

12. Economics: cash income, enterprise development, markets and trade

This chapter illustrates key economic aspects of insect gathering and farming, such as their potential to produce income at the household level or at larger, industrial scales. It presents key characteristics for developing insect-based enterprises, including how to bring insects to market, and provides data on trade in edible insects.

12.1 CASH INCOME

Gathering and/or farming insects can offer unique employment and income-earning opportunities in developing countries, particularly, but not exclusively, for the poor in urban and rural areas. In many cases, insect collection and cultivation can serve as a livelihood diversification strategy that provides multiple income-generating opportunities for households. For example, silkworms, ants and bees can be considered as multipurpose production systems: silkworms can be used for food and fibre, and weaver ants (*Oecophylla* spp.) combat pests and can be used as food (Offenberg and Wiwatwitaya, 2009b). In the case of bees, both the honey and the larvae can be harvested as food. For example, the Hazda foragers of Tanzania do not remove the bee larvae from the combs when eating the honey (Murray *et al.*, 2001).

In developed countries, insect rearing occurs mainly on family-operated farms. Presently, there are only a few large-scale industrial plants that rear insects. This section looks mainly at the income-earning potential that insects offer poor people in developing countries. The income-earning potential of rearing and processing insects in developed countries is described in following sections.

The large majority of insects used for food in developing countries are gathered from wild populations in nature, on farmlands or in forests. In addition to self-consumption by the gatherer and his family, the excess production of gathered insects can easily be sold for cash (or bartered) at local village markets or in street food stalls by the gatherer or their family members. As well as being sold directly to consumers at local markets, insects can be sold to middlemen and wholesalers at the farm gate. Their interaction and the number of middlemen involved, if any, will set the final price of the insect product for the end consumer.

Examples of insect prices are shown to give an idea of orders of magnitude and are taken from a wide variety of specific cases at the village level, in markets and online. These prices should not be used for extrapolation and should not be taken out of context. In Kenya, 1 kg of termites sells for €10 (V. Owino, personal communication, 2012). One can purchase 70 g of weaver ant pupae online for €7.50 in the United Kingdom of Great Britain and Northern Ireland. In the Netherlands, 50 g of the yellow mealworm and the lesser mealworm costs €4.85, and 35 migratory locusts cost around €9.99 online. In the Lao People's Democratic Republic, the price of grasshoppers is much lower, at approximately €8–10 per kg. In Oaxaca, Mexico, chapulines sell for around €12 per kg. At markets in Cambodia, one can (150–200 g) of fried crickets (*Acheta testacea* and *Gyllus bimaculatus*) sells for €0.40–0.70. Prices vary between rural and urban areas (C. Munke, personal communication, 2012).

In Thailand, middlemen buy insects from farmers to sell as food to wholesaler buyers, who then distribute the products to street vendors and/or retailers. Middlemen can also

BOX 12.1

Harvesting, processing and trade of mopane caterpillars

Women and children perform much of the work involved in harvesting and processing mopane caterpillars. The following tasks are necessary to produce a saleable product.

Collection. Women and children collect the caterpillars, preferably from short trees. When fully grown the caterpillars come down from the trees and are also collected on the ground.

Removing the gut contents. Fully grown larvae empty their guts before pupation. Most consumers prefer larvae at this stage. However, if not fully grown, the larvae need to be squeezed to remove the frass from the guts. The conventional way is squeezing between the thumb and forefinger. Some processors use a bottle as a roller to expel the frass. Buyers confirm whether the guts are clean by breaking the larvae in half. The spines on the larvae can puncture the hands of workers, causing discolouring, bleeding and sores. Some collectors tie bark fibres around their fingers or use gloves.

Roasting and drying. The processed larvae are roasted on smouldering charcoal to cook the caterpillars and remove the spines. Roasting also removes red colouration. Buyers check for signs of colouration to ensure that the larvae have been properly roasted. The caterpillars are then dried in the sun. Some people just add salt and dry them in the sun without roasting. Caterpillars prepared in this manner are only sold in local markets, as outsiders tend to prefer them without spines. Moreover, consumers in urban markets do not want salted mopane caterpillars because they have an undesired whitish appearance. The larvae may be boiled and then dried in the sun. As with salted and sun-dried caterpillars, boiled caterpillars still have spines, which reduce their market value.

Packing and blending. The caterpillars are packed in sacks or large tins to sell to traders or at market. Traders buy and repack the caterpillars in small packets before re-selling. Traders who buy mopane caterpillars in bulk from collectors usually mix low-quality larvae (e.g. those not properly squeezed out) with better-quality ones. This is called blending. A 35-litre bucket contains about 10 kg of mopane caterpillars.

Sales. Buyers rather than sellers determine the prices in most areas. The transaction often involves barter trading and the rate of exchange fluctuates considerably.

Transport and trading. Mopane caterpillars are often sourced far from the main markets, most of which are in urban areas. Traders often have to travel long distances to do business. Transport costs per unit of mopane caterpillars (travel cost plus freight cost) decrease as the weight of product being transported increases.

The traders. Women are confined largely to collecting and processing mopane caterpillars and to selling small volumes at open markets, sales points along roadsides, bus termini and municipal markets. Men generally dominate the more lucrative long-distance and large-volume trading chains of mopane caterpillars.

Markets. Mopane caterpillars are sold at a wide variety of outlets, both to consumers and to other traders. The major outlets are supermarkets and stores, bus termini, open municipal and roadside markets, and beer halls. Supermarkets are the main retail outlets for pre-packed and labelled mopane caterpillars supplied by wholesale food-packing companies.

International trade. At the time of the survey, mopane caterpillars from southern Zimbabwe were being traded to Botswana, the Democratic Republic of the Congo, South Africa and Zambia. Details of this trade are difficult to come by because of its informal and, in some cases, illegal nature (e.g. avoiding customs duty).

Seasonal fluctuations in availability and price. Local fluctuations in price throughout the year largely reflect variations in supply and demand. Some traders stockpile mopane caterpillars to sell during shortages, when prices are higher.

provide live insects as breeding stock for sale to farmers who start rearing operations (A. Yen, personal communication, 2012).

Consumers can buy processed and unprocessed insects at village markets, retail supermarkets and stations and from street vendors. Insects can also be consumed in restaurants, depending on the extent to which entomophagy is recognized in a given region.

In southern Zimbabwe, mopane caterpillars are sold at rural and urban markets, and several market players are involved (Box 12.1). In Thailand, both fresh and cooked edible insects are sold at local markets, wholesale supermarkets and minimarts (Box 12.2). They are available either precooked (at street carts and food stalls) or uncooked in frozen packages in supermarkets (Hanboonsong, 2012). They are also marketed in ready-to-eat and microwaveable packages.

BOX 12.2

Wholesale markets in Thailand

Well-known edible insect wholesale markets are Rong Kluea at Sakeaw Province (the biggest edible insect market near the Cambodian border), Klong Toey market (Bangkok), Talad Thai (Bangkok), and Jatujak market (Bangkok; this market sells mainly mealworms as edible insects for pet feed) (Hanboonsong, 2012). With increasing demand for edible insects, quantities of these insects are also brought into Thailand from Cambodia and the Lao People's Democratic Republic to sell at the Rong Kluea market. These imported edible insects are mainly collected in the wild.

12.2 ENTERPRISE DEVELOPMENT

People gathering insects in the wild for sale at nearby markets generally act on an individual basis in the same way as insect farmers. Box 12.3 summarizes the key feasibility issues to be taken into account when starting an insect-based enterprise.

BOX 12.3

Feasibility study before starting a street-food business

Market feasibility:

- types of street and snack foods sold (are insects already on sale?);
- selling prices of street and snack foods;
- types of customers (families, children, office workers, etc.);
- buying frequency of customers;
- quantities sold;
- competition;
- quality and safety required by customers.

Technical feasibility:

- processing and preparation methods required to provide the desired quantities;
- hygiene and safety requirements for processing;
- legal requirements for hygiene and safety;
- farm produce required to supply ingredients;
- equipment needed;
- labour needed;
- skills required.

Continues

Box 12.3 continued

Financial feasibility:

- start-up costs;
- operating costs;
- cash flow;
- profit potential;
- loans.

Source: FAO, 1997a.

12.2.1 Formation of cooperatives and associations

Insect product-based enterprises are still very much an emerging value chain. This means that there will be challenges, such as in legislation and the regulation of the edible insect sector, which cannot be solved by individuals. Therefore, stakeholders need to work together to further their common agenda, strengthen recognition for their activities and increase their bargaining power.

Associations and organizations are an essential link between decision-makers, NGOs and farmers. By offering a common voice to farmers and gatherers – in this case those who are involved in the edible insects sector – they can aid the planning, design and implementation of policies and programmes that directly or indirectly affect their livelihoods (FAO, 2007). In short, associations of insect producers (gatherers and/or farmers) may prove a powerful tool for the development of the sector. Box 12.4 provides an example of such an association.

BOX 12.4

The Dutch Insect Farmers Association

The production and sale of edible insects in the Netherlands started with the foundation of the Dutch Insect Farmers Association (VENIK) in 2008. Acknowledging the cultural barriers at play, the association opted for a long-term strategy that focuses on insects not only as food but also as feed and pharma. However, designing a future with insects as food requires action through lobbying, the development of business scenarios and roadmapping. VENIK is building a network at the national and international levels with market parties, knowledge institutions and NGOs. It has contacts with policymakers, politicians and the food safety authority. It also provides information on edible insects to professionals, consumers and the media.

VENIK maintains the hope that insects will one day be considered a nutritious, sustainable and credible source of protein. Special production lines are already in place to comply with HACCP standards. Three insect species are being produced for human consumption: the yellow mealworm (*Tenebrio molitor*), the lesser mealworm (*Alphitobius diaperinus*) and the migratory locust (*Locusta migratoria*). These insects are sold freeze-dried.

In the last few years, VENIK has been involved in developing legislation, quality standards and markets. The association is also building a knowledge base to promote acceptance and technical innovation at three levels: substantiation of insects as a protein replacement and techniques for automation; applying the knowledge gained; and performance of practical experiments.

Source: FAO/WUR, 2012.

Organizations can act as an alternative form of support when private and public services have failed. Moreover, they are free to operate in their own manner (FAO, 2007). Several producers at the Expert Consultation Meeting on Assessing the Potential of Insects as Food and Feed in Assuring Food Security at FAO in January 2012 issued a call for an international association of insect producers. Successful associations need to be market-oriented and effectively managed and must have a good organizational structure that clearly sets out everyone's rights and responsibilities, caters for the needs of all members, considers gender issues, and allows for freedom of speech. The benefits of creating and joining such organizations include (FAO, 2011b):

- reductions in the costs of buying farm inputs, production, processing and marketing;
- sharing and pooling resources and skills and the acquisition of new skills as a consequence of cooperation;
- lower transaction and transport costs;
- improved access to credit;
- improved capacity to access urban areas;
- more opportunities for market linkages;
- greater opportunities for training in hygiene, food preparation, business skills development, etc.;
- a unified voice for obtaining licences and permits for marketing from authorities;
- improved social cohesion among members.

12.2.2 Example of strategies for enterprise development: learning from other industries

It is estimated that sericulture can generate 11 workdays of employment per kg of raw silk production (in on-farm and off-farm activities). No other industry generates this level of employment, especially in rural areas; hence, sericulture is used as a tool for rural reconstruction. Sericulture also provides vibrancy to village economies – about 57 percent of the gross value of silk fabrics flows back to the rural cocoon growers (Umesh *et al.*, 2009). The Government of India's XI Plan (2007–2012) stated that extra research and development should be conducted to heighten production capacity, infrastructure development, human resources and other facilities. Production, employment and export rates all grew in 2010–2011 (Government of India, 2011).

The 2011 annual report of India's Ministry of Textiles (Government of India, 2011) provides details of marketing strategies for sales of wild "Vanya" silk products on international markets. The Vanya silk market promotion cell focuses on the promotion, product development and diversification of this type of silk, and has published a directory of manufacturers, traders, retailers and exporters. The promotion cell also organizes and participates in international exhibitions. For product development and diversification, the cell collaborates with the National Institute of Design, which investigates the current level of work, production and socio-economic status of the people, interacts with the artisans, and suggests designs and packaging for silk products.

12.3 DEVELOPING MARKETS FOR INSECT PRODUCTS

Production systems and livelihoods are being increasingly influenced by the demands of urban consumers, market intermediaries, and local and international food industries (Van der Meer, 2004). Against this globalized and integrated market backdrop, small-scale farmers, women, indigenous peoples and other vulnerable people face a disadvantage in market participation because they lack access to information, services, technology and credit and the capacity to offer larger volumes of quality products to market agents (Johnson and Berdegúe, 2004). Middlemen, oligopolies and monopolies often control markets, thus enabling them to determine substantial price increases and exclude small farmers from participation. In some regions of Mexico, middlemen have been found to exploit local indigenous people, who need money to buy household goods such as

pots, clothes and schoolbooks. This often prompts harvesters to continuously exploit the resource, causing pressure on ecosystems and lowering edible insect availability (Ramos Elorduy, Carbajal Valdés and Pino, 2012). Middlemen in Mexico have been found to pay as little as US\$30 to collectors for 1 kg of ant larvae of the genus *Liometopum* (known as escamoles), while the national intermediary sells them for US\$180 to their international counterparts (Ramos Elorduy, 1997). Setting up insect producers or farmers' associations would help address this problem and would be a crucial step towards developing new markets or diversifying existing markets for insect products.

Although insect gathering and rearing for food and feed in developing countries is carried out informally, selling the insects and/or their products at markets occurs in a more formal way. Insect markets and trade are relatively well structured within their own local contexts and form a network including producers/collectors, middlemen and sellers and processors. Nonetheless, when insects are not seen as an important, or even real, human food source, it can be difficult for actors to enter or create new markets. This section presents the many issues involved in bringing insects and related products to the market and gives examples of the market strategies of some companies that have or are developing specific markets for their insect products.

12.3.1 Accessing markets: the example of street foods

In developing countries, edible insects are mostly marketed as street foods. Insects offered in stalls and local restaurants are particularly popular in southern African and Southeast Asian countries. Street markets have existed for hundreds of years in both rural and urban areas and provide inexpensive food that generally reflects local diets. Street food is mostly sold to consumers directly. It provides an inexpensive food that is ready to eat on a daily basis. As such, consumers choose street food based on cost and convenience. These markets also follow seasonality of production and harvest and allow for variation in consumer diets. The economic contribution of these markets to developing countries is considerable but is often underestimated or neglected (FAO, 2011a).

While it is true that traders may not conduct formal market research, they certainly observe and learn from experience and adapt accordingly. Traders and vendors regularly experiment with and test approaches in marketing and selling: for example, small plates of prepared or unprocessed insects versus bulk sales and plastic bags; larger volumes and packages aimed at other traders and middlemen; and smaller portions aimed at end consumers. This type of testing and adaptation, based on observation and experimentation, is in fact a form of market research, even if not in the formal sense.

FAO published an overview of how this informal market functions that may provide inspiration and guidance for aspiring foodstall operators considering selling edible insects (Box 12.5).

BOX 12.5

FAO Diversification Booklet 18, *Selling Street and Snack Food*

Processing and preparation issues:

- the kinds of instruments and fuel sources needed – e.g. electricity, wood (taking into account cost);
- how to process the food item (taking into account the food item, insect species and traditions);
- how to package and label the food item (taking into account cost);
- how to transport the food item (taking into account cost);
- credit, loans and the availability of microfinancing for starting entrepreneurs.

Continues

*Box 12.5 continued***Basic questions:**

- What street and snack foods are in demand?
- What prices can be obtained?
- How to ensure food quality and safety?
- Who are the likely competitors?
- What level of sales can be made and where are the best selling locations?
- What are the travelling distances and times from the farm to the selling locations?
- How are the foods items to be sold (e.g. by street hawking or setting up a street stall)?

Marketing strategy:

- The vendor needs to have direct contact with the consumer in order to be proactive.
- Direct feedback of products should be obtained and tasting activities conducted.
- Free gifts and social interactions are important strategies.
- Food quality and safety and observing hygienic conditions are important elements of a marketing strategy.
- The choice of location and display is important, particularly the way in which the products are ordered, but also the impact of the sun on products. The presence of the vendor also constitutes a major part of the display.
- Decide what to sell.

Source: FAO, 2011b.

Packaging material can be made from locally available materials, provided that they are safe and hygienic and do not alter food quality. Leaves are frequently used as wrappers for street foods because they are cheap and readily available. Other locally available materials include clay pots and bowls for yoghurt, wooden boxes for bottles, and sacks made of plant fibres such as jute and cotton.

Street food enterprises are commonly family or one-person businesses and the majority operate without licensing within the informal sector. Studies in developing countries have shown that 20–25 percent of household food expenditure is incurred outside the home, and some segments of the population depend entirely on street foods. Street foods are especially popular in Asia. In Bangkok, 20 000 street food vendors provide city residents with an estimated 40 percent of their overall food intake (FAO, 2011a).

12.4 MARKET STRATEGIES

Insects and their related products can be mass-produced and sold for crop protection (beneficial insects), crop pollination (bumblebees) and health (maggot therapy), as well as for human, pet and livestock nutrition, for research, and a host of other uses on national and international markets, such as collectors' items. Many types of insects are sold live; however, insect products and byproducts probably account for the majority of insect commercialization (Kampmeier and Irwin, 2003).

Markets in developing countries are highly diversified, yet little is known about their establishment and development. In many cases, insects are also exported to other regional markets, as in the case of tarantulas and crickets in Cambodia. Due to the informality of this trade, little accurate information is available regarding the quantity of insects bought and sold on the market (C. Munke, personal communication, 2012).

A wide range of examples of market research and development, as well as strategies by companies to bring insects to markets in developed and developing countries, are given below. These examples show the wide variety of approaches ongoing in different markets in different countries, but are by no means exhaustive.

12.4.1 Insects as exotic foods in the United States

In the 1960s, the North American company Reese Finer Foods started selling chocolate-covered ants, bees, caterpillars and grasshoppers, French fried grasshoppers, French fried silkworms and roasted caterpillars. The initial idea of the Chicago food importer, Max Ries, who founded the company, was to import exotic food items such as Japanese seasoned sliced whalemeat and rattlesnake meat to please exotic palates. The next president of the company developed the idea and imported ants from Colombia and later Japan. The production of this novelty item ceased because of environmental movements against their importation. Today, Reese Finer Foods is still a distributor to grocery stores in the United States, but exotic foods no longer feature in its range of products.

12.4.2 Western approaches today: insects as novelty and exotic foods

The last decade has seen the return of insects to novelty and exotic food stores and delicatessen shops, especially in developed countries. Several kinds of insect have appeared on shelves, or are sold via the internet, in Europe, Japan and the United States. These products range from canned ants and silkworm pupae from Japan to maguery caterpillars from Mexico and fried grasshoppers. Canned white agave caterpillars have been exported to Canada and the United States. These cans contain only five or six larvae per can and sell for US\$50 per kg (Ramos Elorduy *et al.*, 2011).

The “novelty” concept is a marketing strategy for selling insects. Fried insects embedded in chocolate or hard candy, and fried and seasoned larvae, can be found in the United States, while the world’s most famous luxury stores, Harrods and Selfridges, sell fancy insect products in London. Exclusive chocolates topped with crickets dipped in gold paint are also sold in Brussels. Buying luxury products (with insects) directly from producers via the internet is also possible.

12.4.3 Insects as pet food

Some insects are imported from developing countries to developed countries for sale in pet shops. The Chinese company HaoCheng Mealworm Inc. exports 200 tonnes per year of dried mealworms to North America, Australia, Europe, Japan, Korea, South Africa, Southeast Asia and the United Kingdom of Great Britain and Northern Ireland, among others. The company sells yellow mealworms, superworms and fly maggots. The yellow mealworms are sold alive, dried, canned or processed into a mealworm powder. The superworms are sold alive, dried or canned, and the fly maggots are sold canned (HaoCheng Mealworm Inc., 2012). Mealworms and superworms can be used as a feed supplement for pets, including birds, dogs, cats, frogs, turtles, scorpions and goldfish. According to the company, the mealworms can also be used as human food – incorporated into bread, flour, instant noodles, pastry, biscuits, candy and condiments, and directly into dishes on the dining table.

In the Netherlands, companies that rear insects as pet food now sell mealworms and locusts for human consumption. Kreca is an example of such a company. However, mealworms are still a niche market in the human food industry, and these companies survive mainly through the sale of insects as pet food.

12.5 TRADE

The trade in insects as food to Western countries is driven mainly by demand from migrated communities from Africa and Asia, or by the development of niche markets for exotic foods.

A case study conducted in the Central African Republic observed that the principal importers of caterpillars were Chad, Nigeria and Sudan, via the Economic and Monetary Community of Central Africa. The Central African Republic also exports caterpillars to African communities in Belgium and France (Tabuna, 2000) (see also Box 12.6). Zimbabwe trades caterpillars to Botswana, the Democratic Republic of the Congo,

South Africa and Zambia. Mexican agave worms are exported to the United States (Ramos Elorduy, 2009; Ramos Elorduy *et al.*, 2011). Seven hundred tonnes of edible insects from the Lao People's Democratic Republic and Cambodia are imported for sale in Thailand because of high consumer demand (Yen, Hanboonsong and van Huis, 2013). Edible insects are also exported to the United States for supply to Asian communities (Pemberton, 1988). A particular example of international trade in Asia is the trade in Japanese wasps (Box 12.7).

BOX 12.6**Ethnic foods through migration:
the export of caterpillars from Africa to France and Belgium**

Mopane caterpillars are mostly exported from Africa to Europe. Annually, Belgium imports 3 tonnes and France 5 tonnes of dried mopane caterpillar (FAO, 2004), mainly from the Democratic Republic of the Congo (Tabuna, 2000). Congolese immigrants from the Congolese quarter in Brussels, Matongé, are the main consumers of the mopane caterpillar.

BOX 12.7**Japanese trade in wasps**

Insects are consumed in the mountainous areas of Japan during autumn. Although entomophagy has generally declined, the eating of wasps (*Vespula* spp. and *Vespa* spp.) can still be found. Wasp nests are sold in markets during the harvest season in autumn for the regular price of US\$100 per kg. As a result of increased demand, wasps are imported from China, New Zealand and the Republic of Korea. Increases in demand may lead to overexploitation. However, if such insects are to be used sustainably, appropriate commercial use depends on people's awareness of the insects' habitats and their habitat requirements.

Source: Nonaka, 2010.