. The Tabora Beekeepers Co-operative Society, formed in 1962, has grown from the initial 100 members to 6 000 in 36 local branches. It has a processing unit at Kipalapala that can handle 1 000 tonnes of honey per year. The beekeepers separate the honey from the combs and fill it into 20-litre plastic buckets that have clip-on lids. These are the most convenient containers for transporting honey over rough bush roads without spillage. When farmers have collected at least six tonnes of honey, they arrange for it to be collected. A truck from Kipalapala is loaded with empty buckets and follows a route that enables empty buckets to be dropped off at camps on the outward journey and return with full buckets. Each member is given a receipt for the number of buckets of honey that are bought by the Society, at a price that is established at the start of the season. The honey is processed at the Kipalapala unit, and packed into jars for the local market, or in 300 kg drums for export. By 1972 they were exporting 300 tonnes of honey to Holland and 12 tonnes to the UK. However, this collapsed in 1979 when the exports had to be made through a parastatal organization, whose costs were so high that there were insufficient margins to pay the beekeepers. By 1987, changes in legislation allowed the Society to take control of its export marketing and to retain 50 percent of its export earnings. The trade revived and exports resumed. Honey processing enables up to 50 000 villagers and their families to benefit from a cash income without the need for capital investment, and without competing with other rural activities or scarce resources such as agricultural land and water. (Source: Herklots, 1991).

people attending sports' or social events (juices, bakery products, etc.).

For many rural processors the main markets for their products are likely to be local (categories 1-3 in Table 9). Attention to the points in Table 10 can increase sales in these markets.

How to do it: appropriate equipment and methods

There are much longer time intervals between the different production stages in agriculture when compared to food processing. Several months may elapse between ploughing, weeding and harvesting, and the size of equipment for the different tasks does not therefore need to be matched. In food processing, the stages in a process are often separated by a few minutes or hours, and all equipment must have a similar throughput to avoid delays caused by one piece of equipment being too small. It is therefore necessary to take account of the whole process when selecting equipment. In this section, the methods and equipment that are suitable for village processing of the products listed in Table 6 are described. Most are simple techniques, which require only household equipment such as knives and pans at micro-scale of production. Specialized equipment necessary for higher production levels is identified.

Bakery products

There is a wide range of bakery products that can be made at a small-scale including biscuits, cookies, leavened or unleavened breads, cakes, flans, pastries, pies, pizzas, samosas and scones. Each can be made with different shapes, sizes, flavours, etc., and the range of potential products is therefore extremely large. Production of selected products is described in outline below.

Bakery products rarely cause food poisoning because the heat during baking reduces the numbers of micro-organisms to safe levels. However, products such as pies that contain meat, fish or vegetables, or cakes that contain cream have a greater risk of causing food poisoning. Pies should be stored in a refrigerator or in a hot display cabinet. Products that contain cream should be stored in a refrigerator. Careful food handling and thorough cleaning of equipment are essential to produce these products safely. Most products from small-scale bakeries are not packaged, except in simple polythene or paper bags to protect them from dust and insects. However, biscuits require more sophisticated packaging for a longer shelf life, and are packed in cartons covered with a moisture-proof and airtight film such as cellulose, polyester or polypropylene, or stored in airtight tins or jars.

The main item of equipment in a bakery is the oven, and this can be built by a local bricklayer. Ovens can be either heated internally (Figure 4) or have a separate firebox. Internally heated ovens are simple and relatively cheap to construct, but the food can be contaminated by smoke and ash from the burning fuel. Fuel is burned on the hearth for a few hours and the embers are raked out before the dough is baked. A new fire is built to reheat the oven after a few batches. An externally heated oven consists of a brick or earth structure that contains a steel baking chamber (e.g. an oil drum) over the firebox. This design provides for continuous baking without the need to re-light the fire, has good fuel economy and no contamination of products by smoke or ash. Fuelwood is cheap or free in rural areas, but in many countries deforestation has resulted in increased costs and legal restrictions on its use. Wood also produces a light fluffy ash that can easily contaminate products. Charcoal is more expensive, but it produces an intense heat with little smoke. However, restrictions on charcoal burning may also apply in areas that are suffering deforestation. Where coal is available, this is the ideal fuel for bakery ovens.

Doughs and batters need to be evenly mixed, and a mixer is an important piece of equipment in a bakery.

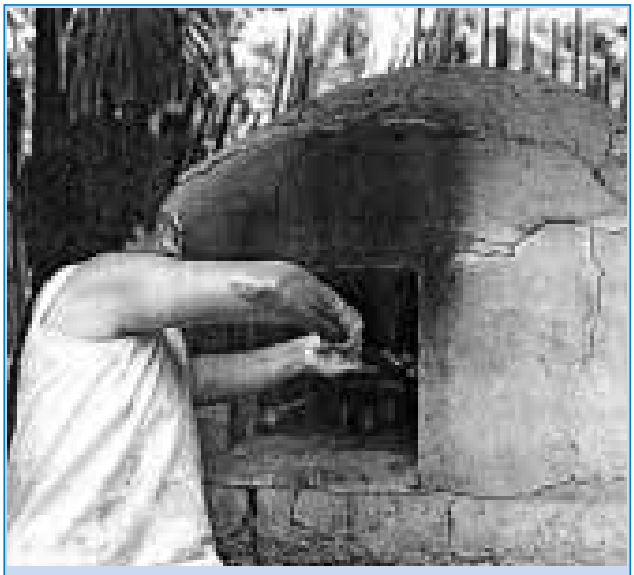


FIGURE 4 Bakery oven near Tarapoto, Peru. (Photo, Rios, 1996)

Mixing by hand is possible at micro-scale, but when larger quantities of dough are required an electric mixer is necessary. A simple proving cabinet for fermented doughs can be made from a wooden framework, covered in polythene sheeting, with a gently boiling pan of water inside. Dough is placed in the cabinet on racks for the required time. Commercial bakeries also require a range of baking trays and tins and small hand-tools, such as biscuit or pastry cutters, flour sieves, glazing brushes, rolling pins and whisks.

Breads. Leavened bread is produced by mixing together "strong" wheat flour, yeast, water, fat and salt to form dough. This is then kneaded and placed in a prover to allow the yeast to expand the dough with gas. It is then divided into the correct sized pieces and proofed again to

allow the dough to relax. After "knocking back" to remove large gas bubbles and a final proof to allow the yeast to gently inflate the dough, it is baked in an oven. Differences in the amounts of ingredients and the conditions used at each stage of the process give rise to the wide variety of breads that can be produced. Dough for unleavened flat breads, tortillas, etc., is prepared and rolled thinly before baking on a hotplate. Batter-based breads are made by mixing the ingredients to form a uniform batter, and then pouring a portion on to a hotplate. After a few seconds, the bread is turned over and the other side is baked.

Biscuits dough is made by mixing flour, sugar, baking powder and egg, together with any nuts, dried fruit or flavourings that are required. It is rolled out and cut to the required shapes with biscuit cutters, and decorated as required (e.g. with sugar crystals, chocolate chips, crystallized fruit, etc.) and baked until golden brown.

Pastries are made by first boiling together water, butter and salt. Flour and then egg is added, beating all the time until the paste is smooth and shiny. It is piped on to trays as "finger" shapes, or "rounds" and baked in an oven. Alternatively, pastry cases can be filled with many different types of sweet or savoury fillings.

Cakes, scones or soda bread rely on gas produced from baking powder to produce an aerated product. There are two main methods of making cakes: 1) Fat or butter is beaten with sugar to create a light foam, and any colouring or essences are added. Then egg is mixed in and flour/baking powder is carefully folded it into the batter, and 2) sugar and egg are whisked to form a batter. The flour is carefully folded into the mixture until it is smooth. In both methods, other ingredients (fruit, nuts, etc.) are then blended into the batter and it is poured into baking tins and baked in an oven. Scones are made by rubbing in margarine into the flour and baking powder to form a crumb. Sugar and dried fruit are added to form dough. It is rolled out to the required thickness and cut into round shapes using a biscuit cutter. These are baked on a hotplate until browned on each side. Soda bread is similar to bread made with yeast, but uses baking powder to aerate the dough.

Beverages

Wines and beers

Wines are produced from fruit juice or pulp by fermenting sugars into alcohol using "wine yeasts". Almost any fruit can be used, but the most popular are pineapple, papaya, grape, passionfruit, banana, melon and strawberry. Beers are produced using

different varieties of yeast, by fermenting a mash of cereal grains (sorghum, maize, etc.) that have been allowed to sprout. The main equipment is narrow-necked fermentation vessels, made from food grade plastic or glass and plugged with cotton wool or fitted with an air lock (Figure 5). After fermenting, wine is filtered through a muslin or nylon cloth and siphoned into clean containers and allowed to clear before it is bottled. A clearing agent such as bentonite is needed to produce a crystal-clear product with some types of fruit. Beer is filtered and either sold from the container or filled into bottles.

Juices, squashes and cordials

The consumption of **juices,** especially pineapple, passionfruit and citrus juices is increasing in urban centres in many countries. Juice can be extracted from fruits in a number of ways, depending on the hardness of the raw material. Soft fruits, such as melon and pawpaw, can be pressed in a fruit press, pulped using a juicer attachment to a food processor, or "dissolved" in a steamer. Citrus fruits are "reamed" to extract the juice without the bitter pith. Harder fruits, such as pineapple are peeled and pulped using a liquidizer. At large-scale operations, a pulper-finisher separates skins and seeds from the pulp. When a clear juice is required, it is filtered through a fine cloth or stainless steel juice strainer. Juices are filled into bottles and pasteurized in hot water. Juice production from seasonal fruits can be spread over a large part of the year by processing a sequence of fruits, or by part-processing pulps and storing them in a preservative such as sodium metabisulphite solution. **Squashes** are made from fruit juice mixed with sugar syrup. **Cordials** are crystal-clear squashes. A sugar syrup is heated to boiling and mixed with filtered juice in a stainless steel pan, before filling into bottles. These drinks are diluted with water and used a little at a time, so they may contain a preservative (usually sodium benzoate) to prevent spoilage after opening.

FIGURE 5 An airlock used in wine making. (Source: Fellows, 1997)

Confectionery

Sweets are made by boiling sugar syrup to remove water. A wide variety

of confectionery products are possible by varying the ingredients, the temperature of boiling, and the method of shaping the sweets. **Fondant** is made by boiling sugar syrup with glucose syrup. It is then cooled and beaten to reduce the size of the sugar crystals. **Creams** are fondants that are diluted with a weak sugar solution. They have a shorter shelf life because of the higher water content. **Gelatine sweets** including gums, jellies, pastilles, and marshmallows have a spongy texture, which is set by gelatine. **Toffee** and **caramels** are made from sugar, milk and fat. **Hard-boiled sweets** are made from sugar syrup with added flavourings and colourings, which is boiled to a high temperature and then cooled to form hard products. For each product, the temperature of boiling can be measured using a sugar thermometer, or a sample of product is cooled and, when cold, it is checked for the correct texture. The boiled mass is poured onto a metal, stone, or marble table to cool the product uniformly before it is shaped by hand and cut into pieces. Sweets can also be made using moulds made from rubber, plastic, metal or wood. Starch moulds are made by making impressions in a tray of corn flour, using wooden shapes. In areas of high humidity, unpackaged sweets absorb moisture from the air and become sticky. Waxed paper, aluminium foil or plastic films are used to wrap individual sweets by hand. Sweets can also be stored in glass jars, or tins with close-fitting lids.

Dried or smoked foods

Drying

Dried foods can be "high-volume, lower-value" (e.g. staple cereals or root crops), or "low-volume, higher-value" foods (dried fruits, vegetables, herbs and spices and dried meat and fish). This second category offers better opportunities for profitable production by small-scale processors. Drying removes most of the water from foods to extend their shelf life and to increase their convenience and value. The loss of weight also makes transport cheaper and easier. Care and attention to hygiene are essential during drying, especially when processing low-acid foods such as meat or fish. The temperature during drying is not usually high enough to kill any bacteria or moulds that contaminate the food and, when the food is rehydrated, they can grow again and cause spoilage or food poisoning. Polythene film is only suitable for storing dried or smoked foods for a short time before they pick up moisture, soften and go mouldy. Polypropylene gives a longer shelf life, but it is usually more expensive and it may not be available in many

countries. Sealed earthenware pots or metal tins are suitable alternatives for home storage.

Blanching prevents changes in colour, flavour and texture during storage of dried vegetables. Sliced vegetables are heated for a short time in a wire basket in hot water. Sulphur dioxide prevents browning in dried foods such as apple, apricot, pineapple, root crops and coconut. In **sulphuring** cut or shredded foods are exposed to burning sulphur in an enclosed cabinet. In **sulphiting** the food is soaked in a solution of sodium sulphite or sodium metabisulphite. dioxide. In some industrialized countries, there is increasing consumer resistance to fruits that are treated with sulphur, and if products are considered for export the local export development board or export agents should be consulted about its use. Dipping in citric acid, lemon or lime juice is also sometimes used to prevent browning of light coloured foods. **Syrup pre-treatment** can be used to extract some of the water from fruit pieces before drying. Fruit is boiled for a few minutes in syrup and soaked overnight. This produces a succulent, soft texture in the dried product.

Sun drying is only possible in areas where the weather allows foods to be fully dried immediately after harvest. The main problems are:

- damage by pests;
- slow drying in cloudy weather and at night;
- no protection from rain or dew, which causes mould growth;
- variable quality products due to over- or under-drying; and
- large areas of land needed for the shallow layers of food.

Solar dryers protect foods from dust and pests and they increase the rate of drying compared to sun drying. They can be constructed from locally available materials at relatively low cost and there are no fuel costs. However, the extra investment in dryer construction may not be recovered by higher income if local consumers are not willing to pay higher prices for improved quality. High-value products, particularly for export, may justify investment in a **fuel-fired dryer**. These are more complex and expensive to build or maintain, and require skilled labour for their operation. A compromise is to fit a fuel-fired heater to a solar dryer to give better control over drying conditions, to allow drying at night or in cloudy weather and produce a higher quality product.

Smoking. Two methods of smoking (cold and hot smoking) are used. Cold smoking changes the colour and flavour of the food, but it is not cooked

FIGURE 6 Combined solar and fuel-fired dryer. (Photo by the author)

or preserved by the process. Hot smoking cooks and dries the product as well as changing the colour and flavour. Locally-constructed smokers can be made from wood or brick. They may have an external smoke generator or the smoke can be produced in the smoking chamber. "Forced draught" smokers have a fan between the fire-box and the smoking chamber or in the chimney. These give greater control over the time and temperature of smoking**.** With all types of smokers, the temperature and smoke density can be controlled by adjusting the air supply to the smouldering wood.

Preserves

Jams, jellies and marmalades

Jam is made from fruit pulp or juice with added sugar and sometimes added pectin or citric acid. Jellies are crystal-clear jams made from juice that is filtered through a fine cloth, instead of using fruit pulp. Marmalades are produced from clear citrus juices and have fine shreds of peel suspended in the gel. The high sugar content and acidity of all preserves prevents mould growth after opening the pack so that it can be used a little at a time. These products are made by boiling fruit pulp/juice with sugar in a stainless steel pan to concentrate the mixture. For some fruits that have little natural pectin (e.g. melon), powdered or liquid pectin is added. The correct point to stop boiling can be checked using a jam thermometer, by placing a drop

FIGURE 7 Jam making. (Photo by the author)

of the product in cold water to see if it sets, or by using a hand-held refractometer. However, a refractometer is likely to be too expensive for many small-scale processors. Preserves are hot-filled into glass or polypropylene containers using jugs and funnels.

Pastes, purees and fruit "cheeses"

The most common types of pastes and purees are tomato and garlic, which are widely used in cooking. The high solids content and natural acidity preserve them for several weeks, provided they are properly packaged. They can be made at a small-scale by carefully boiling the pulp in a pan with constant stirring to prevent it darkening or burning. An alternative method of making tomato paste is to hang the pulp in a sterilized cotton sack and allow the watery juice to leak out. Salt is then mixed in and it is hung again until the weight falls to one third of the original. This method produces a product that has a natural flavour and uses considerably less fuel than boiling (deKlein, 1993). Fruit cheeses are fruit pulps that are boiled until they set as a solid block when cooled. They can be cut into bars or cubes to eat directly or small pieces can be used in confectionery or bakery products.

Pickles and chutneys

There is a wide variety of pickled fruits and vegetables. **Fermented pickles** are made from vegetables such as cucumber, cabbage, olive or onion using lactic acid bacteria to ferment sugars in the food to lactic acid. **Unfermented pickles** are vegetables packed in jars with vinegar, salt and sometimes sugar and pasteurized in a bath of hot water. **Sweet pickles** are made from single fruits or mixtures of fruits and vegetables. They are preserved by the combined action of lactic acid or vinegar, sugar and in some cases added spices. Pickles may be packed in small quantities in sealed polythene pouches, or in plastic pots. **Salted vegetables** are made in a drum by building up alternate layers of chopped or shredded vegetable (e.g. cabbage) with layers of salt. The salt draws out water from the vegetables

to form a concentrated brine, so products can be kept for several months. The salt is reduced by washing the vegetables before they are eaten. **Chutneys** are thick, jam-like mixtures made from a variety of fruits and vegetables, sugar, spices and sometimes vinegar. The high sugar content and acidity preserves the product. Some products are boiled which pasteurizes them, and others are allowed to ferment so that acids produced by the bacteria preserve the product. Some spices such as ginger, mustard, chilli and garlic also have a preservative effect. In the process, ingredients are boiled until thickened and packaged in a similar way to pickles.

Sauces

Tomato sauce, chilli sauce and mixed fruit sauces such as "Worcester" sauce are thick liquids that are made from pulped fruit and/or vegetables. They are boiled together with salt, sugar, vinegar and spices (e.g. cinnamon, cloves, allspice or cayenne pepper). The acidity, salt and sugar prevent spoilage after the pack is opened. On a small scale, the ingredients are heated in stainless steel pans with constant stirring to avoid burning the product, and packed in bottles.

FIGURE 8 A range of chilli sauces. (Photo by the author)

Snack foods

Sliced root crops (yam, cassava, sweet potato, Irish potato, etc.) and a number of starchy fruits, (jackfruit, breadfruit or banana) can be fried and eaten as snack foods. No specialized equipment is required at microscale production, but on a larger scale, a deep-fat fryer and a slicing machine can be used to produce more uniform products and reduce the time and effort involved in processing. They can be stored for a short time in polythene bags, but rapidly develop a rancid flavour. Polypropylene film is needed for longer storage. **Doughnuts** are made by fermenting dough made from water, flour, sugar and yeast and made into balls. Ring doughnuts are made by removing the centre from the dough piece with a cutter. The dough is fried in deep oil until all sides are golden brown. Doughnuts can be coated with sugar or filled with jam or cream. **Samosas** are triangular packages of "filo" pastry, which are filled

with vegetables or ground meat or fish. They are fried until heated to the centre and stored in a hot cabinet until consumed.

Yoghurt

Yoghurt is produced by fermenting milk using two species of bacteria that change milk sugar (lactose) into lactic acid. This forms the characteristic curd and restricts spoilage so that yoghurt is preserved for up to ten days in a refrigerator. Milk is a low acid food, which can contain food poisoning bacteria. It should be handled hygienically and kept cool until it is used. In the process milk is pasteurized and cooled to body temperature, and a starter culture of the bacteria is added. Either the starter can be bought as a powder or it can be taken from a previous batch of product. A simple incubator can be made using a block of thick polystyrene to hold the pots, which maintains the temperature of the product for several hours. Alternatively, pots are placed in an insulated box, fitted with an electric light bulb. The heat from the bulb maintains the temperature. Set yoghurt is made by filling pots with milk after adding the starter. For liquid yoghurt, the yoghurt is stirred to break the gel and then poured into pots. Chopped fruits or nuts can be added to each type of yoghurt, but care is needed to ensure that they are thoroughly cleaned to avoid contamination by moulds. Less acidic fruits such as melon or pawpaw are more successful because they do not react with the milk. Acidic fruits (lemon, lime, pineapple, etc.) may cause curdling and separation of the yoghurt.

Supporting resources required for small-scale processing

The resources and services required for successful exploitation of markets by small-scale processors include the following.

1. A suitable processing room with reliable services, including clean water and for some products, electricity and fuel supplies.
2. Access to raw materials, ingredients and packaging.
3. Sources of affordable equipment and local servicing skills.
4. Adequate transport, good road infrastructure and feeder roads.
5. Training, skill development and networking.
6. Access to technical backup for advice on topics such as quality assurance.
7. Good linkages with suppliers and sellers (described in more detail in Fellows, 2002).

Resources, facilities and services listed 1-6 are summarized in the following section.

Production facilities

The building

All food processing businesses should have a hygienic and easily cleaned building to prevent contamination of products. It should be on a fenced site to keep out animals, with short grass to trap airborne dust. The investment in construction or modification of a building should be appropriate to the size and expected profitability of the business. Within the building, foods should move between different stages in a process without the paths crossing, to reduce the risk of contaminating finished products by incoming often dirty, raw materials. There should be enough space for separate storage of ingredients, packaging materials and finished products.

Overhanging **roofs** keep a building cool and fibre-cement tiles provide greater insulation than iron sheets against heat from the sun. A panelled **ceiling** should be fitted, rather than exposed roof beams, which allow dust to accumulate and contaminate products. Beams are also paths for rodents and birds, creating contamination risks from hairs, feathers or excreta. It is important to ensure that there are no holes in the ceiling or roof, and no gaps where the roof joins the walls that would allow pests to enter. All internal **walls** should be plastered or rendered with concrete. They should have no cracks

that could harbour dirt or insects. The lower parts of the walls are most likely to get dirty and they should either be tiled or painted with white gloss paint. Higher parts of walls can be painted with emulsion paint.

Natural daylight is the preferred lighting in processing rooms. The number and size of **windows** depends on how much money a processor wishes to invest, and the security risk in a particular area (windows are more expensive than walls, especially when security bars or grilles are needed). Storerooms do not need to have windows. All windows should be screened with mosquito mesh. **Doors** should not have gaps beneath them, which would allow pests to enter. If the doors are used regularly, thin metal chains or strips of plastic can be hung from door lintels, or mesh door screens can be fitted to deter insects and some animals.

Floors should be made of good quality concrete, without holes or cracks. The floor should be curved up to meet the wall to prevent dirt collecting in corners. Except in dry processes (e.g. milling or baking), the floor should slope to a drainage channel, fitted with metal gratings that are easily removed for cleaning. A wire mesh cover should be fitted over the drain opening to prevent rats and crawling insects from entering the room.

Services

The availability of clean water, electricity, fuels, servicing and maintenance facilities and transport varies considerably in different countries and between regions of the same country. **Water** is essential in all food processing, either as an ingredient or

FIGURE 9 A well-constructed processing room. (Photo by the author)

for washing equipment. An adequate supply of safe water should be available from taps in the processing room. There is unlikely to be a mains water supply in many rural areas, and water from boreholes is the preferred choice. It is likely to be less contaminated with micro-organisms than river water, but it may contain sand. River water should only be used if no other source is available. To remove sand, two high level covered storage tanks should be installed, either in the roof-space or on pillars outside the building. While one tank is being used any sand in the other tank settles out. If necessary, water should be treated to remove micro-organisms by dosing it with bleach.

Good **sanitation** is essential to prevent contamination of products, and equipment should be thoroughly cleaned after each day's production. All wastes should be disposed of in a way that does not damage the local environment. Solid wastes should be removed from the building at regular intervals, and either buried or turned into animal feed or compost. In processes that produce large amounts of liquid wastes, these should be carefully disposed of to prevent local pollution of streams or lakes. A soak-away should be constructed that cannot contaminate drinking water supplies. **Toilets** should be separated from the processing area or be in a separate building. Workers should have hand-washing facilities with soap and clean towels, and they should receive training in hygiene and safe food handling.

Electric power is needed at larger scales of processing for some products. If mains electricity is not available, the main alternative is a diesel powered generator, although the cost may be prohibitive for many processors. Support agencies could also investigate the local potential of wind- or water-powered turbines. Photovoltaic cells may be useful for lighting, for small refrigerators or for topping up batteries, but they do not supply sufficient power to run most processing equipment. Where electric power is available, sockets should be located high enough on walls to prevent them getting wet when equipment is washed down. All plugs should have appropriate fuses for the power rating of the equipment, and the mains supply should have an earth leakage trip-switch. Where lighting is needed, florescent tubes use less electricity than light bulbs.

Fuels are required for processes that involve heating (boiling, drying, smoking, etc.) and these can be an important constraint in some areas. This is particularly the case where wood is the only available fuel and supplies are reduced because of deforestation. Gas does not contaminate

products with smoke, it is easily controllable, has a high heat output, and cylinders are transportable for re-filling. Where gas cylinders are not available, a biogas generator can be constructed to provide fuel, if the use of manure does not detract from its use as fertilizer and if there are sufficient quantities to produce enough gas for processing. Solar heaters may also be useful to pre-heat water.

Transport is needed for incoming raw materials, ingredients and packaging, and for outgoing products. Most small-scale processors are able to hire a pickup truck when needed, but they have little control over the conditions during transport, which may cause damage to packages or contaminate foods (e.g. by transporting them with non-food materials, live animals or contaminating them with grease or oils). Feeder **roads** to villages are often in poor condition, and may only be open during part of the year. Delays caused by poor quality roads add to the cost of processing and cause damage to raw materials and packages (especially glass containers). The condition of roads is an important consideration when selecting a site for processing, if it is intended to supply markets other than the local village (Table 9).

Servicing and maintenance facilities
Most domestic equipment used for micro-scale processing can be maintained by careful use and regular cleaning. Specialist equipment such as presses, ovens, etc., should ideally be made by local workshops that can also maintain them, or there should be a supplier of spare parts in a local town. Local equipment manufacture may require the collaboration of food research institutes and university food technology departments to develop and test prototypes so that they meet the needs of both workshops and food processors. Where imported equipment is used, a supply of spare parts should be provided, and the business owner should be trained to correctly replace worn-out parts.

Small-scale food processing requires reliable, affordable, locally produced and locally repaired, technology of a suitable size for the people who operate it.

Training, skill development and networking

One approach to improved village processing is to upgrade traditional products to improve their quality or shelf life and hence increase sales in more distant markets. Another approach is to produce non-traditional foods from existing crops or animals. Both types of processing require support through training,

advice and skill development. When successful this support can lift rural people out of poverty by increasing their skills, confidence, knowledge and resources, and by providing diversified opportunities for them to process and sell their products. However, in practice, the consequences of introducing food processing to a rural community may be difficult to predict. Although potential adverse effects of a new technology on rural producers can to some extent be predicted and avoided by careful studies before a project is implemented, there are a large number of factors, which affect the final outcome and determine who will benefit from technological changes. There is thus a need for sensitivity and understanding

TABLE 11 **Some criteria for assessing the suitability of processing technologies for rural communities**

- Conformity to local traditions, beliefs and food habits.
- Conformity with existing administrative or social structures.
- Technical effectiveness – can the process produce foods in the required amount and to the required quality standards?
- Costs of purchase and maintenance/repair of equipment and any ancillary services required.
- Cost and availability of fuels and power; alternative sources of energy (e.g. solar, biomass, wind or water power).
- Operating costs, expected sales income and overall financial profitability.
- Distribution of profits within the community.
- Effect of increase in employment or displacement of workers.
- Training and skill levels required.
- Health and safety issues.
- Environmental impact (e.g. noise or dust production, pollution of air or local water supplies).

Adapted from: Azam-Ali, S., Judge, E., Fellows, P.J. and Battcock, M., 2003, Small Scale Food Processing – a directory of equipment and methods, 2nd Edition, IT Publications, London, UK.

by planners and field workers of the social and cultural context in which the changes are introduced.

Advisers and planners have a responsibility to carefully evaluate processing technologies to ensure that they are effective in meeting the needs of the individual communities that are being assisted. The evaluation criteria are complex and inter-related and may differ in different communities, but a summary of the main aspects is given in Table 11.

Food processing developments should build on existing skills, traditional knowledge and practices, and not cause abrupt changes to village life styles or cultures. It is important that the criteria in Table 11 are not simply used by advisers as a checklist, but should be used to assist their judgement of the needs and solutions required by each individual community. Care should also be taken to

CASE STUDY 12 **Benefits of training**

Palmyrah is a type of palm tree that produces a sweet sap, which is made into a solid sweetener named "jaggery". In the Indian state of Tamil Nadu, there are over 500 000 families engaged as palmyrah labourers working for landlords. The work is seasonal, poorly paid and dangerous, and workers are mostly poverty-ridden and oppressed. In the late 1980s, the development organization FAKT began work with a voluntary organization, the Palmyrah Workers Development Society (PWDS), to improve the socio-economic conditions for palmyrah workers and their families through empowerment and self-reliance. The aim was to produce marketable, value-added products from the palm sap instead of the traditional jaggery. They decided to produce "palm candy", a crystalline sweetener having nutritive and medicinal properties. A pilot project showed that production was technically feasible and economically viable. Seeing the success, workers in five neighbouring villages set up candy-making units and all are now being successfully operated. Each employs from 10 to 15 workers, operating as a partnership. Income from sales of palm candy is shared among them in proportion to the amount of sap they provide for processing. Their income has doubled compared to the time that they were making jaggery. In recent years, systematic training programmes have been introduced by PWDS for NGOs to promote the approach, and for workers to set up and manage their own units. An evaluation of the training has shown that it enables poor palmyrah workers to become efficient entrepreneurs supplying high quality products and generating incomes of which they could previously only dream. (Source: Jayaraj, 1999)

ensure that the activities can be accommodated within family routines, without excessively increasing the workload on individual family members, and most importantly that there is sufficient profit to make the venture worthwhile. Poor communities with few resources are vulnerable to risk and advisers should make every effort to minimize the risks inherent in new ventures by conducting careful feasibility studies.

Village scale processing can be done either by individual families or

CASE STUDY 13 **Advice and support from development agencies**

The loss of socialist bloc markets for coconut oil in the 1980s had severe adverse effects on coconut farmers in the Ben Tre province of Viet Nam and they were left exporting low value fresh coconuts to China. Farmers began cutting down coconut trees to seek alternative higher value crops. However, the trees are a natural windbreak against the frequent typhoons in the area and, between 1989 and 1991, the Swedish Red Cross planted 300 000 trees as part of its disaster relief programme. This was followed by the development of a sustainable desiccated coconut-processing unit, implemented by International Development Enterprises (IDE). The aim was to strengthen and expand the market for coconut products and make coconut cultivation a more stable income generating activity for farmers.

Over 20 years, IDE set up the unit, trained 80 workers and sought new markets for the product. It established the independent Dat Lahn Company, trained the board members and supplied the company with US$30 000 worth of equipment made in Viet Nam and US$10 000 start-up capital. The board secured a further US$30 000 bank loan to renovate the site and upgrade water and electricity services. After one year of operation, the factory processed 160 000 coconuts per month, selling over US$500 000 of desiccated coconut to confectionery manufacturers in Viet Nam and Taiwan Province of China, and putting US$190 000 per year back into the hands of up to 1 500 coconut farming families in the province. Since 1996 it has expanded production to 30 tonnes of product per month and has profits in excess of US$50 000 per year. The company retains 50 percent of the profits for expansion, gives 30 percent to the workers and management, and donates 20 percent to support humanitarian activities in the province. The business not only ensures that the economic benefits from adding value to the coconuts remain in Viet Nam, but has created jobs in poor rural areas. The economic benefit from the multiplier effect of these jobs has also reduced rural to urban migration. (Source: Slater and Van Quang, 1998)

by cooperation from a number of families. If a cooperative approach is chosen, the residents of a village need to decide how they wish their community to develop, how they want to benefit from food processing, and how these developments should be managed within the community. As part of this process the benefits of joining forces with other communities, or national and international groups should also be explored. A selection of

CASE STUDY 14 **Sustainable support for small food processing enterprises**

During the 1990s, the UK development consultancy Midway Technology worked with the Uganda Manufacturers Association to develop a novel approach to support small food processing businesses. The programme first identified the support needs of small businesses and trained their owners in technical and business aspects of processing. Potential trainers and consultants were selected from among training course participants. They were then trained in participative training techniques to enable them to design and hold their own short courses. Courses were affordable and appropriate to the levels of knowledge and time constraints of small food businesses (e.g. short blocks of training, one day/week, etc.). Each training course was designed to have full cost recovery without subsidies. Selected consultants received training to operate professional commercial consultancy services, to provide on-site technical or management advice and information at an affordable cost.

The programme also created a not-for-profit company to supply equipment, specialist ingredients, packaging materials and information on technology choices, new products, markets, management methods, etc., and to coordinate training and consultancy services. Income generated from sales of equipment, books, materials and training and consultancy services enabled financial sustainability, and hence long-term support for small businesses with minimal external inputs. The company also created networks of small-scale processors, and involved government research and training institutions to support small businesses. The programme resulted in improved knowledge and practical skills of entrepreneurs and support institution staff, improvements in the quality and range of processed foods, increased productivity of food processors through the introduction of improved equipment and more efficient processing methods and increased profitability of small food enterprises. It also improved the availability of more market-orientated support services and developed a more commercial attitude and approach by trainers and consultants. (Source: Project reports from Midway Technology, 1994-97)

institutions and agencies that can offer advice and support is given in Annex A and sources of further information are given in Annex B.

Lack of education, rural isolation, and adverse social structures may each contribute to poorly developed production and selling skills in rural communities. The lack of direct contact with consumers means that villagers are often not aware of their changing quality requirements and, as a result, do not produce foods to the standards of hygiene or quality that are required. Training programmes that are held as part of a food processing development programme should include confidence-building techniques, financial management and marketing skills as well as the technical skills needed to produce high quality processed foods (Case study 14). The promotion of linkages between rural processors and buyers of their products is described in Fellows, 2002.

Annex A: Selected international institutions that support small-scale processing

- Agromisa Foundation, P.O. Box 41, 6700 AA Wageningen, the Netherlands. Tel/Fax: 31 317 412217 / 419178, E-mail: agromisa@agromisa.org, Web: www.agromisa.org.

- APICA. Ensia-Siarc, BP 5098, 34033 Montpellier Cedex 01. Fax: 33 (0) 4 67 61 70 55. E mail: giroux@cirad.fr.

- Centre for the Development of Enterprise (CDE), Avenue Herrmann Debroux 52 B1160 Brussels, Belgium Tel: 32 2 679 18 11, Fax: 32 2 675 19 03, E-mail info@cdi.be, Web: www.cdi.be.

- Commonwealth Secretariat Marlborough House, Pall Mall, London SW1Y 5HX Tel: 020 7747 6385 - Fax: 020 7839 9081, E-mail: info@ commonwealth.org.uk, Web:www.commonwealth.org.uk.

- Danish International Development Assistance (DANIDA), Udenrigsministeriet, Asiatisk Plads 2, DK-1448 København K, Denmark, Tel: 45/ 33 92 00 00, Fax: +45/ 32 54 05 33, E-mail til ministeriet: um@um.dk, webmaster@umweb.dk.

- Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH,Dag-Hammarskjöld-Weg 1-5, 65760 Eschborn, Germany, Tel: 49 (0) 6196 79-0, Fax: 49 (0)6196 79-1115, E-mail: gtz@gtz.org.ge, Web: www.gtz.de.

- Enterprise Works, 1828 L Street NW, Suite 1000 Washington, DC 20036, USA Tel: 1 202.293.4600 Fax: 1 202.293.4598, E-mail: info@enterpriseworks.org, Web: www.enterpriseworks.org.

- Finnish Department for International Development Cooperation (FINNIDA), P.O. Box 127, FIN-00161 Helsinki, Kanavakatu 4a, 00160 Helsinki, Finland, Tel: 358 9 1341 6370 or 1341 6349, Fax: 358 9 1341 6375, Email: kyoinfo@formin.fi, Web: http://global.finland.fi/english/.

- Food and Agriculture Organization (FAO), 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.

- Fordergesellschaft fur angepasste Techniken in der Dritten Welt mbH (FAKT), Gansheidestrasse 43, D-7000 Stuttgart, Germany. Tel 49 711 210950, 2109526, Fax - 0049-711-2109555 E-mail: Fakt_ger@comuserve.com.

- GRET. 211-213 rue La Fayette, 75 010 Paris, France. Tel: (33) 1 40 05 61 61, Fax (33) 1 40 05 61 10, E-Mail: gret@gret.org, Web: www.gret.org.

- Intermediate Technology Development Group (ITDG), The Schumacher Centre for Technology & Development, Bourton Hall, Bourton-on-Dunsmore, Rugby, CV23 9QZ, UK. Tel: 44 1926 634400, Fax: 44 1926 63440 E-mail: itdg@itdg.org.uk, Web: www.itdg.org.

- International Agricultural Centre (IAC), Lawickse Allee 11, 6701 AN Wageningen, P.O. Box 88, NL 6700 AB Wageningen, the Netherlands, Tel: +31 (0)317 495495, Fax +31 (0)317 495395, E-mail iac@iac.agro.nl, Web: www.iac.wageningen-ur.nl.

- 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.

- International Institute for Tropical Agriculture (IITA), International or c/o Lambourn (UK) Limited, Carolyn House, 26 Dingwall Road, Croydon CR9 3EE, UK, Tel.: (44) 020 8686 9031, Fax.: (44) 020 8681 8583, E-mail: IITA@cgiar.org.

- International Labour Office (ILO), Communications and Files Section (DOSCOM) 4, route des Morillons, CH-1211 Geneva 22, Switzerland, Tel: 41.22.799.6111, Fax: 41.22.798.8685, E-mail: ilo@ilo.org,Web: www.ilo.org.

- Midway Technology Ltd., 19 High Street, Bonsall, Derbyshire, DE4 2AS, UK. Tel: 44 (0)1629 825267, Fax: 44(0)1629 822534, E-mail: midway@peterfellows.freeserve.co.uk.

- Natural Resources Institute (NRI), Medway University Campus, Central Avenue Chatham Maritime. Kent, ME4 4TB, UK, Tel: 44 (0)1634 880088, Fax: 44 (0)1634 880066/77, Email: nri@greenwich.ac.uk, Web: www.nri.org.

- Protestant Assistance For Cooeration In Development (EZE) Mittelstrasse 37, Zentralstelle Bonn, Germany, Tel - 228 8101 190, Fax - 228 8101 120.

- Royal Tropical Institute (KIT), P.O. Box 95001, Mauritskade 63, 1092 AD Amsterdam, The Netherlands, Tel: 31 20 5688 272, Fax 31 20 5688 286, Email: kit@kit.nl, Web: www.kit.nl.

- Secrétariat technique du réseau (TPA), 211-213 rue La Fayette, 75010 Paris, France, Tél: 33 (0) 1 40 05 61 69, Fax: 33 (0) 1 40 05 61 10, E-mail: tpa@gret.org.

- 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 Organization (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.

Alternative Trading Organizations in Europe

- 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.

- Magasins du Monde-OXFAM, 7a, Rue Michiels, 1180 Bruxelles, Belgium, Tel: +32 2 332 01 10, Fax: +32 2 332 18 88. E-Mail: mdm.oxfam@mdmoxfam.be.

- Oxfam Wereldwinkels VZW, 15, Ververijstraat, 9000 Gent, Belgium, Tel: +32 9 18 88 99, Fax: +32 9 18 88 77, E-Mail: oww@oww.be.

- Solidar'Monde, 86, Rue Berthie Albrecht, 94400 Vitry s/Seine, France, Tel: +33 45 73 65 43, Fax: +33 45 73 65 42, E-Mail: solidarmonde@wanadoo.fr.

- GEPA, Gewerbepark Wagner, Bruch 4, 42279 Wuppertal, Germany, Tel: +49 202 26 68 30, Fax: +49 202 266 83 10, E-Mail: marketing@gepa.org.

- Ctm Altromercato, Via Macello, 18, 39100 Bolzano, Italy, Tel: 0039 0471 975 333, Fax: 0039 0471 977599. e-mail: ctmbz@altromercato.it.

- Fair Trade Organisatie, 5, Beesdseweg, 4104 AW Culemborg, Netherlands, Tel: +31 345 54 51 51, Fax: +31 345 52 14 23, E-Mail: info@fairtrade.nl.

- INTERMÓN OXFAM, Calle Louis Pasteur, 6, (Parque Tecnológico), 46980 Paterna, (Valencia) – Spain, Tel.: + 34 96 136 62 75, Fax.: + 34 96 131 81 77, E-mail: comerciojusto@intermon.org.

- Claro LTD, 19, Byfangstr., CH-2552 Orpund, Switzerland, Tel: +41 032 35 60 700, Fax: +41 032 35 60 701, E-Mail: mail@claro.ch.

- 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.

References used in the text

Anon. 2001. Confectionery making in Peru, *Food Chain,* 29, 8.

Axtell, B. and Intermediate Technology, 2001. Personal communication Peru.

Azam-Ali, S., Judge, E., Fellows, P.J. and Battcock, M., 2003, Small Scale Food Processing – a directory of equipment and methods, 2nd Edition, IT Publications, London, UK.

Clarke, B. 2002. *High hopes for post harvest,* Booklet. FAO, Rome, Italy. (in preparation).

de-Klein, G. 1993. Tomato and fruit processing, TOOL Publications. Amsterdam, *Food Chain,* 7, 10-11.

Edirisinghe, C. 1998. The sweet smell of success, *Food Chain,* 22, 21-23.

Fellows, P.J. & Axtell, B.L.A. 2001. *Opportunities in food processing – setting up and running a small food business*. CTA Publications, Wageningen, the Netherlands.

Fellows, P.J. & Hampton, A. 1991. *Small scale food processing – a guide to appropriate equipment*, IT Publications, London, UK.

Fellows, P.J. 1997. *Guidelines for small-scale fruit and vegetable processors,* FAO Technical Bulletin 127, pp 58.

Fellows, P.J. 2002, *Promoting linkages between food producers and processors.* Booklet, FAO, Rome, Italy. (in preparation).

Ferre, T. 1993. Netetou – a typical African condiment, GRET/TPA and *Food Chain,* 9, 11-12.

Good, A. 1997. Fruit factory in the forest, *Food Chain* 21, 4-5.

Herklots, J. 1991. Making money from honey, *Food Chain,* 3, 3-5.

Hidellage, V. 1999. Empowering small-scale cashew processors in Sri Lanka, *Food Chain,* 24, 11-15.

Jayaraj, J. 1999. Training in food processing – a sustainable approach in India, *Food Chain,* 24, 19-21.

Makoko, M. 1994. Baking bread in rural Malawi, *Food Chain,* 11, 3-5.

Rios, W. 1996. Cassava – variations on a theme, *Food Chain,* 17, 8-9.

Slater, D. & Van Quang, N. 1998. Coconut processing in the Mekong Delta, *Food Chain,* 22, 16-19.

Trager, J. 1996. *The Food Chronology,* Aurum Press, London, UK.

Food Chain is published free by Intermediate Technology Development Group to support organizations and small businesses in developing countries. (Address in Annex A).

Sources of information*:- *Technical information

Information on suppliers of equipment, ingredients and packaging materials is often difficult to find, but catalogues and sometimes databases of equipment manufacturers and importers may be available for consultation by field-workers at:

- Offices of national and international development agencies
- Chambers of Commerce
- University food science or technology departments
- Food research institutes
- Embassies of other countries
- Trade or manufacturing associations

Commercial information

Gathering market and business information is essential for all businesses, however small. It can be done by the owner or by paying someone to do it. Sources of published information include:

- Catalogues, price lists or advertisements of competitors' products
- Feedback from retailers
- Newspaper and radio reports about competitors or articles on changes in technologies
- Publicly available statistics and studies from government ministries or other national and international organisations
- Paid-for or free information from employers' or manufacturers' associations, research organizations, surveys of consumers or retailers, Chambers of Commerce, etc.

Further reading:- Technical aspects

- *Affordable Water Supply and Sanitation*, Pickford, J., Barker, P., Coad, A., Dijkstra, T., Elson, B., Ince,M., and Shaw, R (Editors). 1995, IT Publications, London, UK.

- *Appropriate Food Packaging*, Fellows, P. and Axtell, B. 2002, IT Publications, London, UK.

- *Disinfection of Rural and Small-Community Water Supplies*, Anon, 1989, Water Research Centre, Medmenham, Bucks, UK.

- *Food Poisoning and Food Hygiene*, Hobbs, B. and Roberts, D. 1987, Edward Arnold Ltd, 41 Bedford Square, London WC1B 3DQ, UK.

- *Guidelines for Small Scale fruit & Vegetable Processors*, Fellows, P.J., 1997. FAO/AGS Technical Bulletin #127, FAO, Rome, Italy.

- *Making Safe Food*, Fellows, P. and Hidellage, V. 1992, CTA/IT Publications, London, UK.

- *Manuals of Food Quality Control*, Vols. 1-9, FAO, Via delle Terme di Caracalla, 00100 Rome, Italy.

- *Packaging: Food Cycle Technology Source Book No 6,* 1993. Oti-Boateng, P., & Axtell, B. IT Publications, London, UK.

- *Rural Home Economic Food Preparation*, Anon., Series 1, Food Preservation, Series 2, Labour Saving Ideas, Series 3, FAO, Via delle Terme di Caracalla, 00100 Rome, Italy.

- *The Food Hygiene Handbook*, Sprenger, R.A., 1996. Highfield Publications, Doncaster, DN5 7LY, UK.

- *Traditional and Non-Traditional Foods*, Ferrando, R., 1981. FAO Publications, Via delle Terme di Caracalla, Rome, Italy.

- *Traditional Foods*, Fellows, P.J. 1997. CTA/IT Publications, London, UK.

Business aspects

- *Do Your Own Scheme, a Manual for the Entrepreneur*, Anon. 1992. Small Business Promotion Project, Nepal Ministry of Industry (and GTZ), Kathmandu, Nepal.

- *Doing a Feasibility Study: training activities for starting or reviewing a small business,* Suzanne Kindervater. (Editor), 1987, OEF International, 1815 H Street NW, 11th Floor, Washington, DC 20006, USA.

- *How to succeed as your own Boss*, Ondeng, P., 1999. Enterprise Publications Ltd, Nairobi, Kenya.

- *Improve Your Business (Basics & Trainers' Guide*); M. Borgenwall, *et al*; International Edition; 1999, International Labour Office, Geneva, Switzerland.

- *Market Research for Food Products and Processes in Developing Countries,* R.H Young and C.W MacCormac. 1986, IDRC, Ottawa, Canada.

- *Marketing Research and Information Systems*, Crawford, I. M. 1997. FAO, Rome, Italy.

- *Monitoring and Evaluating Small Business Projects: a step by step guide for private development organisations*, Buzzard, S. and Edgcomb, E., (Editors), 1992, PACT, 777 United Nations Plaza, New York, NY 10017, USA.

- *Starting a Small Food Processing Enterprise*, Fellows, P.J, Franco, E. and Rios, W. 1996, IT Publications, London, UK.

- *Successful Approaches to Training in Food Processing,* Battcock, M. Azam-Ali, S. Axtell B. and Fellows P.J., IT Publications, 136pp, 1998.

- *Training Village Entrepreneurs: Guidelines for Development Workers*, 1986, Skills for Progress, IT Publications, London, UK.

Website sources of information

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 Organization (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.

- ITDG Publishing, 103-105 Southampton Row, London, WC1B 4HL, Tel: 44(0)20 7436 9761, Fax: 44(0)20 7436 2013, Email: itpubs@itpubs.org.uk, Web: www.itpubs.org.uk, www.developmentbookshop.co.uk.

- 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.

- Secrétariat technique du réseau (TPA), 211-213 rue La Fayette, 75010 Paris, France, Tél: 33 (0) 1 40 05 61 69, Fax: 33 (0) 1 40 05 61 10, E-mail: tpa@gret.org.

- 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 (PUBL), Tel: 41.22.799.7866, Fax: 41.22.799.6117, E-mail: publns@ilo.org., Library and Information Services (BIBL), Tel: 41.22.799.8675, 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,

Annex C: Glossary

Acidity	Foods are grouped into low acid foods that have a pH above 4.5, and high acid foods that have a pH below 4.3 The acidity of foods influences the types of micro-organisms that can grow in them, and thus the methods of processing needed to destroy them or inhibit their growth. Increasing the acidity of foods preserves them (e.g. vinegar in pickles and sauces, or fermentation to produce lactic acid in yoghurt). Acidity contributes to the taste of a food.
Eating quality	The colour, flavour, texture and appearance of a food.
Enzymes	Proteins that catalyse biological reactions. There are many hundreds of different enzymes in foods, some of which cause spoilage (e.g. by causing foods to darken or develop a rancid flavour).
Food poisoning	Caused by some types of bacteria from raw materials or poor personal hygiene by people who handle foods. It can result from eating a food that has a large number of live bacteria, or from poisons (toxins) produced by bacteria in the food. Some types of toxin can withstand heat and remain in the food after the micro-organisms have been destroyed. It can be prevented by correct processing good quality raw materials, training workers in correct food handling and by adopting quality assurance techniques.
Food spoilage	Changes in flavour or texture, loss of colour, shrivelling and drying out or damage caused by pests and by micro-organisms.
Gluten	A protein found in wheat that creates the structure of bakery products.
Micro-organisms	Minute creatures that cannot be seen until they are present in vast numbers (e.g. a spot of mould on bread). There are four basic groups: yeasts, moulds (or fungi) bacteria and viruses. Within each group, there are hundreds of different types. Some are safe and are used in processing, but others cause food spoilage or food poisoning. In general yeasts prefer more acidic wet foods (e.g. fruit products), bacteria prefer less acidic wet foods (e.g. meat, fish, milk) and moulds are able to tolerate dry foods better than the other types, (e.g. cereals or nuts).
Packaging	Protects foods after production until they reach the consumer. The main hazards to foods are damage due to crushing or impact, environmental factors (moisture, air, heat, light etc.), damage caused by pests and micro-organisms, chemical and enzymic changes within the food (e.g. staling, rancidity, browning, etc.), theft, adulteration and tampering with products. A package should also keep the contents together without leakage until they are used.
Pathogens	Food poisoning micro-organisms.
Pectin	A substance found in fruits that forms the gel in jams.
Rancidity	Unpleasant flavours in fats and oils caused by enzymes, micro-organisms or when they are broken down by heat or light.
Shelf life	The time before a processed food begins to spoil.