





## Greetings

### The impact of Food Chain in Uganda

Earlier this year we carried out an evaluation of the impact of the journal in Uganda – this complemented the research previously carried out in Peru and Sri Lanka and helped to give a more global coverage to the study. The findings of this first phase of the research were featured in issue 29 of Food Chain in November 2001.

Seventeen readers were interviewed, both from Kampala and other smaller towns and rural areas. Unsurprisingly, much of the information we collected in Uganda was very similar to that collected in Peru and Sri Lanka. The majority of readers interviewed reported how much they value the journal as it is often the only source of practical information on food processing that they receive or have access to.

We are delighted to find that the material and information in Food Chain does not just sit and collect dust on the shelves of libraries or directors offices, rather that it is a valued resource that is read by many readers and used in a variety of ways.

The ways in which the journal is used include the following:

- As a source of technical information
- For commercial and marketing information
- To keep up to date with food processing issues
- To prepare lecture notes
- As training material
- For income generation
- As reference material to prepare articles
- For further research
- For book reviews and information on websites and recommended resources

We appreciate that publishing the journal in English is not the most accessible language for the majority of our target audience whose first language is not English and many of whom are illiterate. However, it is our most appropriate option for meeting a diverse group of readers across the globe. We rely on you, our readers, to share the information and ensure that the messages are conveyed to those who have no access themselves. We positively encourage you to do this. From the information you gave us, we estimate that between 4 and 20 people read each copy of the journal. You shared with us the various methods you use to ensure

that the material is disseminated widely and reaches the people who will benefit from it. These methods of information sharing include the following:

- Translation of articles into local languages
- Photocopying interesting articles and passing them on to others
- Production of simple posters and comic strips to convey relevant information
- Reprinting of material in local books

We are always keen to hear your comments and feedback on the articles in the journal and welcome your suggestions for improving the journal to meet your needs. You came up with some very interesting suggestions on what you would like to see in the journal. These included the following:

- Electronic publishing to reduce costs
- Include more articles and information from the north
- Translate articles into local languages
- Some articles have too much text – more flow charts, diagrams, illustrations and summary boxes will be more useful for those who do not have English as a first language
- More technical details should be included to enable readers to replicate the ideas
- More sophisticated articles should be included
- The journal should be delivered on a regular basis
- There should be more holistic articles that cover the broader context
- And lastly, there should be more articles from Africa and, in particular, Uganda.

We are grateful for these suggestions and will endeavour to implement as many of them as is appropriate to the journal. We also need your help. For us to include more articles from Africa – or from anywhere in the world for that matter – we need you to keep sending us practical experiences from the field that you would like to share with your fellow Food Chain readers.

As always we hope you find this issue of Food Chain interesting and useful for your work.

*Front Cover: Bread making in Peru*

A4 Peru I14.01

Annie Bungeroth

*Back Cover: Baked products – bakery training in Sri Lanka*

A4 Sri Lanka G2.02

@ Zul

*Sue Azam-Ali  
Production Manager*

# Fairly traded dried mango



Burkina Faso

Africa

Over a period of 10 years, a small co-operative in Burkina Faso has turned round the lives of some 600 rural farmers in this, one of the poorest countries of the world, right on the edge of the Sahara Desert. This was achieved by making use of one of the oldest food processing technologies known – sun drying. The co-operative produces over 50 tonnes of sun-dried mango a year, which is exported to wholesalers in the UK and Europe.

## Introduction

Mangoes are plentiful in Burkina Faso, in fact during the height of the mango season, they are considered by some to be a national nuisance and even a health hazard. Piles of rotting mangoes are a common sight, so much so that people get sick of the sight and smell of the rotting fruit. Monsieur Tougouma, the manager of Cercle Des Secheurs (CDS), a small co-operative in Ouagadougou, wondered if there was something that could be done to prevent this wastage. He considered the potential to export the fresh fruit to consumers in the cold northern climates, where mangoes are considered a luxury item. But, inconveniently, many varieties of mango do not ripen well if they are picked young. Also, the ripe ones are easily damaged during transport, making air-freighting a risky and expensive option.

## Solar drying technology

As an alternative option, CDS decided to investigate the viability of solar drying technology. They discovered that many different models of solar drier had been used and experimented with in tropical countries, with varying degrees of success. The type of drier Tougouma initially decided to use were simple ventilated tunnels, covered in a type of plastic that is resistant to damage by the sun (Figure 1).

These solar driers were designed by the Centre Ecologique Albert Schweitzer (CEAS) in Ouagadougou with whom CDS work closely. The finely sliced mango is placed on trays, which are placed in the tunnel at the start of the day (Figure 2). The

scorching heat of the sub-Saharan sun can be sufficient to reduce the moisture content of the slices down to 10% by the end of the day, when the slices are removed, sorted and packaged into sealed moisture-proof bags.



Tropical wholefoods

Gradually over the years, CDS's and CEAS's innovative technology, which is cheap and easy enough for farmers to build themselves, caught on amongst other progressive farmers. They were also attracted by the democratic structure of CDS and its robust support of members, which gave them pre-financing to enable them to get started with their business, plus plenty of training and technical back up. Over 85% of the farmers are women. In a country where 91% of the women are illiterate, this level of women's participation is impressive and has been actively encouraged by CDS. As CDS became more profitable for its members, they increasingly invested in the new drying technology developed by CEAS. Gas fired mechanical driers were used at night to supplement the solar driers and in some cases entirely replace the solar driers.

As production grew, Tougouma sent out samples of dried mango to Fair Trade Businesses including Tropical Wholefoods, Traidcraft and Oxfam Trading in the UK and similar organisations in Europe. These UK-based organisations were very impressed by the high quality of the product and the democratic, equitable organisation of CDS and made a concerted effort to support CDS by assisting with marketing the products in the UK. There is now a huge, solid demand for the products in the UK. In addition to selling the 100% pure sun-dried mango, Tropical Wholefoods also invested time and effort in product development. 'Magical Mango Muesli' and 'Mango dipped in Fair Trade Chocolate' are some of the enticing products that have been developed and which are popular with consumers in the UK (Figure 3).



Tropical wholefoods

Figure 2: Mangoes in the drier

Figure 1: Mango growers in Burkina Faso

Figure 3: Mango dipped in chocolate



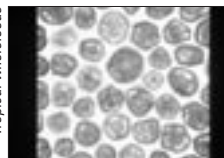
Burkina Faso

Africa

### Diversification of products

More recently, CDS have started to diversify their products and are now producing a high quality Burkinabe sun-dried tomato, which is a strong competitor

Tropical wholefoods



for the traditional Italian sun-dried tomato, which has grown in popularity in Europe and the UK (Figure 4).

### Organic certification

A major coup for CDS was that in 1999 they gained organic certification for a large number of their mango orchards, so that Burkinabe Dried Mango can now be sold in the UK under the organic mark of the Soil Association (see box). As Kate Sebag, Marketing Director of Tropical Wholefoods comments, 'this organic certification opens up potentially even greater markets in Europe for Burkinabe products, which is great.'

### The future

Burkina Faso is a poor country – out of 174 countries that were statistically surveyed in 1996, the United Nations Development Programme (UNDP) ranked Burkina Faso

third from the bottom. Through relatively stable politics, the country has managed not to descend into the kind of ruinous chaos that its near neighbours such as Sierra Leone or Liberia have suffered. But with precious few exportable commodities available, a highly precarious Sahelian environment, landlocked borders and over half of the population under 16 years of age, it is hard to see how the Burkinabe economy will ever flourish.

In this harsh national context, Monsieur Tougouma's co-operatively produced dried mangoes are certainly only a tiny drop in the ocean for the people of Burkina Faso, but the more we buy of them, the greater the chances for the modest but inspiring example of innovation to succeed.

Tropical Wholefoods Organic Dried Mangoes, Magical Mango Muesli and Mango dipped in Chocolate are available in most health food shops in the UK. The mango is also available through Oxfam Trading and Traidcraft, also in the UK.

*Kate Sebag is Marketing Director of Tropical Wholefoods, 7 Stradella Road, London SE24 9HN. Monsieur Tougouma is the Manager of Cercle des Secheurs (CDS), Ouagadougou, Burkina Faso.*

Figure 4: Sun-dried tomatoes



The Soil Association exists 'to research, develop and promote sustainable relationships between the soil, plants, animals and the biosphere, in order to produce healthy food and other products while protecting and enhancing the environment'.

Soil Association Mission Statement

The Soil Association is a membership charity which has been researching and promoting organic farming as the key to sustainable agriculture since 1946. It is the UK's leading campaigning organisation and certification body for organic food and farming. It campaigns against issues like GMOs in food and the routine use of antibiotics in conventional farming. A comprehensive information and education service is available for both consumers and producers alike, through publications, leaflets and an annual programme of events.

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# Practical aspects of processing dried mango

This article has been taken from the NRI publication 'Producing solar dried fruit and vegetables for micro and small-scale rural enterprise development'. This short synopsis is a summary of the handbook on practical aspects of processing, which is handbook 3 of the NRI package.

To produce good quality dried fruit and vegetables that are acceptable for both export and local consumption, there are several factors to consider. These include the following:

- Purchase of fresh produce of good quality
- Careful transport and storage
- Proficient preparation of produce
- Correct loading and operation of the dryer
- Drying to the correct moisture content
- Proper packaging and storage of the dried product
- Achieving good product quality
- Efficient management of all operations to assure quality, minimise losses and maximise business profitability.

Most importantly, activities must always be carried out with due diligence at all times with regard to cleanliness, hygiene and food safety aspects.

## Preparation of fruit

The preparation of fruit and vegetables for drying usually involves the following stages:

- Selection
- Washing
- Peeling (for some produce such as tomatoes, peeling is unnecessary)
- Cutting and slicing
- Drying
- Packing.

## Selection

Fruit should be selected individually and rotten, damaged or diseased fruit discarded. To obtain maximum yields of top quality dried product, it is important to choose ripe fruit. As the dryer needs to be loaded to its maximum capacity as often as possible, it is better to buy a little too much fruit.

### Key points on selection

- Select fruit individually
- Use only ripe, good quality fruit
- Discard rotten or diseased fruit.

## Washing

Wash water should be treated with a well known brand of household bleach (containing a chlorine agent) to produce a mild disinfecting solution for washing the fruit. A typical solution is made by adding one part of bleach to 50 parts of clean water in a clean bucket. The solution should be allowed to stand for a few minutes before use. Concentrated bleach is dangerous to the skin and eyes and spoils clothing. Therefore plastic gloves and protective clothing should be worn during handling. The cleaning water easily becomes contaminated by the fruit during washing. As a general rule, 10 litres of treated water should be sufficient to clean about 20kg of fruit.

Selected ripe fruit should be washed and scrubbed individually in the treated wash water. Care must be taken to avoid breaking the skin of the fruit and thereby contaminating the flesh. If the fruit is very dirty, it can be pre-washed in clean water before washing in the disinfectant. Washed fruit should be taken promptly to the peeling area.

### Key points on washing

- Clean all working areas before handling fruit
- Prepare bleach solution according to instructions
- Use clean baskets/buckets to carry washed fruit
- Replace wash water bleach solution regularly
- Dispose of used solutions safely.

## Peeling

The main aim of peeling is to remove all the peel, with minimum removal of the flesh. Damaged or bruised parts of the fruit should be removed at this point. Clean, sharp stainless steel knives must be used for peeling, although bananas can be

### Key points on peeling operations

- Clean preparation area before handling fruit
- Wash hands with clean water using unperfumed soap
- Remove damaged portions during peeling
- Dispose of peelings and debris promptly to a separate area.





The optimum thickness of slices for drying varies with different produce. Experience in Uganda recommends the following thickness of slices:

Pineapple	2–3mm
Mango	2–3mm
Banana	5mm
Tomato	3–5mm

peeled by hand. Pineapples should be topped and tailed before peeling. Tomatoes do not need peeling, but should be handled very carefully.

Peelings should be put in buckets and disposed of as soon as possible since they attract flies and other insects. They can be used for animal feed, as a mulch in fields or buried if there is no other use.

### Cutting and slicing

It is important to cut and slice peeled fruit to a particular thickness depending upon the kind of fruit being dried as:

- Thicker pieces will dry at a slower rate than thinner pieces
- Very thin pieces tend to stick to the drying trays and will be difficult to remove
- Thicker pieces may not dry fully and subsequently deteriorate after packing
- Packages of dried pieces of varying thickness appear relatively unattractive and may be difficult to market.

#### Key points on cutting/slicing operations

- Wash hands in clean water using unperfumed soap
- Ensure slices are of the correct thickness and even
- Discard any damaged or discoloured slices
- Handle slices with care
- Store slices for drying in clean bowls.

### Loading the trays

The trays should be brushed clean to remove any old fruit pieces. They should start to be loaded as the fruit is being sliced rather than waiting until all the fruit has been sliced or cut. This reduces the problem of the pieces sticking together in the bowls and will allow the drying process to start as soon as possible.

#### Key points on loading the trays

- Clean trays before loading
- Always have clean hands for handling fruit
- Load each tray as sliced fruit is produced
- Place slices close together on the trays
- Do not let slices overlap
- Place loaded trays directly into the dryer.

It is very important to lay the pieces on the trays carefully and as close together as possible without overlapping, to ensure that the trays are fully loaded. It is important to keep away flies and insects and to load the trays promptly.

### Loading the dryer

The dryer should be positioned in a flat area, unobscured by trees or buildings, so that it is fully exposed to the sun throughout the day. If the wind blows predominantly in one direction for long periods, the dryer should be placed end-on to the wind. This will reduce the cooling effect of the wind blowing directly into the drying cabinet and lengthening drying times. It will also reduce the likelihood of dust entering the cabinet.

#### Key points on loading the dryer

- Ensure dryer is in good condition and out of the shade
- Clean interior of dryer before loading trays
- Clean clear plastic covers
- Load trays into the dryer as soon as they are ready
- Close doors quickly after loading each tray.

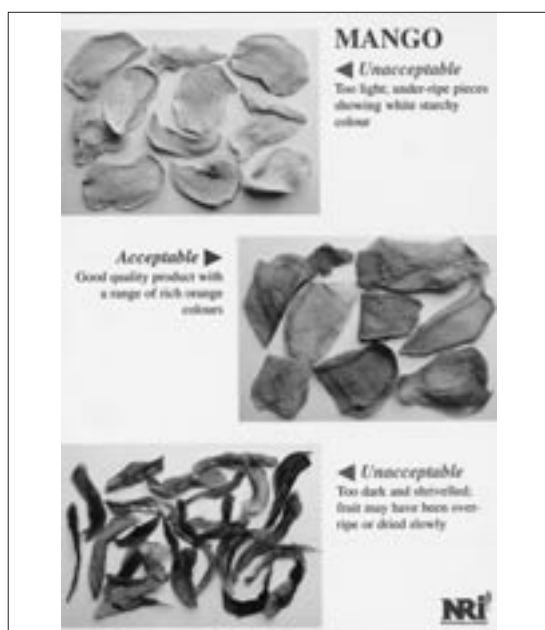
The outside plastic covers should be brushed or washed clean of dust since dirty plastic will reduce dryer performance and lengthen drying times.

### Drying

During the first few hours of drying, particularly during very hot and sunny weather, fruit may dry at such a rate that moisture condenses on the inside of the plastic covers. This can be avoided by opening the loading doors slightly (20mm) to increase air circulation, but covering the gap with mosquito mesh. This will only be necessary (if at all) on the first day and

#### Key points on drying operations

- Open doors if moisture condenses on covers for short times only (cover the gap with mosquito net)
- Check the slices are dry before removing trays
- Never leave loading doors open at night
- Prevent insects entering the chamber.



### Key points on unloading the dryer

- Do not unload early in the morning
- Unload trays in a clean and dry area
- Ensure hands are clean and, ideally wear clean gloves
- Unload dried slices into clean baskets
- Sort out poor quality slices.

Simple, low cost equipment is not available for measuring moisture content, but it is critical to achieve a low final moisture content for safe long term storage. The buyer of the products will check it as a critical factor when assessing quality. This is particularly the case if the products are to be sold into export markets: poorly dried products will result in future loss of sales to buyers and consumers.

### Unloading the dryer

When the fruit is considered to be dry, the dryer should be unloaded as soon as possible. This must not be carried out in the early morning since overnight dew and high humidity may cause condensation of moisture onto the fruit.

Trays should be removed from the dryer and taken into a clean and dry covered area for removal of the dried fruit. Operators must have clean hands and, ideally, wear clean gloves when handling the fruit. Over-dried (crisp), discoloured and under-sized slices need to be separated from the remainder. Under-dried slices should also be removed and, if space permits, replaced in the drier.

### Packing and storing

Packing should be carried out immediately after unloading the trays since the dried slices will re-absorb moisture and be susceptible to attack by insects and other pests. The dried product needs to be packed in clean plastic bags using clean hands and preferably clean gloves. For extra protection against damage, it is recommended to 'double-bag' the fruit inside a second bag.

Each bag should be clearly marked with the date when it is packed and the name of the producer. The packed bags should be placed in containers for temporary storage before despatch. They should be stored in a cool dry place which is secure and protected from rodents and other pests. Products should not be stored for more than one month before being sold.

during the sunniest part of the day (from 1000 to 1400 hours). The doors should only be kept open for a minimum period of time and closed again as soon as the weather becomes cloudy. The doors should never be left open during the night.

In poor weather drying will stop. If it rains, it will rapidly cool the dryer and this will usually result in the cover fogging over due to condensation. It will be some time before the dryer will start to work again once the sun returns. Ideally, putting a portable locally constructed thatched cover over the dryer in poor weather will help operations.

Under fine and sunny conditions the fruit slices should be dry after two full days in the dryer. However, it is essential to test the slices. If they are not sufficiently dry they will become mouldy and completely unsaleable in a short time. Judging dryness is an important skill and not an easy one to describe – it is easier to show. As a check, several slices should be removed from the dryer and allowed to cool for several minutes. The fruit may be sufficiently dry if:

- It is not possible to squeeze out moisture from the slices
- Tearing a piece in half, the middle is no longer moist
- Slices are kneadable and pliable, but do not stick together.

If the slices are not properly dried, drying should be allowed to continue for one to two hours and then checked again.

The final moisture content of the dried fruit should be around 10% on a wet basis.

*Reference card – Checking mango quality (part of the NRI package)*

### Reference

Producing Solar Dried Fruits and Vegetables for Micro and Small-scale Rural Enterprise Development. NRI Publications (1996).

1. Assessing Opportunities.
2. Dryer Construction.
3. Practical Aspects of Processing.
4. Business Profitability.

Reference cards – Checking product quality.



## More on marketing research – getting and staying ahead

### A quick re-cap...

In the last edition of Food Chain (issue 30) the article “Starting with the Market: The importance of Marketing Research” set out some practical guidance for micro- and small-scale entrepreneurs (MSE’s) on how to approach simple, yet effective marketing research.

Running a small business involves calculated risk taking so it is important for MSE’s to use tools that provide the information needed to understand and mitigate those risks. Following the steps in the Marketing Process ensures that a business is gathering information on which to make decisions rather than relying on instinct – which can sometimes prove disastrous.

The previous article concentrated on Steps 1 and 2, (see Figure 1) which for most MSE’s involves conducting a survey, focusing on customers, and also carrying out a short test marketing phase.

### Conduct a survey – focus on customers not markets

Very few MSE’s can afford to conduct elaborate market research, which typically is a broad study providing a wide and often in-depth picture of what the market is like for a product, including who the competitors are and the likely demand. Markets are constantly changing so this sort of research tends to get out of date very quickly. Instead smaller entrepreneurs should focus their energies on consumer research (sometimes called ‘Marketing research’ rather than Market research). This will give valuable information on how well the product is

likely to do in the market place.

Conducting a survey will give entrepreneurs the who, what, where, how much answers which will enable them to make decisions about what they want to do in the future. This is the basis of forming a marketing strategy.

### Test the market

Testing marketing is a very valuable exercise. Having completed a consumer survey the next step is to produce a batch of products which will meet the stated expectations of the target group. The products are sold with a view to learning about how the product is received.

- Is the quality acceptable?
- Is the price too high?
- Is the selling location getting maximum trade?

This can be a highly effective part of the research phase, before the product is launched and it will provide information on whether it is likely to sell well or if modifications are required, for example to the price, or quality. It is worth remembering that changes to the product as a result of customer feedback may not always mean increasing the quality. For example, the target group may prefer a more standard product at a lower price. It is important to remember that it is possible to “spec the product out of the market” – in other words make the quality too high so that the price is out of reach of the target group.

If setting up the business requires a significant amount of investment it is very important to conduct thorough marketing research. Then test marketing can be useful for fine tuning the “product offering” (i.e. not just the physical product but also the other attributes associated with the product such as convenience or image).

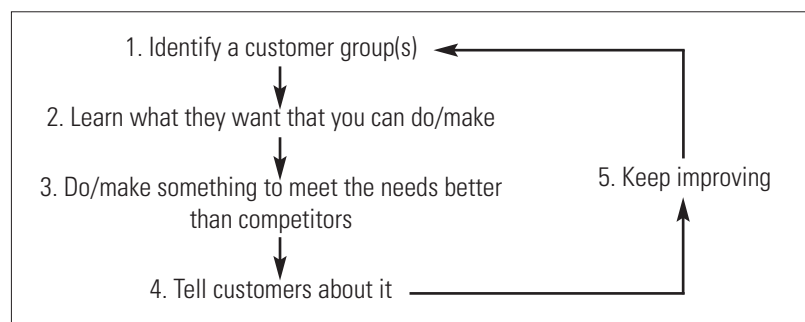


Figure 1: The Marketing Process

### Rapid Market Appraisal Manuals (FIT 2000)

These manuals are a useful, practical resource with guidance on how to conduct basic marketing research. They can be downloaded free from the ILO website. (Also available in Spanish from ILO Lima):

<http://www.ilo.org/public/english/employment/ent/sed/publ/index.htm>



### Step 3. Meeting needs better than competitors...

#### ...developing and maintaining “Competitive Advantage”

The last Food Chain article highlighted that understanding competitors is a valuable part of the research to be done before launching a new product. However, markets are not static and even a micro-entrepreneur with a bright or novel idea will soon find that other small businesses copy the ideas. For example, if one business starts selling a range of unusual icecream flavours or new snacks then it is likely that other producers will soon copy.

Therefore, developing “competitive advantage” is as important for a micro-entrepreneur as it is for a large commercial company.

#### Product differentiation

In a highly competitive market it can be difficult for a small-scale entrepreneur to find a point of difference – something that will make customers buy from them. Additional benefits or services are good ways of ensuring that customers develop loyalty. For instance, are there extra services such as free delivery or a discounted “top-up” that would attract potential customers and keep them loyal?

#### Customer service

Many businesses fail to realise how important customer service is, especially when it comes to keeping customers and developing a good reputation. There is no point in spending resources trying to get new customers if existing ones are

dissatisfied and do not make the all-important “repeat purchases”.

Supplying a product that meets with the agreed specification is crucial, as is timely delivery.

All complaints must be dealt with efficiently and fairly. This is particularly important for food products. If a customer complains that the product is not fresh, or they found a small stone in their snack the issue should be dealt with quickly. Many large companies have found that if they deal with a complaint properly their customers respond very positively. Feedback told them that their customers valued the fact that their complaint had been taken seriously and the incident helped to develop customer loyalty.

### Step 4. Promotion...

#### ... telling customers about the product(s) and the business

There are many ways in which entrepreneurs can tell people about their business and their products.

**Location** of the business is very important, particularly if there is direct selling to customers. If there is an opportunity to get passing trade then attractive, clear signboards are invaluable.

Once the customer is at the business location other aspects become important:

- Product display (not too cluttered, clean and appealing)
- Ease of access (customers can move around easily to look at products)
- Selling environment (letting customers see the products – maybe even touch or taste them).

#### Box 1 Competitive Advantage

##### Key question: What is different about the product?

What are the “attributes” that set it apart from other products:

**Features** – what it has and/or can do

**Quality** – how well made it is

**Design** – appearance and how it has been put together

List these factors, and then work out what the **benefits** are that give a customer a reason to buy the product, compared to a competitors.

Benefits might include:

Saves money	Lasts longer
Saves time	Tastes better
Is healthier	Is easier to use
Lighter to carry	Performs the task better etc

Adapted from Agar SED vol 10/4



**Selling tactics** – by talking to potential customers about the products, an entrepreneur has the opportunity to give them specific information that can lead to a purchase. Learning basic sales techniques will avoid wasting time e.g.

- Establish the customer's basic need - ask the customer what they want
- Emphasise a products benefits, not features (see Box 1)
- Offer the product to be held or tried
- Provide sales support materials (samples, pictures or photographs can be useful if selling off-site).

**Advertising** – is it worth it?

A micro-entrepreneur is likely to be wary of advertising because of the unknown response. It is important therefore to maximise the chances of a positive response to the investment in advertising and Box 2 offers some helpful tips. In particular it is important to be clear which groups of customers are being targeted so the adverts can be tailored.

#### Box 2. Key questions when designing adverts

- Who do you want to tell? (use different adverts for different groups)
- What do you want to tell them? (what is new, different or special)
- Where will they see your message? (what do they read, see, hear and where do they go)
- When is the best time to tell your message? (before or after pay day, before or after harvest)
- How will you attract their attention? (headline, picture, colour, strong benefit?)
- What do you want them to do next? (contact you – if so how? Buy the product – if so from where?).

Jason Agar SED vol 10/4

Key point: the most important promotion for any business is satisfied customers who tell others about the products and services.

#### Step 5. Keep improving

The Marketing Process, as the phrase implies is not a collection of "one-off" activities, but requires entrepreneurs to be constantly re-assessing:

- What existing and potential groups of consumers might want
- How it is possible to fulfil this demand better than competitors.

The environment a micro-entrepreneur operates in is always changing so they must:

- Get constant monitoring and feedback from customers
- Develop innovative ideas about how to keep one step ahead.

**Making for the Market – Facilitating User Led Innovation** (The FIT Manual Series 2000) is a good resource to help MSE's develop new products with valuable input from the end-users of those products – the customers or users.

The manual can be downloaded free from the ILO website (also available in Spanish from ILO Lima).

<http://www.ilo.org/public/english/employment/ent/sed/publ/index.htm>

These two articles have aimed to give MSE's practical tips on how to approach the area of marketing – which should be the starting point for any business. It has been shown that the steps of the Marketing Process are as relevant and useful to MSE's as they are to large companies – it's just that the focus and the level of investment may be different. For MSE's the key is to focus research efforts on customers. Information from existing and potential customers should be valued and acted upon. The worn, favoured adage of commercial marketing departments holds true for MSE's too: "The Customer is King".

#### Acknowledgements

This article has borrowed heavily from: *Marketing for the Local Market*, Jason Agar, Small Enterprise Development, Vol. 10 No 4, 1999.

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# Improvements to a grain puffing machine

In this article, Diana Colquichagua and Juan Ramos of the ITDG-Peru Food Processing Programme describe adaptations made to a grain puffing machine of Chinese origin that is widely used in Peru. The machine is referred to in Peru as the 'small cannon' (canoncito) due to the very loud noise it produces during operation when the pressure is released. ITDG-Peru has done a lot of work on food processing equipment, making technical changes to standard pieces of equipment so that they are more efficient and accessible to small-scale producers.

## Introduction

The 'small cannon' is a grain expander or puffer that is widely used by micro entrepreneurs in Peru's informal sector. The machine works on the principle that a rapid change in pressure causes moisture that is trapped within food to evaporate and therefore expand. Food grains such as rice, maize, wheat, barley and quinoa are used in the machine to produce a puffed cereal product. Puffed cereals are popular in Peru, mainly among children and adults as a snack food.

Technically the machine works by pre-cooking the grain in a sealed container, which is heated. This results in a very high internal pressure. When the pressure is suddenly reduced to that of the atmosphere, the water in the grain instantly vaporises resulting in a considerable increase in grain volume.

In grain expanders, the increase in pressure is obtained by providing energy in the form of heat. For example, at a typical pressure of 140 pound/inch<sup>2</sup>, the water would be at a temperature of about 175°C. It thus functions as a gas, and exerts a pressure on the walls that imprison it, in this case the grain.

Grain expanders submit the cereal to a sudden change of pressure. When the pressure is suddenly reduced to atmospheric the water instantly changes

to steam and forms micro channels in the grain. The effect of this is an increase in the volume of the grain (up to 2 or 4 times the original volume).

## Existing equipment in Peru

The most commonly used equipment in Peru is a small puffing cannon based on a design of Chinese origin and which costs about US\$185. It is used to make a range of products including *Cuculiche* (puffed rice) and *Trigo Atomico* (puffed wheat).

A quick look at the materials used to make the equipment helps to explain the low price. The iron puffing globe is fitted with a lid or door and is supported by a metal frame. The inside of the iron lid is coated with lead to allow the chamber to be hermetically sealed and to withstand the high internal pressures that develop during use. The equipment is heated

with a kerosene-fuelled blowtorch. A manometer is fitted to allow the internal pressure (and thus temperature) to be controlled. The mechanism is manual and in use the cannon is rocked in its frame to move and mix the cereal charge.<sup>1</sup>



D Colquichagua

## Improvements to the equipment

ITDG analysed samples of puffed cereals found in popular markets and discovered that they contained traces of lead, making them unfit for human consumption.<sup>2</sup> Ingested quantities of lead accumulate in the body and are not easily eliminated. Over time they can build up and lead to chronic poisoning.

Based on these analyses it was assumed that the lead was being introduced into the puffed cereal by the equipment during the puffing process. However, the evidence was not conclusive and more tests need to be carried out at different stages of the production process to confirm this theory.

While these tests were being conducted, several improvements were made to the equipment. The main improvements were to change the parts that come into contact with the food:



D Colquichagua



The canoncito in operation

View of the improved canoncito showing the Teflon coated door



- The inner lining of the globe was changed to stainless steel.
- The material inside the lid was changed to Teflon to ensure the machine would be hermetically sealed when closed.
- The heat generator was changed to a gas system to prevent the environmental pollution caused by kerosene.
- The manometer was replaced by a high-pressure electric resistant manometer system.

The services of a machine tool workshop in Lima were hired to make the changes. The advantage of this way of working is that the technicians in these companies are fairly experienced. At the same time, if the technology proves to have market potential the same firm will disseminate it.

#### Cost analysis and evaluation

The equipment has a similar appearance and capacity as the cannons of Chinese origin but the higher costs of the materials used in its construction resulted in the price increasing to about US\$600. Unfortunately this high price will prevent small-scale producers with limited resources from gaining access to the technology.

The equipment has been tested in the production process and compared with the original machines. In all other aspects the machine is a great improvement. It is much safer to operate and the products are not contaminated with lead, thus making them fit for human consumption.

The improved puffing unit has been acquired by a private micro-entrepreneur in Colombia and is currently operating in the city of Medellín.

#### Conclusion

In addition to being accessible to small and medium-scale enterprises, the improved technology also demonstrates a commitment to ensure that the machinery is safe to operate and that the products meet the appropriate quality standards and are safe for human consumption.

- 1 For more information, see the booklet on Puffed Cereals (Expandidos) produced by the Food Processing Programme of ITDG (1992).
- 2 Tests conducted on 11.11.01.

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#### Editors note

Considering that the improvements to the puffing machine, both with respect to safety of use and the food safety of the product, have resulted in the equipment being too expensive for the small-scale entrepreneur, it would appear that there is a need to carry out further research to see if the cost of the improved machine can be reduced. For instance, it may be possible to maintain the iron body of the original machine, and just replace the lead lining from the door rather than using stainless steel, which is expensive.



*Booklets in Spanish,  
available from ITDG*

# Food Chain

The International Journal of  
Small-scale Food Processing



**PRACTICAL ANSWERS  
TO POVERTY**

## Food Chain Features

November 2002 marks *Food Chain's* twelfth anniversary of production. During this time, thirty issues of the journal have been published, which represents a wealth of information on a range of themes and subjects. While some of our readers have been receiving the journal since the first issue, many of you have joined over the years. We thought it would be useful to provide an index or list of the articles that have

featured over the years. The titles are listed in the table below, classified according to subject area, with a reference to the journal number. Please contact *Food Chain* (FoodChain@itdg.org.uk or the address on the back cover) if you would like copies of any of these articles, or any back issues (subject to availability).

Nuts	Vegetables and root crops	Oils and essential oils
<ul style="list-style-type: none"><li>● Sun-bathed coconut meets market demand. (7)</li><li>● Making peanut bars. (21)</li><li>● Coconut processing in Vietnam. (22)</li><li>● Empowering small-scale cashew processor in Sri Lanka. (24)</li><li>● Some kind of nut –you can make snacks, cosmetics and cooking oil out of inchi. (26)</li><li>● Global agricultural practices for successful cashew development. (28)</li><li>● Harvesting/processing cashews. (28)</li><li>● Cashew sub-sector intervention strategy. (28)</li><li>● Strategies for addressing constraints in micro-scale cashew processing. (28)</li><li>● Sustainable use of the nuts of the soapwood tree in the Alto Mayo region of Peru. (29)</li><li>● Small-scale peanut butter processing in Tanzania – the experience of women processors. (30)</li></ul>	<ul style="list-style-type: none"><li>● Cassava. (1)</li><li>● Sago product development in Papua New Guinea. (2)</li><li>● At the root of tropical diets – cassava and sweet potato. (4)</li><li>● Processing a glut of potatoes. (4)</li><li>● Mushroom cultivation in Ghana. (10)</li><li>● A mouldy old business spawns some money. (14)</li><li>● Ways to use sweet potato. (16)</li><li>● Cassava –variation on a theme. (17)</li><li>● Utilisation of tomato processing by-products. (22)</li><li>● Cultivation of the oyster mushroom in traditional brick pots. (23)</li><li>● Cassava doughnuts. (24)</li></ul>	<ul style="list-style-type: none"><li>● Small-scale oilseed processing. (5)</li><li>● The ram press of Tanzania. (5)</li><li>● Diminishing returns in Bangladesh's oilseed sector. (5)</li><li>● Traditional technologies ease Mozambique's oil shortage. (5)</li><li>● Technical solutions in Nepal. (5)</li><li>● A well oiled industry – essential oil distillation. (5)</li><li>● Extracting oil from avocado. (11)</li><li>● Decentralised oil processing in Zimbabwe (leader and article). (16)</li><li>● Shea butter processing – some problems and possible solutions. (22)</li><li>● Essential oil distillation. (24)</li><li>● Citronella – the plant of a thousand properties. (24)</li><li>● Essential oil distillation in Ecuador. (24)</li></ul>

Fruit	Enterprise Development and BDS	Equipment
<ul style="list-style-type: none"> <li>● A date-like snack food from cashew fruit. (2)</li> <li>● Candied fruit production in Peru. (3)</li> <li>● Apricot magic in Pakistan.(7)</li> <li>● The solar drying of persimmon fruits. (10)</li> <li>● Utilising fruit waste. (12)</li> <li>● Preparing fresh fruit- cutting transport costs. (16)</li> <li>● Use of prickly pear fruit. (18)</li> <li>● Fruit factory in the forest. (21)</li> <li>● Adding value to bananas. (21)</li> <li>● Mango ripening. (21)</li> <li>● Training to process fruit. (23)</li> <li>● Solar drying of fruits and vegetables in Armenia. (25)</li> <li>● Production of melcocha and queso de tuna from cactus pear in the centre of Mexico. (26)</li> <li>● Small-scale production of ready to drink pineapple juice. (27)</li> <li>● Processing of wild bael fruit for rural employment and income generation. (27)</li> <li>● The preparation of pectin from tamarind kernel powder. (30)</li> </ul>	<ul style="list-style-type: none"> <li>● Training entrepreneurs in Sri Lanka. (6)</li> <li>● Decision tree. (6)</li> <li>● Food processing, small business and entrepreneur development. (6)</li> <li>● The business plan – a guide to your success. (11)</li> <li>● Processing for people and profit. (15)</li> <li>● Food processing training – some problems and possible solutions. (19)</li> <li>● Success in business – advice from a successful businessman. (21)</li> <li>● A profitable and sustainable small-scale food processing activity (pickles). (21)</li> <li>● Training in food processing – a sustainable approach in India. (24)</li> <li>● Women mean business in Sudan. (25)</li> <li>● Insights into supplying organic and fair trade markets – using a case study of cashew in El Salvador. (29)</li> <li>● Market testing new food products with illiterate and semi-literate consumers. (29)</li> <li>● Starting with the market- the importance of market research. (30)</li> </ul>	<ul style="list-style-type: none"> <li>● Tray dryer – adaptability for sustainability. (7)</li> <li>● Tubular pasteuriser for fruit juice. (10)</li> <li>● Low cost evaporative cooling chamber. (12)</li> <li>● Peanut stripper and sheller. (15)</li> <li>● The design and fabrication of food processing equipment. (18)</li> <li>● Seasonal profits from the Freezit Making Machine. (18)</li> <li>● Divergent roller fruit sorter. (20)</li> <li>● Low-cost multi purpose sand roaster. (20)</li> <li>● Peanut sheller. (21)</li> <li>● Appropriate palm kernel shell separator. (21)</li> <li>● Impulse heat sealer. (21)</li> <li>● Hand operated cashew cracker. (21)</li> <li>● A new device to prevent the contamination, loss and wastage of fruits and vegetables. (26)</li> <li>● Low cost mud solar dryer. (27)</li> <li>● Development of a low cost cooler to preserve perishable foods in countries with arid climates. (29)</li> <li>● No more fingertip shelling – the TEK groundnut sheller to the rescue. (30)</li> </ul>

Nutrition and health	Food processing methodology and QC	Packaging
<ul style="list-style-type: none"> <li>● Guatemala’s health snacks for children. (8)</li> <li>● Fighting disease with fortified foods. (8)</li> <li>● The best lemonade in the world. (8)</li> <li>● Targeting the vulnerable in Malawi. (8)</li> <li>● About aflatoxin. (17)</li> <li>● Weaning foods. (22)</li> <li>● Small-scale production of spirulina. (24)</li> <li>● Amirtham – a low cost, ready to eat nutritious food. (26)</li> </ul>	<ul style="list-style-type: none"> <li>● Using solar heat to disinfect grain. (7)</li> <li>● Some economic considerations of drying. (7)</li> <li>● How to turn waste into food. (9)</li> <li>● Biotechnology. (13)</li> <li>● Gluten measurement – QC article. (15)</li> <li>● The Pearson Square – common calculations simplified. (17)</li> <li>● Simple methods of quality assurance. (18)</li> <li>● Simple methods of quality assurance (19)</li> <li>● Principles of food dehydration. (19)</li> </ul>	<ul style="list-style-type: none"> <li>● Packaging in Sri Lanka. (12)</li> <li>● Packaging in glass – with resource page of contacts. (12)</li> <li>● Low cost vacuum packaging. (12)</li> <li>● Slatted wooden crates – transporting mango. (16)</li> <li>● A simple form-fill seal packaging machine.(17)</li> <li>● New packaging options for transporting tomatoes in India. (29)</li> </ul>

Honey	Fish	Safety and hygiene
<ul style="list-style-type: none"> <li>● Making money from honey. (3)</li> <li>● Innovations in beekeeping in Bangladesh. (10)</li> <li>● Quality of honey for export. (14)</li> <li>● Honey as an antibiotic. (27)</li> </ul>	<ul style="list-style-type: none"> <li>● Fish smoking – chorker smoker. (1)</li> <li>● Small scale manufacture of shrimp crackers. (23)</li> <li>● Improving some traditional Malaysian fish products. (30)</li> </ul>	<ul style="list-style-type: none"> <li>● Safety of street foods in Calcutta. (14)</li> <li>● Improving standards of hygiene. (14)</li> <li>● Sanitation and hygiene. (16)</li> <li>● Manual for the detection of mycotoxins. (21)</li> </ul>

Traditional foods	Dairy	Beverages
<ul style="list-style-type: none"> <li>● Food preservation by Turkana people. (19)</li> <li>● Promoting and protecting traditional food products. (25)</li> <li>● Irelands traditional foods. (25)</li> <li>● Mumu – a traditional method of cooking food in Papua New Guinea. (25)</li> <li>● Chepangs and chiuri – the use of non timber forest products in Nepal. (26)</li> </ul>	<ul style="list-style-type: none"> <li>● Cheese means business. (6)</li> <li>● Small scale butter making. (11)</li> <li>● Paramount dairy. (20)</li> <li>● Containerised dairies. (21)</li> <li>● The manufacture of yoghurt and cottage cheese. (24)</li> <li>● Using tree species to treat milk for palatability and preservation. (26)</li> </ul>	<ul style="list-style-type: none"> <li>● Honeybush tea. (20)</li> <li>● Small-scale processing of cocoa. (23)</li> <li>● Brewing is womens business. (30)</li> </ul>

Medicinal plants	Spices/flavourings	Additives/colours
<ul style="list-style-type: none"> <li>● Herbs that cure. (15)</li> <li>● The processing and sustainable management of Amazonian medicinal plants. (26)</li> <li>● Medicinal plants help combat climate change. (26)</li> </ul>	<ul style="list-style-type: none"> <li>● Processing of black pepper. (3)</li> <li>● Netetou – a typical African condiment. (10)</li> </ul>	<ul style="list-style-type: none"> <li>● Small-scale annatto processing. (3)</li> <li>● Production of a natural food colorant from turmeric. (17)</li> <li>● Natural colouring of food using insect pigments. (27)</li> </ul>

Sweets/snack foods	Cereals/starch and baking	Fermentation
<ul style="list-style-type: none"> <li>● Making sweetmeats using soy. (1)</li> <li>● Marketing snack foods in Asia. (1)</li> <li>● Facing up to competition in Peru – peanuts/crisps. (2)</li> <li>● Hello chou-chou – Goodbye dal bhat. (2)</li> <li>● A date-like snack food from cashew fruit. (2)</li> <li>● Importance of mishti in Bangladeshi culture. (9)</li> <li>● Making soy channa. (9)</li> <li>● Candy production. (22)</li> <li>● The sweet smell of success. (22)</li> <li>● Barefoot caterers in Sri Lanka. (27)</li> </ul>	<ul style="list-style-type: none"> <li>● Taking the water out of starch. (4)</li> <li>● The food for the future – Quinoa. (4)</li> <li>● Making the most of Nigerian ogi. (8)</li> <li>● Baking bread in rural Malawi. (11)</li> <li>● Bakers yeast. (13)</li> <li>● Bread making. (18)</li> <li>● Ecological flour with Pupunha. (20)</li> <li>● Artisanal production of maltose from cassava starch. (21)</li> <li>● The happy bread and biscuit factory. (23)</li> </ul>	<ul style="list-style-type: none"> <li>● Fermented foods –Sudan. (13)</li> <li>● Nata de coco. (13)</li> <li>● Bakers yeast. (13)</li> <li>● Yeasts, mould and bacteria. (15)</li> <li>● Indigenous fermented cereal snacks in Kenya. (15)</li> <li>● Wadian – a fermented Indian food. (17)</li> <li>● Tempe – a nutritious food for developing countries. (20)</li> <li>● Opportunities for fermented food products in developing countries. (23)</li> <li>● Improving madila- a traditional fermented milk in Botswana. (23)</li> <li>● Gundruk – a traditional Nepalese fermented food. (23)</li> </ul>

## Sugar

## General food processing

- Open pan sulphitation sugar processing. (17)
- New use for panela. (25)
- Old skills, new opportunities: small-scale food processing in Russia. (25)
- Decentralised food processing – fruit ice cream in Peru. (27)
- Food Chain – what impact does it have? (29)
- Information networks – crucial to the success of the food processing sector. (30)



# Designing a sustainable food processing project: ITDG's experience in the Peruvian Amazon



This article is an extract from a recent publication "ITDG's experiences with small agro-industries in San Martin, Peru". This project was carried out in two stages: field work over five years to design and implement a programme of training and technical assistance followed by policy recommendations to resolve the constraints that face small producers. The authors hope that these experiences will prove useful to others designing complex food processing projects.

## Phase 1

Between 1996 and 2000, ITDG Peru, with funding from the British Government Department for International Development (DFID), carried out a project to promote the development of small agro-industries in the Amazonian San Martin area of Peru. The aims of the project were to establish enterprises in the two principle towns, strengthen the demand for local raw materials and increase employment possibilities for poorer people. The project worked to strengthen some 80 small enterprises as shown in Table 1.

**Table 1. Types of enterprise supported by the project**

Products	Number of enterprises
White rum	22
Wines	9
Milk products	14
Bakeries	18
Meat products	5
Fruit products	3
Milled products	2
Miscellaneous	7
Total	80

## Criteria for selecting beneficiaries

Market surveys were carried out to identify products with the potential to benefit small producers. The possibility of diversification and access to inputs and technologies in the region were also considered. Other factors considered were the motivation of the producers and their interest in working with the project, their potential for creating employment, the continuity of their work and their line of business.

## Training and technical assistance

Two stages of training were provided. The first was very general information on production, management and marketing together with assistance from specialist trainers. In the second year training and assistance became more specialised and was provided in response to the specific needs of the beneficiaries.

## Project impacts

The project resulted in an important feeling of ownership by the client group; on average this increased 28% with respect to the base line study. The effect was particularly strong in bakeries, in particular mothers clubs who took advantage of selling to the national programme of food aid (PRONAA). Other groups who showed significant improvements were producers of processed meats, butter, nougat, snacks and starches.

Employment increased by 40%, from an average of 2.7 workers per enterprise to 3.8 at the end of the project. Finally, incomes of companies increased by 56% by the end of the project.

## Phase 2 – the projects closing activities.

In 2000 ITDG negotiated a 20 month extension for the project during which time it would close. This phase had two goals:

1. To assist sustainability (obtaining inputs, credit and technical assistance)
2. To draw up recommendations to guide public policies and development programmes for small food processing enterprises in the region.

In effect ITDG was changing its role from implementer to facilitator for the activities.

This entailed a period of reviewing public policies and proposing new policies that would support the small-scale processor.

## Public policies

During phase one, a number of problems were identified that influenced the way the project developed. These were related to policies and legislation that blocked the development of small enterprises. Those felt most strongly by SME's were the costs



of formally setting up an enterprise and unfair competition.

In the second phase, the project aimed to influence public and private organisations in San Martin to improve policies and agro-processing SME programmes. The strategy was to improve interactions between public and private bodies and form a Micro-enterprise Working Group to influence the policies of public bodies in the area. Consequently, the Concerted Action Committee of Micro Enterprises (CACME) was formed. This Group has functioned regularly since February 2001 and its members include representatives from the Peruvian Association of Small-scale Entrepreneurs (APEMIPE) and a wide range of Ministries, local authorities and interest groups.

The Group had a strategic agenda and defined work responsibilities. It gave priority to actions with short and medium term impact and participated in debates over decentralisation at the national level. The Group created an Association of Agro-industries of San Martin.

Three main areas of work were identified by the group:

- The certification of quality of processed foods
- The intervention of the State to develop technical assistance and support for SME's
- Put in place regulations against unfair trading.

Quality certification is centralised in the Ministry of Health (DIGESA) in Lima and four major cities and they tend only to work in these cities. This results in high costs for SME's and encourages informal enterprises. It was suggested that the Ministry of Health should, through DIGESA, promote the new laws for SME's.

In the area of marketing of technical services, experiences of a successful national pilot project that provides training certificates could be extended to all areas of the country. Its impact in developing SME's is evident, and makes subsidies an efficient tool. The pilot project supported by the Swiss, working with local agencies, aims to convert the experiences to a national level. The Ministry of Labour has responded to this suggestion by proposing the re-launching of a National programme.

Unfair competition involves concerns over strategies and regulations to apply norms and policies of central government. The SME Working Group has formed a sub-group to initiate campaigns regarding the regulation and control of foods and to make certification and formation of SME's simpler.

### **Limitations of the experience**

At the end of the first phase of the project there were a few limitations that were overcome during the second phase (support for local supply of inputs and technical assistance, improved access to credit etc). However to improve the diffusion of experiences we need to strike a balance between our strategies and way of working and take into account, through lessons learnt, our own limitations. The following section looks at lessons learnt.

## **Lessons learnt**

### **Regarding the project design**

There was no strategy of prioritisation that would have helped to avoid dispersion of forces and resources. Work was carried out with a wide range of products (about 30) and 80 different enterprises. In addition, there were no serious efforts made to open dialogue between farmers and enterprise. This only occurred in the areas of wines and sugar.

### **Segmentation**

The project followed the criteria of the particular product but not the level of economic development of individual enterprises. Each group of enterprises should have received different support according to their needs which should have resulted in greater impact.

### **Regarding forming societies and the economies of scale**

In this area there is no tradition of working in associations or co-operatives. People work as individuals. However, given the small size of most of the enterprises, forming associations could help. It would allow them to meet demands for large orders which individually they cannot supply. In this area outputs of the project were minimal. Associations were formed but combined marketing and common brands were not developed.



### **Training and technical assistance.**

The training strategy in the first two years tried to cover too many areas, was too rigid and rapidly saturated participants with new information. This made them feel overwhelmed rather than competent. The shift to more flexible training and assistance that responded to specific needs proved to be more effective.

### **Developing the market for technical assistance**

The project worked with small enterprises assuming that the owners and workers could improve their livelihoods by developing the enterprise. No recuperation of training costs was involved. However during the closing phase enterprises began to pay for assistance, albeit with a subsidy. It is important that SME support projects consider mechanisms for subsidised payment for technical assistance.

### **Development of local capacities**

The project generated a strong dependency by SME's for the supply of inputs such as preservatives, packaging and equipment. Often these were bought in Lima by project staff, which distorted the real costs. The dependency was due to a lack of local suppliers and a lack of a strategy to strengthen local people by the project staff. While one of the project aims was local empowerment this was largely forgotten. Meeting project goals was made easier by acting as an implementor rather than a facilitator.

### **Access to credit**

The project addressed access to credit through bodies such as the San Martin Rural Bank but the results were limited. Funds were only made available to 30% of beneficiaries. There were poor systems of information between those supplying credit and the beneficiaries. During the second phase of the project the situation improved when two co-operatives became credit providers.

### **Influence on policies**

The lack of strategies to influence policies affecting SME's was a limitation during the whole project. This was most apparent in areas such as quality certification, regulation of unfair competition and

access to state buying programmes. In the case of quality the existing laws are too complex for SME's and demand a financial cost that they cannot afford. The centralised system, based in Lima adds to the problem. Never the less, lack of quality certification has a direct impact on viability as it impedes access to markets.

In the second phase it was planned to overcome these problems through the Working Group and the identification of critical points as a working agenda for those involved. This suggested to us that, in order to have a sustainable impact, it is necessary to work in the area of policy from the start of a project. For those involved in such work it is important to assure that better methods of promoting SME development is translated into policies of the State.

### **What the small enterprises did**

This project was based on the principles of Fritz Scumacher who founded ITDG. He believed that is essential to understand what small-scale producers do and help them to do it better in a participative way. In the area of markets this means promotion of products in San Martin rather than in large cities. This second action may have had greater impact but would have required a totally different strategy. The objective of this project was to make changes in local micro-enterprises to benefit poor people.

### **Strategies for agro-industrial development**

We can now review and rethink the model used. We believe that support to small-scale producers of foods and drinks must concentrate linking value added chains of all those involved. This will allow chains of added value targeted at extra regional markets. In other countries in the region there have been important developments based on this idea. In Colombia the theme has been called "productive chains". The focus should be based on extra-regional demand that can be produced, with added value, in San Martin. This requires a study of the local demand for training and technical assistance from which a strategy for technical and financial support could be designed.

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# The Hohenheim solar tunnel dryer – 20 years of success

With nearly twenty years experience of drying in tropical and sub-tropical countries, the authors briefly describe the Hohenheim solar tunnel dryer and report some of the features of the dryer and of drying in general that have contributed to the success of this model. The dryer was designed and developed by the Institute for Agricultural Engineering in the Tropics and Subtropics of Hohenheim University and the Innotech Ingenieursgesellschaft, in Altdorf, Germany. A significant amount of research and development has gone into the design of this dryer and the resulting model is carefully engineered to give optimum performance.

## Introduction

The solar tunnel dryer, which was developed in close cooperation between the Institute for Agricultural Engineering in the Tropics and Subtropics of Hohenheim University and the Innotech Ingenieursgesellschaft, has proved to be successful in drying agricultural produce in more than 60 countries of the world.

## Design of the Hohenheim solar tunnel dryer

The Hohenheim solar tunnel dryer was invented for use in sunny areas of tropical and subtropical countries and over the years, with some modification, it has become fully adopted to the prevailing conditions in these areas. Its design focused mainly on overcoming the existing bottlenecks in this conservation technique, which include the availability of a reliable energy supply, paying attention to the hygienic conditions of processing and consideration of the labour requirements. The design of the solar tunnel enabled even small farmers or women groups to produce high quality dried products without permanent supervision of the drying process.

The solar tunnel is one of the few solar dryers that were successfully introduced for the processing of dried products. Nowadays it is used by different target groups and for drying of most types of agricultural produce including fruits, vegetables, spices, medicinal plants and marine products. The dryer is used by research institutions, farmers and small co-operatives, womens' groups and small and medium sized businesses to produce anything from several hundred kg up to around 150 tonnes of dried products per season.

## Size is important

The capacity of the solar tunnel dryer, which is in the region of 150 to 250 kg per batch, mainly depends on the crop itself and the shape. On the one hand, it is not too big to ensure that the preparation (washing, slicing and pre-drying processing) of the product to be dried can be completed within a certain time period. On the other hand it is big enough to enable the user to generate income and thus to create new jobs. In comparison to natural sun drying or to natural convection type solar dryers, the use of the solar tunnel dryer leads to a considerable reduction of the drying time and a significant improvement of the product quality in terms of colour, texture and taste.

The solar tunnel dryer, which basically consists of three major components - the Photovoltaic (PV) drive, the solar air heater and the drying compartment – has proved to be very robust and reliable. The drying system is described in detail in the reference by Esper and Mühlbauer (1996). Even under adverse conditions, it has a life span in excess of 5 years. The only part that may need replacing from time to time is the plastic cover. The life span of the plastic cover is mainly dependent on the location and the care taken of the material. The dryer is only available in one size and costs Euro 4994 plus Euro 332 for packaging.

## Ensure the success of the dryer

Although the introduction of the solar tunnel dryer has been a considerable success – there are over 1000 units in operation in more than 60 countries - the

### Key words

Solar dryer, tunnel dryer, drying

A Esper



Construction of the tunnel dryer



experiences of the past two decades show clearly that certain preconditions have to be met. These preconditions and limitations include the following:

- Consideration of the nature and geographic location
- Consideration of the users needs and prevailing local conditions
- Consideration of the local and international markets.

process cannot be started before noon, half of the day's solar radiation will be wasted, resulting in a significant reduction of the capacity, since the drying process cannot be finished on the same day.

- The performance of the solar tunnel dryer is significantly dependent on the weather conditions. Both the heat required for removing the moisture as well as the electricity necessary for driving the fans are generated by solar energy only. In addition to the pre-treatment of the product, the weather conditions have the biggest influence on the capacity of product that can be dried within a certain time period. The drying time is short under sunny conditions and accordingly extended during adverse weather conditions. The difference in drying capacity between dry and rainy season has to be



A. Esper

These factors have to be carefully considered and taken into account when designing a solar dryer (or any dryer) for a new venture to guarantee the desired successful utilisation of the solar tunnel dryer.

### Lessons learnt

Over the last twenty years, staff at the University of Hohenheim and Innotech Ingenieursgesellschaft have gained a wealth of experience of solar drying in a range of climates and conditions. The main lessons learned from these experiences are as follows:

- The solar tunnel dryer is a very helpful and necessary tool for the producers, but the production of high quality dried products requires the optimisation of each single step within the processing chain and not only of the equipment used for drying. Non uniform sulphuring of the products will lead to a non-homogenous product after drying, independent of the dryer used. The process should be well thought through and the capacity of machinery and staff at each step should be large enough to ensure a smooth flow of material for processing. Disorganised and untimely preparation steps will lead to a delay in loading the solar dryer. If the drying
- taken into consideration for the calculation of the yearly capacity of the dryer. The influence of the weather conditions on the quality of the dried product is under normal circumstances negligible.
- The utilisation of solar energy as the only energy source offers the possibility to use the solar tunnel dryer at nearly any sunny location, even in remote areas without access to the mains electricity or in areas without reliable energy supply. The operational cost of the solar tunnel dryer in terms of energy amount to zero.
- Furthermore the dependency of the performance of the PV-drive on the solar radiation shows certain advantages over grid-driven fans. The fans of the solar tunnel dryer are directly coupled to the solar panel, which results in a simple and therefore very reliable system. However, the downside of this system is that it also produces a fluctuating air flow rate – the air flow rate is high under sunny conditions and low when clouds appear. By using a well adapted direct coupled system, the maximum temperature within the drying chamber can be automatically controlled and adjusted to a certain level by the number of fans installed. The maximum

Completed dryer



permissible drying temperature will be exceeded only for a short time period, which is a prerequisite to ensure that the product quality does not deteriorate. Moreover, due to the higher temperature level inside the drying chamber the drying process will be accelerated, resulting in a shorter drying time.

- The adaptation of the characteristic curves of the blade and motor of the fan, as well as the solar panel, is of great importance for the performance of the drive. In particular, it is essential to ensure that the fan starts to operate even at low levels of radiation. This is necessary to remove the moisture from the drying compartment so as to prevent spoilage and or growth of mould and yeast. Cooling fans of cars, which have been used instead of the original ones in several attempts due to their ease of availability and low cost, do not meet this requirement and should therefore not be used.
- The solar tunnel dryer is appropriate for the proper and safe drying of most types of agricultural produce cultivated in tropical and subtropical countries. This is one important prerequisite to guarantee the desired quality and economically viable year-round production of high quality products. Another prerequisite for the production of high quality products is the use of high quality raw material. Even the solar tunnel dryer cannot be used to refine poor quality of raw material into a high quality dried product.
- Moreover, a very important prerequisite for the successful utilisation of the solar tunnel dryer is the access of the producer to the market and the knowledge of the specification of the customers. It is of great importance that there is a price differentiation according to the product quality and that people are requesting and willing to pay for the more hygienic product.
- During the rainy season, which is not the best season for the utilisation of any kind of solar dryer, the most efficient method of using the solar tunnel dryer is in combination with an artificial dryer.



A. Esper

If the weather conditions are fine, the product can be dried as in the dry season, using only the solar tunnel dryer. While under rainy conditions, the product will be pre-dried during the daytime in the solar tunnel dryer and dried to the final moisture content at night time in the artificial dryer. This method is also suitable if the production has to be extended due to an increased request for high quality dried products.

- Numerous attempts have been made to copy the original solar tunnel dryer to make use of locally available material and to significantly reduce the investment cost. The experiences have shown that this has only been totally successful in a few cases. In most cases it was not possible to significantly reduce the investment cost without lowering the performance and the life span of the system. Also, the efficiency of the original version was not reproduced. The most successful replicas of the tunnel dryer have been made under licence in Vietnam and Turkey, where the construction was carried out step by step and in close cooperation with or under direct supervision of the producer of the original solar tunnel dryer.

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*Solar dryers in operation  
in Turkey*

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# The modernisation of small business through the EcoStove in Nicaragua



In many parts of the world women earn income by cooking foods for sale, often as fast street food. Commonly, such food is cooked over a simple three stone fire that is extremely fuel-inefficient and also presents a health hazard. In this article the authors demonstrate that the use of improved cooking systems not only greatly reduces health problems caused by smoke and burns, but also adds to the profitability of a business.

## Introduction

In Nicaragua and in many other countries, most women spend a great deal of the day cooking over a traditional three-stone fire. Burns are common and the family breathes in smoke which damages their health. After diarrhoea, acute respiratory illness is the leading cause of death in young children in Nicaragua and the culprit of this health crisis is an archaic fire design that begs for modernisation.

The traditional three-stone stove also adds to the economic difficulties of families and women who use the stove for income generation due to the combustion inefficiency and the huge demand for wood. To heat small amounts of food, women will often place large pieces of wood or the entire trunk of a small tree (Figure 1) into one side of the stone structure. Much of the heat is dissipated, rather than being directed at the food being cooked.

In Nicaragua, the typical meal is *nacatamale* – a mixture of maize, vegetables and meat that is boiled for two hours inside a wrapping of plantain leaves. Many women set up small

businesses cooking tortillas (an unleavened maize “bread”), soups and quick meals and this is often the main income-generating activity for a family. As the unemployment rate has risen very rapidly many women are forced to support an entire extended family on the small income of a cooking enterprise. Many sell food products from the backdoor of a home or from a street-side stand in the hope that the small profits will sustain the family until a husband or older child might find work. Younger daughters, and occasionally sons, will contribute to the mother’s enterprise by shaping tortillas or feeding the fire—further increasing their health problems and adding to the economic burden of buying constant fuel wood.

In the capital, Managua, and in smaller cities a new variety of stove is finding acceptance as an alternative to traditional three-stone models. The EcoStove, an efficient enclosed stove, was first developed in Honduras under the auspices of Proleña, an NGO devoted to sustainable energy development in Latin America, with technical support from APROVECHO and financial support from TREES, WATER and PEOPLE, (both US based NGO’s).

R de Miranda



R de Miranda

In the EcoStove the fire is entirely enclosed within a ceramic firebox placed within a casing of insulated material such as pumice rock (Figure 2). Above the fire there is a plancha (a large metal griddle) that is heated directly by the flames and also by the hot gases (smoke) being circulated under the plancha. The smoke leaves the stove via a chimney (Figure 3).

## Key words

Stove, business, health, smoke, profit, EcoStove

Figure 2: The EcoStove

Figure 1: Cooking on a highly inefficient stone stove



Nicaragua

## Central America

### The Advantages of the EcoStove

The small firebox and insulation results in a 50% reduction in wood consumption and the smoke produced is also halved compared to an open fire. In addition, as the firebox, plancha (heat transfer surface) and the chimney are all connected in a sealed system, there is no air pollution in the building.

Women can place various cooking materials on the surface of the EcoStove without fear that smoke will contaminate the food. This greatly improves the quality of the cooked products. Moreover, they can cook tortillas directly upon the surface of the stove. This particular design overcomes many of the aspects of a three-stone fire that so directly damage the health and economy of a Nicaraguan family. Women who once complained of constant breathing problems, headaches or diminishing eyesight while working over an open fire now work in the comfort of clear air and clean conditions.

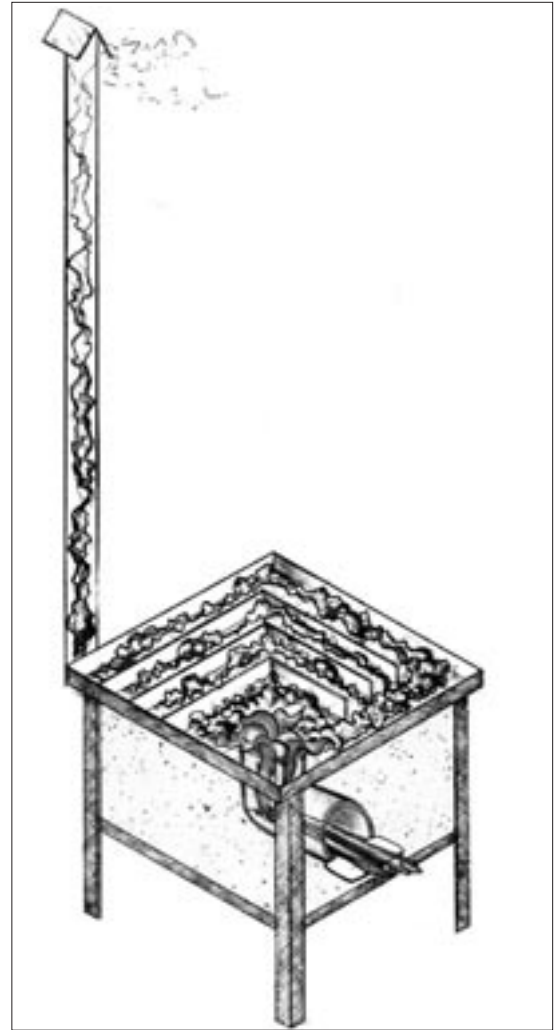
Cleaner air, however, is not the only advantage of an EcoStove. Whereas families would once spend a significant part of their income on firewood they now save 50% of their fuel expenses. For Luisa Hernandez, from Managua, the departure from a three-stone stove style to an EcoStove marked a dramatic shift in lifestyle.

#### Case Study 1: Doña Luisa Hernandez

Besides caring for the home and child of a foreign couple during the week, Doña Luisa maintains a flourishing business in her home selling nacatamales during the weekend with the help of her daughter. 'The difference,' she says, 'is the huge savings in firewood.' With her old stove, Doña Luisa complained of watery eyes, stuffy nose, breathing problems, headache and a chronic cough and never-ending cleaning due to a build up of soot within the home and economic

difficulties stemming from the cost of wood. Every two to three days, she would have to spend 80 córdobas (US \$5.90) on firewood. The cost of wood cut into her profits as one nacatamale sold for only 8 córdobas (US \$0.59).

Doña Luisa works all weekend selling nacatamales, soups and sometimes a traditional meat dish to people in her neighbourhood [Figure 4]. Now, she says, the *plancha* is much better and hygienic and everything is always clean. It is just much more economical. She used to buy 12-15 cords of wood to make 80 *nacatamales*; now she can make the same amount with only five or six cords. This helps the family greatly. Now, my cooking takes less time and costs less too. The profit from 130 *nacatamales* that she sells each weekend on the new stove helps to send her children to university. 'My husband thinks the purchase of the stove was a good decision.



R de Miranda



R de Miranda

Figure 3: Schematic of an EcoStove

Figure 4: Making nacatamales



Nicaragua

### Case study 2: Janet Socorro de García

Another woman supports her family with a street-side tortilla business that she started four years ago when her husband lost his job. Working in a small zinc shack with a table and two EcoStoves she makes about 250 tortillas every day on each stove. She sells three tortillas for one córdoba (US\$ 0.07).

She works from five in the morning to six in the evening and then spends the rest of the night processing the corn for the next day's tortilla production. She says that her business is 'very, very important' and that it 'completely supports' the family and that with the improved stoves she only uses a fraction of the wood. The concept of an economically advantageous stove is welcome because it augments the profit of the family business.

Her sister was highly sceptical about the US\$60 purchase of an EcoStove because it seemed an excessive and unsure investment. Very soon, however, she became convinced of the economic advantages and bought her own pair of stoves.

R de Miranda



### Case Studies

As this article shows, abject poverty in Nicaragua has forced women to fend for their families through the establishment of small family-run businesses. The use of improved, fuel-efficient stoves can have a major impact on the profitability of the enterprise through savings on fuel. Other benefits include improved health and reduced environmental impact.

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*Rogério Carneiro de Miranda is a Brazilian forester working since 1992 in Central America. Concerned with the ecological, economical and health impacts from wide spread primitive techniques of woodburning, he founded PROLEÑA, a NGO dedicated to promote modernisation of the fuelwood sector in Honduras and Nicaragua.*

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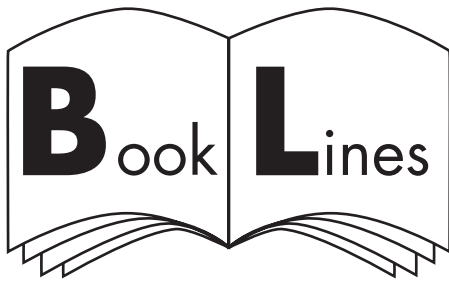
*For further information on the EcoStove, the authors can be contacted at Ecofogones y Reposición Forestal, PROLEÑA/Nicaragua, Apartado Postal C-321, Managua, Nicaragua. Fax (505) 249 0116 Email: prolenna@sdnnc.org.ni or, rmiranda@entelnet.bo*

### Editors Note

It is important to note, however, that the promotion of a stove design depends largely on the type of food being cooked and the traditional cooking and food preparation methods. In Sri Lanka, for example, the two-pot stove has been designed and developed to accommodate the traditional practice of cooking rice and curry. The two-pot stove allows a combination of high temperature cooking for curries with lower temperatures for cooking the rice. The EcoStove may not be as efficient as the two-pot stove in this particular situation. Numerous stove designs have been developed to meet the particular cooking habits in different countries. Further information on stoves, household energy and the use of appropriate energy can be found in the ITDG journal Boiling Point.

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*Figure 5: Reducing wood consumption by using EcoStoves to make tortillas*



Note: NFTRC was formally called Botswana Food Laboratory, which evolved into Food Technology Research Services (FTRS), a department under Botswana Technology Centre. In November 1999 FTRS was granted autonomous status and became NFTRC.

### Opportunities in Food Processing: Setting up and running a small food business

*Edited by Peter Fellows and Barrie Axtell. Published by CTA, Postbus 380, 6700 AJ Wageningen, The Netherlands. ISBN 92 9081 246X*

**Opportunities in Food Processing** is a record of both pitfalls and tested practical solutions that a potential and an existing business operator needs to be aware of in order to succeed. In essence, the book describes a critical "pathway" that every entrepreneur must walk. It reflects the immense knowledge and experience of the authors on setbacks associated with food processing in the developing world. This book is a very well thought and well organised guide that should serve as a valuable "companion" for all entrepreneurs and beginners in the food technology profession. It should be an asset for every technology oriented institution.

The use of simple English throughout and the stylish inclusion of *tips for success*, *summary of chapter* and the *entrepreneur's checklist* in every chapter makes the book enjoyable and easy to follow. Several pictures and case studies are used to illustrate typical setups found in most small-scale processing businesses. Inclusion of these allows entrepreneurs to directly relate their businesses to the book.

The book is divided into ten chapters and three valuable appendices for starting entrepreneurs. Chapter one defines the food processing business, outlining different scales of operations and their advantages and disadvantages. The chapter also gives a guide on how to make best use of the book and gives a summary of all the other chapters. Chapters two to ten give detailed discussions of crucial sequential steps involved in setting up and running a food business.

Chapter two outlines the intrinsic and extrinsic factors that characterise and affect the product and the principles behind food preservation and processing that one needs to understand in order to manufacture a good quality product. Chapter three brings to light the essential pre-establishment assignments that every entrepreneur has to undertake in positioning his/her products in the market. The chapter also equips the reader with marketing tools for effective penetration of the market.

Quite often small-scale business people make informal trade deals with their clients (Gentlemen's agreements), which often lead to the downfall of their businesses. Chapter four discusses contracts, emphasising the importance of having such in every business deal. Examples of different contracts are given for reference.

In chapter five the authors highlight important points to consider in designing, constructing and equipping a food factory. Quite often it is not possible to get perfectly sized equipment that suits small-scale processing. Entrepreneurs tend to purchase whatever equipment they find in the market, and they usually fail to match the different pieces to construct efficient production

lines. This chapter assists with ideas of matching different pieces in a process line, and matching the process line capacity with the market size.

Chapter six takes stock of the legal requirements of any commercial food-processing establishment. The chapter discusses legal aspects of registration of the company, taxation and food regulations. This chapter is very relevant to developing countries where food regulations and food standards have just been, or are being introduced.

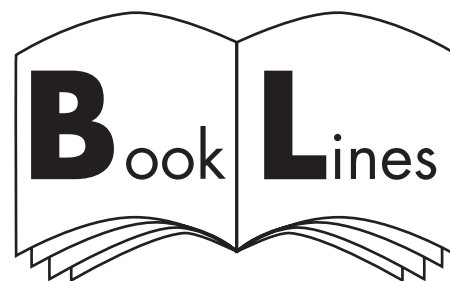
The rest of the chapters deal with typical managerial procedures required for optimal performance of the enterprise. Issues discussed include financial planning and management, the importance of business records, the benefits of good customer service, and general management of the enterprise.

#### Comments

**Opportunities in food processing** is very relevant to Botswana. The food industry in the country is at its infancy stage, dominated by micro- and small-scale enterprises. These have been shown to have a higher survival rate than the medium and large-scale establishments in all sectors of manufacturing. The Government of Botswana is availing financial assistance schemes to citizens to establish manufacturing enterprises, with the objective of diversifying the engines of economic growth. Financial schemes introduced earlier failed because most beneficiaries of the scheme either did not have the necessary skills to start and run a manufacturing business or could not assess opportunities effectively. This book comes as a valuable reference material to existing and potential food processors in the country, especially because professionals in food technology who could advise are very scarce. Enhanced use of the book in Botswana could lead to a well established food industry.

Whilst the book outlines the key elements to be considered when starting and/or running a food processing business, I think the authors should consider a special mini chapter which details typical characteristics of a *progressive entrepreneur*. I think such a chapter could serve as a 'mirror' for entrepreneurs to reflect on their business stance. Entrepreneurship development is a new concept in most developing countries and often everyone, even those who lack entrepreneurship spirit/character, end up wasting resources trying to become business persons. In my opinion, based on experiences in Botswana, entrepreneurship is a 'career', one needs to have prerequisite qualifications for it, most of which are centred on the individual's character.





## Professional Charcuterie

*John Kinsella and David Harvey. Published by John Wiley & Sons, Chichester, UK. ISBN 0-471-12237-8. www.cbipsbooks.com*

In general we advise small- and medium-scale enterprises against venturing into the processing of foods such as meat as they carry a very high public health risk. Mistakes can easily result in serious illness and even death. The high temperatures in tropical countries, combined with unreliable electricity supplies and cold chains make the risk even greater.

A recent survey, however, has shown that sausages, hamburgers, bacon and hams are being produced with considerable success in many countries by medium-scale enterprises. The market to tourists, expatriates and medium-class buyers is growing. Given this fact we feel that this book, which is full of information and recipes will greatly assist producers. It covers all aspects of meat processing,

including smoking, in clear simple language but without avoiding technical areas. Microbiological hazards and the action of nitrate and nitrate curing are, for example, covered in depth. We recommend this book as essential for all small-scale meat producers as it provides not only background information but also a large number of tried and tested recipes that will allow the development of new products.



# Books



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# Resources



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# Food Chain

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Contributions on all food processing related matters are invited for future issues of **Food Chain**.

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Our vision is of a more equitable and just world in which technology enriches and benefits the lives of poor people.

Our mission is to build the technical skills of poor people in developing countries enabling them to improve the quality of their lives and that of future generations.

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