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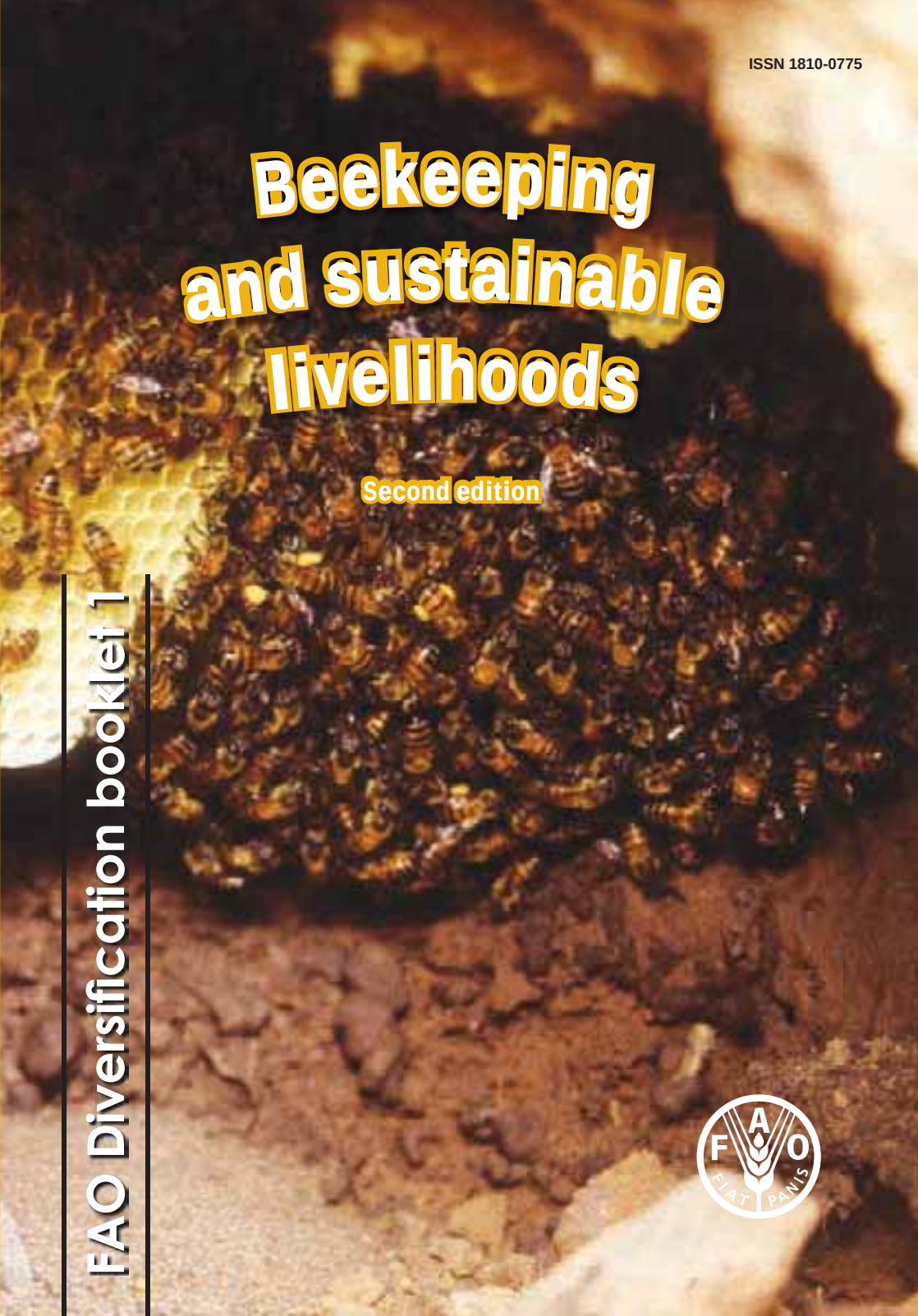
Beekeeping and sustainable livelihoods

Second edition

FAO Diversification booklet 1



Diversification booklet number 1
Second edition

Beekeeping and sustainable livelihoods

Martin Hilmi, Nicola Bradbear and Danilo Mejia

Rural Infrastructure and Agro-Industries Division
Food and Agriculture Organization of the United Nations
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Preface

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

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

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

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

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

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

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

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

Acknowledgements

This booklet considerably updates the first edition of the FAO Diversification booklet No1 *Beekeeping and sustainable livelihoods* written by Nicola Bradbear in 2003, but has used minor parts of the original text within this second edition. Moreover this second edition of the FAO Diversification booklet in the section on *The livelihood activity* has sourced from FAO.2009. Bees and their role in forest livelihoods, by N. Bradbear, *Non-wood forest products* No. 19, Rome pp. 32- 42 and FAO.2006.Value-added products from beekeeping, by R. Krell, *FAO Agricultural Services Bulletin* No. 124, Rome and Curtis, G. 1982. *Small scale beekeeping. Appropriate technologies for beekeeping*, Peace Corps, Washington D.C.

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Gratitude is owed to Doyle Baker, Senior Technical Officer, Rural Infrastructure and Agro-Industries Division (AGS), FAO, for his vision, encouragement and constant support in the development of the FAO Diversification booklet series. Martin Hilmi managed the development, production and post-production of the series and provided technical support and inputs. Michael Breece undertook the design and layout of the booklets and desktop publishing.

Introduction

In nearly all countries of the world bees and their products are not only well known and have wide consumer preference, but provide sustainable livelihoods to many small-scale farmers and other rural and non-rural people. Bees offer a large potential with minimal investments. As an agricultural enterprise beekeeping does not require land ownership or rental, it can be started with equipment and tools that can be sourced locally and in many instances skills and knowledge required for such an enterprise are found within local traditions. As a business enterprise it offers not only diverse products, for example honey and wax among others, which can be sold in local markets and become an important source of regular income for farm families, but can also provide complementary services, such as crop pollination. Moreover bee products improve farm family nutrition and can provide for traditional health care remedies.

FIGURE 1 Vendors selling raw honey in a variety of recycled bottles at a market
(Photo: FAO/ 24722_0506/G.Napolitano)

BOX 1 **Beekeeping and livelihoods**

Beekeeping tends to be perceived as 'a hobby', or as 'a sideline activity'. These descriptions may often be true, but a resilient livelihood – one that keeps people out of poverty – is one that has access to a range of options. In this case, apiculture and related trades can be sources of valuable strength to countless numbers of rural people's livelihoods. Rather than just a 'hobby', beekeeping may be seen as an important occupation and part of rural life worldwide. In rural communities where access to income is limited, small-scale beekeeping can contribute significantly to livelihood security. Apiculture and related trades tends to be underplayed in both policy and planning. One reason may be the focus of rural development, wherein crop production and livestock rearing are taken to be dominant activities in rural areas. This perspective can render invisible the part beekeeping occupies in social life, culture, and local economies.

Source: FAO.2009. Bees and their role in forest livelihoods, by N. Bradbear, Non-wood forest products No. 19, Rome

Bees and traditional knowledge: Honey hunting vs. beekeeping

Honey hunters can be found in many countries and are commonly involved in subsistence farming. They hunt for honey in the wild as a way to diversify their food supply as well as to sell honey. However fire and smoke that are used to rid the bees from their nests can destroy the entire colony, but can also ignite wild fires. This type of practice also affects the surrounding environment as pollination services are no longer available. This puts in jeopardy the honey hunter's livelihood as well as making crops and other plants in the area more vulnerable. Moreover the honey and wax obtained from such a practice are of low quality. For example honey can be sold with parts of honey comb in it, ash and brood. Wax from the honey comb is not marketed and is usually either thrown away or used as burning fuel.

Along side honey hunting, traditional forms of beekeeping have also developed over the centuries. In this type of beekeeping the small-scale farmer provides protection for the bee colony in exchange for periodic harvests of honey and wax. This protection may be as simple as providing a hole in a wall (see Figure 3), a clay pot or a basket attached to a tree branch so that bees can colonize it. This enables to harvest honey without destroying the colony and risking the important pollination services that bees can provide. The brood taken from wild colonies of bees is sometimes eaten by children as a protein supplement, but is not available on a constant basis, so contributes little to their diets and protein intake.

FIGURE 2 Farmer fells a tree to get at a beehive in its interior
(Photo: FAO/19138/M. Marzot)

FIGURE 3 Removing honeycombs from a hole in a wall
(Photo: FAO/19145/M.Marzot)

More advanced forms of beekeeping involve using purposely made hives (see Figure 4). This not only allows for ownership of the bee colony and its products, but importantly makes it easier to harvest bee products as bees can be kept closer to the farm household and /or can be moved with greater ease, for example to provide pollination services for fruit crops (see FAO Diversification booklet No. 16 *Fruit products for profit*). This, unlike, honey hunting provides far more reliable sources of honey products, on a regular basis and enables small-scale farmers to manage and control the bee colony, like any other agricultural enterprise. It enables more proficient and efficient management and commonly allows for higher yields and more regular supply of bee products for the market.

Beekeeping as a business enterprise and market potential

Beekeeping is a lucrative trade even using simple management

FIGURE 4 Beekeeping: increased populations of honeybees are required for optimal pollination of food crops and for the production of increased quantities of honey
(Photo: FAO/21761/R. Messori)

techniques, but needs to consider local culture and economy for it to be successful. Beekeeping as an enterprise fits in very well with small-scale farmers' livelihoods. It is not invasive; bees work along the natural patterns of local agro-ecological zones and provide positive impacts to the fauna and flora found within. It is an enterprise that can provide for employment, income and economic security for the farm family and others in rural areas. It requires little start–up investments, does not require complex technologies and techniques to start with and bees usually look after themselves, with little need for tendering. Bees provide for a plethora of products (honey, wax, pollen, royal jelly, propolis, venom, etc.) and are well known in many local markets. This provides a portfolio of products that a small-scale farmer can sell from a single farm enterprise. These products can also, with minimal processing, be 'transformed' into value added products, for example wax can be processed into candles, and honey can be made into mead (honey beer) (see FAO Diversification booklet No. 21 *Traditional fermented food and beverages for improved livelihoods*).

CASE STUDY 1 **Beekeeping as a business in Kenya**

David Mutai back in 1997 made his first simple bee hive. The idea to become a beekeeper came to him from his local school. He placed his first hive in a forest near a river bank and was able to harvest up to 20 kilos of honey per year which he used as food.

In 2002, David and other local youths came together to form Segemiat beekeeping self-help group. In 2003 the new group of enthusiastic beekeepers had their first contact with the Baraka Agricultural College/Self Help Development International beekeeping outreach project through the local Ministry of Agriculture extension worker. A local carpenter was trained on how to make improved Kenya Top Bar Hives. After training, the group collectively purchased a tree which they sawed up to make 31 beehives. In 2004 another tree was purchased and 45 more group hives were made. Making their own hives was much cheaper than purchasing expensive factory beehives and made the group self-reliant. In addition to hive making the group also received practical on-site training on beekeeping skills. Also members were trained in honey processing, business, leadership and how to train others through a Training of Trainers (ToT) modality.

Source: Adapted from Apiconsult. 2005. A beekeeping case study, the story of David Mutai (Available at http://www.apiconsult.com/beekeeping-case-study.htm)

BOX 2 **Ten excellent reasons for beekeeping**

1. **Pollination**
   Bees pollinate flowering plants and thereby maintain the ecosystem.
   Bees pollinate cultivated crops.
2. **Honey**
   People everywhere know and like honey, a valuable energetic and healthy food and income source.
3. **Beeswax and other products**
   Beeswax, propolis, pollen and royal jelly. These products have many uses, and can be used to create income.
4. **Few resources are needed**
   Beekeeping is feasible even for people with minimal resources.
   Bees are obtained from the wild.
   Equipment and tools can be made locally.
   Bees do not need the beekeeper to feed them.
5. **Land ownership not essential**
   Hives can be placed anywhere convenient, and so beekeeping does not use up valuable land.
   Bees collect nectar and pollen wherever they can find it, so wild, cultivated and wasteland areas all have value for beekeeping.
6. **Nectar and pollen are otherwise not harvested**
   Nectar and pollen are not used by other livestock: only bees harvest these resources, so there is no competition with other crops. Without bees these valuable resources could not be harvested.
7. **Different sectors and trades benefit from a strong beekeeping industry**
   Other local traders benefit by making hives and equipment, and from using and selling the products.
8. **Beekeeping encourages ecological awareness**
   Beekeepers have a financial reason to conserve the environment: ensuring that flowers are available and bees are protected.
9. **Everybody can be a beekeeper**
   Bees can be kept by people of all ages.
   Bees do not need daily care and beekeeping can be done when other work allows.
10. **Beekeeping is benign and environmentally friendly**
    Beekeeping generates income without destroying habitat.
    Encouraging beekeeping encourages the maintenance of biodiversity.

Source: FAO.2009. Bees and their role in forest livelihoods, by N. Bradbear, Non-wood forest products No. 19, Rome

Purpose of the booklet

The booklet's aim is to create awareness and promote beekeeping as a viable diversification enterprise for small-scale farmers. Its main objective is to demonstrate how beekeeping can become an important business for small-scale farmers in their agricultural endeavours and how this can support their livelihoods in rural and remote areas. The booklet is intended for all those working in rural development projects in public, private and donor organizations.

Benefits of the livelihood activity

Beekeeping at household level

In many countries beekeeping is a family undertaking, where men provide for harvesting, while women and children tend to honey extraction and processing. However this is not always the case as women, in particular, can successfully use beekeeping as a livelihood enterprise. It can be located in and around the farm household; it does not require excessive labour and time to manage, as bees do the majority of the work. Women do not have to travel far to tender the enterprise and it can be a ready source of cash in times of need, as bee products can be sold to neighbours or in local markets. This enables women to be part of an economic activity, which can provide them with income and an independence that can support them in difficult times. It is also a flexible activity, where there is no need for constant tendering, for example as with livestock and crops, and hence allows women to follow other matters on farm as well.

FIGURE 5 Small-scale farmers checking their hives in proximity of the farm homestead
(Photo: FAO/ 23504/L. Miuccio)

Honey, like other bee products, has a good energetic, tasty and nutritional value and contributes to the overall health of the farm family. In many societies bee products are used in traditional medicines and are an integral part of traditional health care.

Bees can also contribute to the pollination of home gardens (see FAO Diversification booklet No. 2 *Livelihoods grow in gardens*) as well as of other crops the farmer grows increasing food security for the farm family.

Bees do not require feeding, and only need a source of clean and potable water. Commonly they can forage in wild, cultivated and even land mined areas as well as in arid areas. During civil strife and war situations bees are one of the few enterprises that can provide farm families with much needed food and income.

Enhancing local skills, knowledge and traditions

In many rural communities and not only, various forms of beekeeping have been in practice for many years. By introducing beekeeping as a business and building on pre-existent skills will improve the knowledge and capacity of small-scale farmers. This will enhance local traditions in beekeeping, while developing such an enterprise to the benefit of many in the local community. Importantly this will not deviate from the use of acquired techniques and equipment in the locality, but enhance them and improve them, thus making up-take far easier and far more successful.

Integration into the farming system

Beekeeping fits in very well to small-scale farming systems. Beekeeping does not require land to be owned and/or rented and soil fertility is not an issue to consider. Feed is also not an issue as they forage on otherwise unused resources: nectar and pollen. In other words beekeeping does not compete for other resources needed by livestock and crops. Bees complement crops with their pollination of farmed crops and this in turn can increase crop yields. Some crops, for example that benefit from pollination services are sisal, cashew, papaya, coconut, oil palm, citrus, sunflowers and clover. Some of these also provide to be good nectar sources for bees. Many of the inputs required for beekeeping can be sourced and made locally and do not impinge on other farm activities and required investments. Products that derive from a beekeeping enterprise use little or any farm inputs, apart from labour in harvest and processing periods.

CASE STUDY 2 **Improved beekeeping in Ethiopia**

Ethiopia is a leading honey producer in Africa and one of the ten largest honey producing countries in the world. Despite the favourable agro-ecology for honey production and the number of bee colonies the country is endowed with, the level of honey production and productivity in the country is still low. The annual average honey production per hive is as low as six to seven kilos. One of the prominent factors for this low honey productivity is the traditional hive and the lack of improved beekeeping management techniques. With the aim of enhancing the level of honey production both in quantity and quality, the Improving Productivity and Market Success (IPMS) project introduced a participatory market oriented value chain development approach in Fogera and with a group of stakeholders worked on improving production, input supply and marketing. The project partners trained beekeepers on colony splitting, hive making and seasonal bee colony management practices. In addition, the project facilitated the establishment of a beekeeping input supply shop and advised beehive producers (carpenters) on the proper design of top-bar and frame-type hives.

The adoption rate of improved beekeeping has been improved substantially after skill development trainings took place and appropriate beehives were produced in the district. The number of improved beehives adopted in the district increased from 200 in 2006 to 882 in 2009, following the 2007 and 2009 beekeeping training through technical and financial support of the IPMS project. Through the beekeeping technology transformation, the average annual honey productivity per hive increased from 7 to 13 kilos. This was achieved by changing the hives from traditional to top-bar hives and frame hives. In addition to what has been achieved in enhancing the level of honey production, the technology transformation also improved honey quality substantially.

Source: Gebey, T., Berhe, K., and Hoekstra, D. 2010. Beekeeping development using value chain approach in Fogera district: experiences from IPMS project interventions, ILRI, Addis Ababa

Dietary contribution

Bee products provide for improved nutrition and consequently better health for farm families and others in local communities. Honey is a useful source of high-carbohydrate food, and commonly contains a rich diversity of minerals, vitamins and others, adding nutritional variety to human diets (FAO, 2009). Honey provides for improved physical performance, resistance to fatigue and improved mental efficiency (FAO, 2006a). Honey also is said to improve food assimilation (FAO, 2006a). It is commonly indicated as a 'lifesaver' for people in critical health (CTA, 2005b). Pollen also contributes to nutrition; however pollen that is consumed needs to derive from different plant sources to provide various nutrients to humans. Pollen contains a range of constituents: 30 percent protein, including all amino acids, a full spectrum of vitamins

and minerals, lipids, trace elements, etc. (FAO, 2009) Propoils is mainly consumed for its medicinal value, while royal jelly is claimed to provide, very much like honey, increased physical resistance and improved intellectual performance. However these properties have not been confirmed by scientific evidence.

Bee brood and adult bees are consumed in many countries and in some are considered as a treat. Brood and adult bees contain reasonable amounts of protein (FAO, 2006a).

TABLE 1 **Components of various bee products**

	Components and weight in %				
Product	Water	Protein	Fat	Carbohydrates	Ash
Honey	17 - 21	0.4	0	79 - 83	0.1
Pollen	25 => 11	22	5	31	3
Bee bread	20 => 14	20	3	24 - 35	3
Royal jelly	67	11	6	9	1
	' => ' refers to the moisture content after drying				

Source: CTA. 2005. Bee products; properties, processing and marketing, Agrodok No. 42, Wageningen, the Netherlands

FIGURE 6 A child being fed honey
(Photo: FAO/19179/M.Marzot)

Traditional medicinal value

There is a considerable history of bees and bee products having medicinal properties. Honey, pollen, propolis, wax, royal jelly and venom are seen by many to have curative properties, even though others suggest the contrary as a result of a lack of critical scientific scrutiny on bee products (FAO, 2009).

Honey is primarily seen in traditional medical systems as having curative properties. This derives from the fact that honey made from a particular medicinal plant (see FAO Diversification booklet No. 17 *Health and wealth from medicinal aromatic plants*) is traditionally assumed to transfer the properties to the honey. However these claims are not supported by orthodox scientific evidence (FAO,2006a). In terms of honey, scientific evidence sees honey as more of a food than a medicine, the benefits deriving more from nutritional effects. However, for example on topical applications honey has demonstrated accelerated wound healings in animals (FAO, 2006a). Moreover common bacteria, *Streptococcus pyogenes*, that cause sore throats, can be inhibited from growth with the use of honey (FAO, 2009).

In terms of beeswax claims are made that it has antibiotic properties and can be used for arthritis and nasal inflammations (FAO, 2009). Propolis is well known to have medicinal value and this has also been proven scientifically. It has bactericidal, fungicidal and antiviral effects. In sub-Saharan Africa, for example, it is used in herbal medicines (FAO, 2006a). Pollen, even though not being recognized as a medicinal drug, is used in traditional medicine, for such aspects as prostate problems. In terms of royal jelly claims are made on its positive effects on human beings, however, opinions differ and some argue that there is no scientific evidence to support such a case (FAO, 2009). Still claims are made of the use of bee venom and its positive effects on rheumatoid arthritis and tendon, strain and muscle injuries, however also here there are people who claim there is lack of scientific evidence to support such affirmations.

On farm processing

Beekeeping and its products, by there very nature, require on farm processing prior to being sold. This provides for opportunities in learning new skills and subsequent capacity building in small-scale farmers in terms of primary processing (see FAO Diversification

booklet No. 4 *Value from village processing*), for example cutting honey comb, extracting honey and filtering. This is a first step in setting up a processing enterprise on farm. Moreover with some minimal training small-scale farmers can learn valued-added processing methods for bee products, referred to as secondary processing (see FAO Diversification booklet No. 5 *Processing for prosperity*). This can produce such value-added products as honey sweets, honey soap and so forth. This importantly demonstrates to small-scale farmers that on farm processing, pending on market demand, can be an important source of value-added and increased income.

Processing is not only important for higher incomes, but also for food security and availability. Bee products that have been appropriately processed are available year round for farm family consumption, but also for consumption by customers in local communities

FIGURE 7 A selection of products made from honey and beeswax
(Photo: FAO/19181/M/Marzot)

Improved income

Many bee products have a good value on local markets and are easily tradable. Honey for example, requires few inputs, and has a good cash value related to bulk and weight. Honey is also easy to transport to distant markets, such as export markets. Honey, if appropriately extracted and processed can become a non-perishable, providing sales of the product well beyond the main harvest times. This can provide a more constant and regular income for the farm family.

Moreover many bee products with minimal processing can be made into value-added products that may not be related to agriculture. For example, beeswax can make candles; honey can be added into soap and so forth. This means more income for the farm family derived from selling value-added products, a source of regular income over the year as well as targeting non-agricultural markets with some of the value-added products.

In some countries there are charges made for pollination services carried out by bees on commercial crops. This has a value for the commercial crops as not only it increases yields, but also increases quality of the crops. This means that there is potential to charge fees for pollination services carried out by small-scale farmers' bees in their local areas.

FIGURE 8 Pots of honey on sale at a roadside market in Niger
(Photo: FAO/15409/R. Faidutti)

Social benefits

Bees provide benefits to many within rural communities. This ranges from improved crop yields as a result of pollination, to improved food and nutrition, an assured supply for traditional medicine and improved community health. In many cultures bee products are valued in festivities and ceremonies, such as births and marriages (FAO, 2009). This reinforces social ties and traditions.

Once more advanced beekeeping methods have been understood and practised for sometime it is not uncommon to find training in beekeeping methods conducted by farmers for younger people in the community. In some instances farmers visit local schools and give practical demonstrations to students.

Beekeeping can also create social benefits as for example when small-scale farmers join together to form an association, either formal or informal. This collaborative work, which fits in very well with beekeeping, especially during honey harvest time, can create scope for working together within a community and the people involved can see and experience the advantages and benefits of collaboration and social harmony.

FIGURE 9 A women's group assembles beehives as part of an effort to provide a new source of income for the village
(Photo:FAO/20894)

BOX 3 **The bee as an environmental monitoring indicator**

A viable and practical biological indicator is the bee as it can indicate environment degradation based on several factors:

- a bee has a body that is covered in hairs, which makes it particularly suitable to hold materials and substances they come in contact with;
- a bee is highly sensitive to most plant protection products;
- bees have high mortality rates when in contact with pesticides;
- toxic and pollutant residues can be found in bee products and in their bodies;
- A bee can fly over wide areas and thus provide environmental monitoring for such areas.

BOX 4 **Flowering plants and bees**

If we look at the many colourful and different looking flowers, we should not forget that they have developed as an adaptation for the bees and other pollinators, and not to please humans! Bees and most flowering plants have developed a complex interdependence during millions of years. An estimated 80 percent of flowering plants are entomophilous i.e. depending more or less on insect pollination to be able to reproduce, and it is estimated that half of the pollinators of tropical plants are bees.

The efficiency of honeybees is a result of their great numbers, their physique and their behaviour of foraging on only one plant species at one time. The bees have to find their food in flowers. Bees have to learn where in a flower the nectar is to be found. To guide the bees, many plants have bee-tracks, which are lines of colour leading the bee towards the nectar. These can sometimes be seen by humans, but some are in the ultra-violet part of the spectrum and visible only to bees, but not humans. In this way, the plant also guides the visiting bee to pass the anthers or stigma in the right way. Bees have no problems in finding the nectar in flat, open flowers, but in flowers that are more complex, they have to learn it by trial and error. After some visits to and in the same type of flower, the bee has learned where the nectar is, and learns this for the next visit.

Source: FAO.2009. Bees and their role in forest livelihoods, by N. Bradbear, Non-wood forest products No. 19, Rome

Environmental benefits

Bees provide numerous benefits to the natural environment and have a critical role in its sustainability. Their role is not readily recognized, even though bees are needed for the pollination of many cultivated crops and for maintaining biodiversity

in ‘islands’ of non-cultivated areas (FAO, 2009). Usually a honeybee can visit between 50 to1 000 flowers in one trip, which takes between 30 minutes to 4 hours. In Europe, a bee can make between 7 to 14 trips a day. A colony with 25 000 forager bees, each making 10 trips a day, is able to pollinate 250 million flowers (FAO, 2009).

The feasibility of the livelihood activity

Starting the business

In promoting beekeeping as a business in rural areas the initial step is to ascertain if beekeeping is being practiced at all in the local area of interest. If beekeeping is being practised it is advisable to consult with local small-scale farmers and others so as to ascertain if they already understand beekeeping as a business, how such a business is managed and marketed. By ascertaining local knowledge and capacity it will be easier to build improved skills and capacity on what is already common knowledge in the local area.

More then often beekeeping as a business is started without adequate information about the feasibility of such an enterprise. Numerous times beekeeping enterprises are started with to many hives and /or expanded to a size that produce is left in storage and not sold. To avert such occurrences it is advisable to conduct a feasibility study of the potential of beekeeping as a business in the local area. Such a study is not overly complex for small-scale farmers to handle, but they will need and require support from the advisor.

Small-scale farmers will need to estimate and consider such aspects as market demand, where and how they can sell their bee products, the scale of production required, the equipment that is required, credit, the overall costs of the enterprise and potential profits that can derive from the activity.

Market research: What products?

Market research is required so small-scale farmers can find out what demand there is in their locality for bee products. Usually the most demanded bee product is honey, followed by wax. In more developed and sophisticated markets such bee products as pollen, propolis, royal jelly and bee venom are more in demand as well as pollination services.

In terms of local markets such aspects as how many kilos of honey, for example, are demanded, what quality is demanded, what prices can be charged and when, where and how can the honey be sold, need to be ascertained. If for example, the small-scale farmer also decides to set up a small-scale on-farm

processing enterprise, for example to make candles, he or she will need to research the local market also to find out, if there is a demand for candles, what prices can be charged and what quantities are in demand.

Small-scale farmers will also need to find out about any competitors there may be in markets. This will entail finding out what prices they sell their bee products for, where do they sell, what quantities do they supply to market and so forth.

It may also be viable to research the market for pollination services that may be required in a local area. However this will depend on how developed such a market is in a local area and if there is a business viability in starting such a market.

Importantly small-scale farmers will need to understand if there are any marketing constraints that can inhibit them from selling bee products. For example lack of roads and transport can hinder access to local markets.

How much to produce?

Once market demand has been estimated, the small-scale farmer needs to estimate what level of production will be required to be able to supply markets. This will involve estimating where bees can forage and the required nectar and pollen flow, where the hives will need to be located and if the areas are accessible for bee foraging, water sources that are accessible and can be used, the number of bee colonies and hives that will be needed, the average production per hive, for example of honey, the risks of lower production levels as a result of, for example, the lack of nectar sources for certain periods, bee diseases and so forth.

Estimates will also have to be made of what labour will be needed, when it is most needed, for example during harvest time, and its availability.

Estimates will have to be made of where processing will take place after harvest: if this will be conducted in a room in the farm household and/or a small building will need to be used/built.

What equipment?

Once the level of production has been estimated, the small-scale farmer will need to consider what equipment is required and if it can be made locally or if it needs to be bought. In the case of local production, estimates will be needed of where the materials can be sourced from, for example, wood to

make hives, if there is access to such a resource and what are the costs.

In the case of buying equipment the small-scale farmer will need to estimate prices, which suppliers are accessible and reliable and what type of equipment is needed and if it can be supplied. Estimates will also have to be made for what packaging is needed. For example for selling honey recycled bottles may be an option or glass jars with lids may be needed, depending on market demand.

In the case of a small-scale on farm processing operation estimates will need to be made of what equipment needs to be purchased. This will be based on what products are in demand, for example candles, honey soap and so forth. There is also the need to understand the quantities of water that will be needed for the processing operation, where it can be supplied from and its quality. In the case of machine powered equipment, power sources and their availability and accessibility will need to be estimated.

Credit

Investing in beekeeping as a business is usually not honours in terms of costs, but this depends on the scale of operation of the business. When bee enterprises become commercial and supplies are sent to market on a regular basis more money is required to invest in the business, but also to cover such aspects as working capital and money to cover marketing costs. This implies that estimates need to be made about what sources of credit are available, for example savings, micro-credit organizations, etc., credit availability in the local area, access to it as well as such aspects as interest rates and payback periods.

Costs and profits

Once estimates have been made for marketing, production, equipment and credit the small-scale farmer needs to ascertain the costs involved. This will need to look at such aspects as start-up or business expansion costs, equipment costs and their depreciation overtime, production and marketing costs and so forth. Once the total costs have been estimated they will need to be compared to market prices that can be obtained for bee products in the market. This will provide an estimate of how profitable the enterprise may be and what can be expected in terms of returns of money invested in such a business.

BOX 5 **The major and minor costs in beekeeping**

The major costs in beekeeping are:
- Processing building (if needed)
- Hives
- Processing equipment (honey extractor/separator)
- Tables

Minor cost items:
- Protective clothing
- Smoker
- Trays
- Tools

Evaluation of the livelihood activity

The final evaluation if to proceed with such an enterprise or expand operations of the current enterprise will mainly be based on profit projections. Importantly though other factors will come in to play, such as, for example, the time needed to tender the new enterprise, who will be responsible in the farm family, and will the enterprise overall generate enough benefits to be worth its while for the farm family. Moreover there may also be other factors to consider, such as local culture and social habits.

The final decision whether to start the enterprise or not must be left in the decision-making realm of the small-scale farmer and his or her family. Advisers should not take the decision for the farmer and/or influence such a decision. Advisers need to provide support and information during the feasibility study, but need to allow any final decision to be made by the farmer and his or her family.

The livelihood activity[1]

For thousands of years it has been known that obtaining a honey crop is made much easier and more convenient than honey hunting if bees are encouraged to nest inside a man-made hive. The hive makes ownership of the colony very clear, it can be kept near to home, and harvesting the honey is easier. Depending on the type of hive, and the species and race of bees, it is also possible to manage the colony.

Beekeeping is a fairly easy activity to start. Importantly novice beekeepers are advised to seek training either from experienced beekeepers and/or tanning services. Interestingly one very good method recounted by many experienced beekeepers is that in the early days of their activities much of what they learnt came from carefully observing bees and how they organise themselves. This is a very important point and will be time and time again referred to as the first step in sustainable beekeeping. Small-scale farmers need to adapt to the bees' necessities and enable the best possible living conditions; adequate hives, good nectar and pollen flows, shade and fresh drinking water. Wise and careful treatment will provide for healthy bees, quality bee products and good yields.

There are many different routes to successful beekeeping that suit different situations. At one extreme is the placement of an empty hive and at some future point if it has been colonised by bees, cropping of honey – with no other interference by the beekeeper. At the other end of the scale is beekeeping involving expensive hives, the provision of selectively bred or instrumentally inseminated queens, sophisticated monitoring and control of honeybee diseases (now essential in many regions), the movement by the beekeeper of the bees to different crops as they come into flower, mechanical harvesting and processing of honey, and much else.

[1] Please note that this chapter of the booklet has partly been sourced and referenced from FAO.2009. Bees and their role in forest livelihoods, by N. Bradbear, *Non-wood forest products* No. 19, Rome pp. 32- 42, the first edition of FAO. 2003. Beekeeping and sustainable livelihoods, by N Bradbear, *FAO Diversification booklet* No.1, Rome, FAO.2006. Value-added products from beekeeping, by R. Krell, *FAO Agricultural Services Bulletin* No. 124, Rome and Curtis, G. 1982. *Small scale beekeeping. Appropriate technologies for beekeeping*, Peace Corps, Washington D.C.

BOX 6 **Beekeeping as an activity**

Beekeeping does not fit easily into the sectoral divides of rural development: as an activity, it spans forestry, horticulture, agriculture, the natural environment, animal husbandry and entomology without fitting precisely into any one of these sectors. Likewise, pollination is an important part of horticulture, yet the management of bees is often considered part of animal production. Similar problems confront the classification of bee products because honey is a food, yet beeswax is listed amongst non-food waxes and oils. Beekeepers have been categorised in different times and places as farmers, hunters and gatherers, cattle-keepers, or rural dwellers – with beekeeping remaining hidden as an important skill and part of their lives. These ambiguities present complications for development policy-makers, practitioners and researchers, even though such complexity is in keeping with the way people themselves link different activities, resources and products together in their daily lives.

Source: FAO.2009. Bees and their role in forest livelihoods, by N. Bradbear, Non-wood forest products No. 19, Rome

FIGURE 10 Bees on an unprotected comb in the Democratic Republic of Congo
(Photo: FAO/ 24683_0259/ G. Napolitano)

The bees

There are many types of bee species and most do not live in colonies. The *Apis mellifera* is one of the honey producing bees and has been introduced in most regions of the world. In trpocial regions there are also bees, such as *Trigona* and *Melipona* that are stingless. In a bee colony there are two types of female bees, the queen and the workers bees and then there is the male referred to as the drone. Queen bees are raised from the same eggs as worker bees, but are provided with more food. There is one queen bee per colony and her main function is to lay eggs. The queen bee produces the most eggs in the first year of her life. Laying rates are in an around 2 500 to 3 000 per day. A worker bee can carry out the following activities: collect nectar and pollen, make honey and wax, feed the queen, tend to eggs, building and repairing the comb, cleaning, temperature control within the colony and guarding the entrance to the hive. Drones have the sole task of mating with the queen bee.

Honey bees live in colonies in the wild and can be attracted into hives or caught in the wild. Small-scale farmers can 'sprinkle' an area with small boxes and/or hives, which have been rubbed with beeswax, in attempts to catch bee swarms. Usually when a bee swarm is formed in the wild it will send out scout bees to look for a new home that is suitable for the colony to develop in.

If foraging conditions are good in terms of abundant flowering plants and good weather the bee colony will develop. Bees will

CASE STUDY 3 **Mayas and bees**

In central America the Mayas developed a system of keeping *Melipona* in log hives. For Maya culture honey was vey important in their festivals, celebrations and religious functions. This is the only case in the world where a bee culture developed with a non-*Apis* species of bee. Today in some regions of Central America Meliponiculture still exists. The log hives provid yields in the range of 10 to 12 kilos.

As a result of low yields and the bees' nature to store honey and brood in particular nest structures, makes this kind of beekeeping viable for home production. However the honey produced is much valued and does have consumer preference.

Source: Adapted from Curtis, G. 1982. Small scale beekeeping. Appropriate technologies for beekeeping, Peace Corps, Washington D.C.

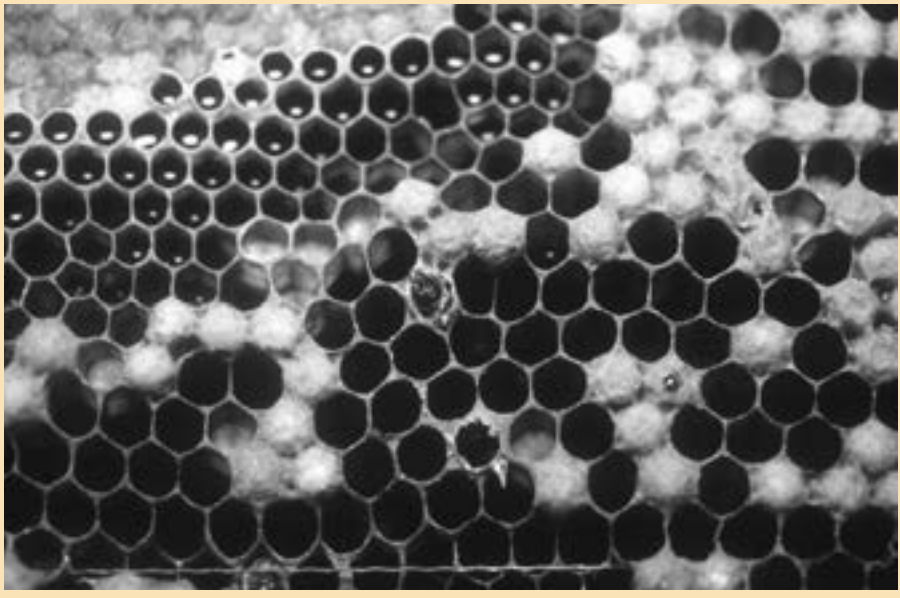

FIGURE 11 Brood honey comb
(Photo: FAO/19147/M. Marzot)

build the comb from the top of the hive downwards and will increase brood (eggs) production. Shortage of food, excessive disturbance and bad management will cause the bee colony to leave the hive. This is called absconding.

When choosing a site for keeping bees it must have the following:

- There are plenty of flowering plants and trees in the area.
- There are no serious environmental problems nearby, such as crops being sprayed with pesticide.
- There is a source of water nearby.
- Hives are sheltered from wind.
- Hives are shaded from strong sunlight.
- Hives are placed out of sight and not near places where humans are likely to be: this is to avoid possibilities of people being stung if the bees are defensive, and to avoid theft.
- Hives are not going to suffer from water dripping from overhead branches.

In any area it is advisable to start with a maximum of 10 colonies and

then gradually find out if the area can support more colonies.

Honeybee colonies must not get too hot. If the colony temperature becomes too high then foragers will be busy collecting water, to reduce the nest temperature, rather than nectar or pollen. In very sunny conditions, colonies protected by shade can produce 50 percent more honey than colonies exposed to the sun. Small-scale farmers can obtain greater honey harvests by providing nearby water sources and protecting colonies from too much heat.

In hot climates, wild-nesting colonies always choose a shady spot for their nest, near to a water supply. The easiest way to protect colonies from the sun is to place them under shade trees in a green grassy area. If no shade trees are available then artificial shades must be constructed. If a large number of hives are to be shaded and a long shade is to be constructed, then it should run east-west to give maximum benefit. Hives can also be painted white or another light colour to reflect rather than absorb heat.

FIGURE 12 New model beehive in Madagascar with a palm cover to protect it from the sun (Photo: FAO/22560/J. Van Aker)

Hives

A hive is just a container to keep bees inside, and good, serviceable hives can be made from many different materials. The purpose of a hive is to encourage the bees to build their nests in such a way that it is easy to manage and maintain them. Different styles of hives may be of greater or lesser convenience for the small-scale farmer, but the honeybee is only concerned having a safe place, large enough for the whole colony (the bees' family) and its stores, and protected from unfavourable weather and predators.

The best method for any situation will be determined by the available human skills, physical and financial resources, and the species and race of bee being utilised.

Hive type need not determine honey quality

The type of hive a honeybee lives in has no effect upon the quality of honey that she makes.

Honeybees always store clean and perfect honey regardless of where they are living: it is subsequent handling by humans that leads to reduction in quality.

The volume of honey harvested from a colony is decided by the forage for bees that is available in the area, and the strength and needs of the colony. As long as the hive is of large enough volume, bees will store as much honey as they can. (The more honey they can store, the greater the chance of the colony surviving through hard times ahead.) Movable frame hives influence honey production because they save bees' effort in creating beeswax comb: therefore, movable frame hives enable harvests of honey rather than beeswax.

Fixed comb hives

These are containers made from whatever materials are locally available: typically, hollowed-out logs, bark formed into a cylinder, clay pots, woven grass or cane. It is

BOX 7 **The three main types of hive**

Fixed comb hives: clay hives, wall hives, log hives, bark hives and many others
Movable comb hives: top-bar hives, of which there are many styles
Movable frame hives: Langstroth, Dadant, Adz, National, Smith, WBC, etc.

Source: FAO.2009. Bees and their role in forest livelihoods, by N. Bradbear, Non-wood forest products No. 19, Rome

common in some countries of Africa, Asia and the Middle East to keep bees inside cavities built into house walls. This keeps bees safe from predators and protected from extremes of heat or cold.

The sole purpose of a hive is to encourage bees to nest in a site that is accessible to the beekeeper. In a fixed comb hive, the bees build their nest inside the container, just as they would build it in a naturally occurring cavity. The bees attach their combs to the inside upper surface of the hive. This means that combs cannot be removed without being broken when the small-scale farmer harvests the nest to obtain crops of honey and beeswax. Bees may or may not be killed during this process, depending on the care provided. If the colony is destroyed, the hive will remain empty for a while. If there are plenty of honeybee colonies in the area then eventually a migrating colony or swarm may settle in the empty hive and start building a new nest.

Usually small-scale farmers using local-style hives often own many hives, and expect only a proportion of these to be occupied by bees at any time. In many ways, this style of beekeeping works well for tropical races of honeybees. In a tropical country it can be a better strategy for a small-scale farmer to have a large number of low cost hives, only some of which will be occupied at any time, than to have a small number of high cost hives, some of which may be empty.

The main region of the world where traditional beekeeping practises are still the most widely used – tropical, sub-Saharan Africa – is also the region with least honeybee disease problems. Frequent natural movement of the colony to new nesting sites means that diseases do not have the chance to remain within the colony as they do when colonies are static.

Movable comb hives

Low-technology hives have been developed as a way of obtaining the advantages of movable frame hives (no need to break combs, standardisation, manageability, efficient honey harvest) without the disadvantage of high cost manufacture. Bees are encouraged to construct their combs from the undersides of a series of top-bars – instead of attaching comb to the ceiling of the hive (as in a fixed comb hive) or building comb inside a rectangular, wooden frame (as in a frame hive). These top-bars then allow individual combs to be lifted from the hive. The combs can then be replaced back in the hive, removed

for harvest, or maybe moved to another hive or colony.

The container for the hive may, like traditional hives, be constructed from whatever materials are locally available. Another advantage of this type of equipment is that it opens up beekeeping to new sectors of society. Low-technology hives can be kept near homes, and can, if constructed and transported with care, be moved between crops as they flower successively.

All equipment for low technology beekeeping needs to be made locally. The only items that need construction with precision are the top-bars. These must provide the same spacing for combs within the hive, as the bees would use in the natural nest. This spacing will depend upon the species and race of honeybees that are being used. As a very general guide, *Apis mellifera* of European origin need top-bars 35 mm wide, and *Apis mellifera* in Africa usually need 32 millimetres. *Apis cerana* in Asia need 30 millimetres. The best way to determine the correct width is to measure the spacing between combs in a wild nest of the same bees. The volume of the brood box should equate roughly with the volume of the cavity occupied by wild-nesting honeybees. Other necessary materials are hive tools, smokers, protective clothing and containers for harvesting, storing, processing and marketing honey.

Movable-frame hives

These are the hives used in industrialized countries and developing countries where beekeeping is an important part of mainstream agriculture and the infrastructure exists to provide specialized expertise and equipment. The objective of movable-frame hive beekeeping is to obtain a maximum honey crop. The possibility of recycling beeswax combs means that the colony can quickly build up honey stores during the flowering season, and may also be managed specifically for the pollination of particular crops.

Rectangular wood or plastic frames are used to support the bees' combs. These frames have two major advantages:

1. They allow the beekeeper to inspect and manipulate the colonies (for example moving frames from a strong colony to strengthen a weaker one).
2. They allow efficient honey harvesting because the honeycombs within their frames can be emptied of honey

BOX 8 **Principles for construction of a movable comb top-bar hive**

Top-bar hives can be made from whatever cheap or scrap containers are available locally. These could be cardboard boxes, barrels cut in two lengthways, tea chests, or hives made from scrap timber. If timber is being used, it must be properly seasoned, otherwise shrinkage and warping of the hive will occur. The wood must be durable and able to last for several years without replacement, and be suitable for carpentry. The hive must be of a suitable volume: large enough for colonies of bees to build their brood combs and have plenty of room left for building extra combs for storage of honey (it is of course the inside measurements of a hive that are important). The hive must be clean and free from any contaminating odours, free of cracks and gaps, and may need some insulation depending upon the climate. Straw or cow-dung is often used as insulation for low-cost hives.

If the hive's top-bars are to be placed next to one another to form a bee-tight top, then each top-bar must be of the correct bee space for the bees to build one comb from each bar (see above). Placing bars next to one another cuts down the number of bees leaving through the top of the hive to disturb the operator, and this can be beneficial when working with highly defensive bees. However, other people recommend using narrower top-bars (that can be cut with less precision) with a plastic sheet placed over the top (Romet, 2004).

Whatever width is used, it must be constant for each top-bar hive in the hive. If top-bars are too narrow, then combs will be too close to one another with no "corridor" for bees to work in – in this case, the bees will fill the gap with comb or propolis. If top-bars are too wide, resulting in too much space between combs, bees will build extra "brace comb" to fill the gap. It is a skilled job to make top-bars of exactly the correct dimensions using hand tools, and if power equipment is available it is valuable for this operation. The width of the top-bars is the only measurement that must be exact in this type of hive.

In the wild, honeybees build combs that have curved edges and are rounded at the bottom. If the side walls of the hive are rounded or slope at approximately the same angle as natural comb then the bees will not attach their comb to the walls and this allows easy removal of comb. The sides of the hive can therefore be curved or slope inwards towards the bottom to form an angle of 5º with the bottom base. However, this is not essential, and hives with sloping sides are more difficult to construct. In straight sided hives, bees will sometimes slightly attach the comb to the sidewall of the hive. In this case, it is necessary to gently cut these attachments before the top-bar and its comb may be lifted from the hive.

Source: FAO.2009. Bees and their role in forest livelihoods, by N. Bradbear, Non-wood forest products No. 19, Rome

and then returned to the hive. This allows increased honey production as the bees' resources are saved from having to build fresh beeswax comb.

Frame hives must be constructed with precision. The spacing between frames must achieve the same spacing as in a natural nest. Frames are contained within boxes and each hive consists of a number of boxes placed on top of one another. Usually the bottom-most box is used as the brood chamber. This means that brood is present only in this box: this is achieved by placing a queen excluder between this box and one above it. The queen excluder is a metal grid with holes of a particular size such that worker bees can pass through but the queen is unable to do so because of her larger size.

This ensures that honey alone is stored in boxes above the queen excluder and allows for an efficient honey harvest. In addition to the boxes and frames, a floor and roof are required, along with various other specialized items of equipment. Frame hive equipment should not be used unless the infrastructure exists for manufacturing it locally. Frame hives require well-seasoned timber, planed

FIGURE 13 A movable hive frame in Nepal. Beekeeping is a new activity in the Shivapuri area. The aim of the FAO project is to improve the economical situation of the local people by developing income-generating activities
(Photo:FAO/16839/G. Bizzarri)

and accurately cut, as well as other material like wire, nails and beeswax foundation. They are therefore relatively expensive to make. Frames and boxes must fit together precisely and need accurate carpentry. There must be access to supplies of the parts, which need frequent renewals, particularly foundation and frames. Centrifugal extractors are needed to achieve full potential in harvesting the honey from frame hives.

Equipment

Although equipment can be imported to serve as a prototype, small-scale beekeeping can only be economical in the long-term with equipment, which can be serviced and manufactured locally. The equipment needed for traditional and low technology beekeeping can usually be made at village level.

Honeybee species and races vary in size. A honeybee nest (of those species that can be kept inside hives) consists of a series of parallel beeswax combs. Each comb contains rows of wax: hexagonal compartments containing honey stores, pollen or developing bee larvae (brood). The combs are evenly spaced and are attached to the ceiling of the nest. This spacing, known as the 'bee-space', is critical in maintaining optimal conditions within the nest with just enough space for the bees to walk and work on the surface of the combs, while maintaining the optimum nest temperature. Bee-space, dimensions of combs and nest volume all vary with race and species of honeybee. The bee-space is a critical factor in the use of bee equipment and honeybees cannot be managed efficiently using equipment of inappropriate size. When buying equipment it is important to have an understanding of the honeybees to be housed and the specification of the equipment offered. Most equipment is manufactured to the specification for bees of European origin.

Honeybee species and races vary in biology and behaviour. Strategies for the management of honeybees have been developed mainly for temperate-zone races of honeybees and mostmovable-frame equipment is intended for this type of management.

Colonies of tropical honeybees show a tendency to abandon their hive – this may be as a result of either seasonal migration or absconding because of disturbance by predators, and no reliable management techniques have yet been developed to prevent these – apart from feeding bees to ensure they do not abscond for lack of food, and to prevent disturbance by predators as far as possible.

During the last three decades, there has been a tremendous increase in the

spread of bee diseases and predators around the world. This has been brought about by man's movement of honeybee stocks. There are still a few remaining regions without introduced honeybee diseases and parasites, and most of these are in developing countries. It will be in the future benefit of these countries if they can retain their stocks of disease-free honeybees. It is therefore essential to ensure that used beekeeping equipment is not imported. Honeybee colonies or even single queen bees must never be moved from one area to another without expert consideration of the consequences.

It can be helpful to import basic equipment (protective clothing, smokers, hive tools, etc.) to serve as prototypes for local manufacture.

For small-scale farmers practising on a larger scale, for example where a cooperative has established a honey packing unit there are often items which necessitate importation, for example honey gates (effective honey 'taps' for use on honey containers), specialized gauzes for the filtration of honey, or the equipment for determining honey quality.

Smoker

A beekeeper needs a source of cool smoke to calm the bees, and this is achieved by use of a smoker. The smoker consists of a fuel box containing smouldering fuel (dried cow dung, hessian or cardboard) with bellows attached. The beekeeper puffs a little smoke near the entrance of the hive before it is opened, and gently smokes the bees to move them from one part of the hive to another. Imported smokers are useful as prototypes, but smokers can be manufactured by village blacksmiths.

Protective clothing

A broad-brimmed hat with some veiling will serve to protect the head and neck from stings. Adequate protective clothing gives beginner beekeepers confidence, but more experienced beekeepers find that too much protective clothing makes it difficult to work sufficiently gently with the bees, and it is very hot. Some people find that a good way to protect their hands is to put a plastic bag over each hand, secured at the wrist with a rubber band, although this can quickly become very sweaty! Rubber bands prevent bees from crawling up trouser legs or shirtsleeves. Always wear white or light-coloured clothing when working with bees – bees are much more likely to sting dark-coloured clothing. Imported clothing can provide useful prototypes, but modified overalls can be made locally and provides a useful stimulus for local industry.

FIGURE 14 Smoking a hive for inspection and/ or harvesting of honey
(Photo: FAO/ 24683_0240/G.Napolitano)

FIGURE 15 A small-scale farmer wearing protective clothing is checking on progress of hibernating bees after putting warm smoke in the boxes to wake them up. He is not wearing gloves because the bees were hibernating and there was no danger of being stung
(Photo:FAO/23498/L. Miuccio)

FIGURE 16 This hive tool is used to lift hive frames and help in other management practices. The hat with veil protects the worker from bee stings
(Photo: FAO/19128/M. Marzot)

Hive tools

Apis mellifera honeybees tend to close up every gap and seal every joint in the hive with a sticky substance known as propolis. The hive tool is a handy piece of metal which is used to prise boxes apart, scrape off odd bits of beeswax, separate frame-ends from the supports, and so on. It is possible to use an old knife for this job, but knife blades tend to be too flexible and give insufficient leverage. Village blacksmiths should be able to produce a suitable implement and once again, an imported hive tool could serve as a prototype.

Management

Like many other agricultural enterprises bees follow a seasonal cycle. In temperate regions it is far more easy to understand the cycles, while in tropical regions it is more difficult. The colony cycle can be subdivided into three periods: build-up, honey flow and dearth. In temperate regions, these periods are well defined, with only one for each period of the year, while in the tropics and sub-tropics periods are variable and more then one of each can occur in a yearly colony cycle.

Bees will respond to the nectar flow and that of pollen. The nectar and pollen flow are defined by weather and seasons. If there is a good flow of both nectar and pollen then the colony will increase its brood (egg laying). As colonies grow in size, the ratio of brood to adults decreases hence enabling more adults to go out and forage and not look after brood. The essence of good management is to obtain a large adult population to coincide with the major nectar flow in an area allowing for a resulting maximum honey flow.

In tropical and sub-tropical regions there is often one major flow of nectar followed by several lesser flows. This is a challenge as it is difficult to ascertain exactly when the major nectar flow occurs. This usually occurs after the rainy season or may come after initial rains following a long dry period.

A healthy colony that is increasing in population requires a queen that has a good capacity to lay eggs, availability of nectar and pollen, space in the hive as well as honey storage for the dearth period, along with a good worker bee population that can look after and feed the brood, forage and maintian temperature control. Good management of these factors in terms of enhancing and improving them are important. The level of sophistication of the enterprise determines the extent to which management can affect these factors.

Managing bees with low cost inputs is a prerogative of small-scale farmer beekeeping and the most sustainable in terms of business. Using local materials for hives and tools, as well as local labour is a way of keeping input costs down. Labour is one of the most important management factors. Labour needs to ensure that bees have good stores of honey and pollen for the dearth period. Labour also needs to increase and reduce space in the colony when and where it is needed. Extra space is needed in the nectar flow season so more honey storage is possible as well as for more brood. In the dearth period less space is required and hence unused comb needs to be removed.

It is important that management interventions occur at the appropriate time and this requires understanding the yearly colony cycle. Management is required in all three phases of the cycle, but is most important in the dearth period.

BOX 9 **Good seasonal management practices**

Build-up period

- Keep the colony in a small space when it is still small, for instance, in a small hive or big hive with divider board.
- Enlarge the hive when the colony grows by removing the divider board, by hanging the combs in a bigger hive or by adding a chamber.
- Ensure there are enough small hives to bait swarms.
- Put late swarms and smaller colonies together.
- Prevent absconding (bees leaving the hive) occurring later in the dearth season by keeping bigger colonies for example by merging them.

Honey flow period

- Do not harvest honey from small colonies.
- Harvest as late as possible when there is enough space in the hive.
- For top-bar hives: hang the combs in a harvest hive, if possible also do this with traditional hives. Do this so that damage to the combs is kept to the minimum and then extract the honey.
- For movable frame hives: remove an entire honey frame, using a bee outlet if necessary.
- Do not harvest honeycombs from the lowest brood chamber. These are for the colony.
- Harvest in moderation so that there is enough honey left over for the bee colony and to limit absconding.

Dearth period

- Prevent absconding by removing empty combs.
- Limit the space by using a divider board, hanging the combs in a smaller hive or reverting to fewer chambers.
- Provide a supply of water inside or close to the hive.
- Open the hives as little as possible.
- Cover the top of the hive well to avoid heat loss.

Source: Adapted from CTA.2005a. Beekeeping in the tropics, Agrodok 32, Wageningen, the Netherlands

Harvesting

Honey is harvested at the end of a flowering season. The small-scale farmer selects the combs that contain ripe honey, covered with a fine layer of white beeswax. These combs are usually the outer-most ones. As far as possible, combs containing any pollen or developing bees need to be left undisturbed.

The honeycomb can be simply cut into pieces and sold as fresh, cut comb honey. Alternatively, the honeycomb can be broken up and strained through muslin or another form of filter to separate the honey from the beeswax. After honey is separated from the beeswax combs, the beeswax can be melted gently (over water) into a block. Beeswax does not deteriorate with age and the scarps of beeswax can be saved until there are sufficient amounts to sell.

Honey is obtained from frame hives by spinning the frames in a centrifugal extractor. The empty honeycombs are then returned to the hive. Because the combs are recycled, bees put effort into honey production rather than beeswax comb production. This explains why the beeswax yield from frame-hive beekeeping is low compared to traditional beekeeping methods.

Choice of harvesting and processing equipment depends upon the quantities to be processed, and the type of product required. In some areas, traditional beekeeping is practised on a large-scale and may well justify the provision of relatively expensive, large-scale honey processing equipment capable of dealing effectively with honey in bulk for export.

Standards, quality and certification

Application of standards, such as those prescribed by Codex Alimantarius, varies from country to country. Quality is a very important matter for consideration, in terms of bee products, as fraudulent practices can take place. For example, honey can be adulterated with cane sugar fed to bees. Importantly quality in bee products enables trade, as inspections, for example at international borders, can be reduced, if bee products are certified prior to entering the country of destination. Moreover quality is important for consumers as well as health and safety and with standards and certifications can reassure consumers when buying bee products.

Codex Alimantarius, for example in the case of honey, states the following: " honey sold as such shall not have added to it any food ingredient, including food additives, nor shall any other additions be made other than honey. Honey shall not have any objectionable matter, flavour, aroma, or taint absorbed from foreign matter during its processing and storage. The honey shall not have begun to ferment or effervesce. No pollen or constituent particular to honey may be removed except where this is unavoidable in the removal of

foreign inorganic or organic matter " (Codex Alimentarius, 2001).

Elements of honey standards

A. Composition and quality factors

1. Honey should not contain any food ingredients other than honey.
2. It should not contain any objectionable matter, flavour or odours due to processing or storage.
3. It should not be fermented.
4. Pollen should not be removed as well as other constituent matter.
5. Honey should not be heated or processed so that the essential composition is changed.

B. Authenticity in production

1. Heating and filtering within prescribed limits and labelled if outside those limits as, "pasteurized" or "filtered."
2. Sugars used to feed bees should not be used to adulterate the honey and not fed to bees during the honey flow.
3. Non-ripe honey may not be harvested nor water added. Honey is ripened in the hive by evaporating water until it reaches a certain water content and is capped by the bees in the honeycomb.

C. Authenticity of labelling descriptions

1. Honey may be labelled according to the honey removal process. Extracted, by centrifugal force of decapped combs. Press or pressed by pressing combs. Drained by draining decapped combs.
2. Honey may be labelled according to its form. Honey, in a liquid or crystallized state or a mixture of the two. Comb when in the comb or cut comb or chunk when containing parts of the comb.
3. Botanical source. Predominant floral source single flower honeys (also known as monofloral or unifloral honey) are unlike most commercial honeys found on supermarket shelves or type floral or honeydew, fir or forest honey. Honey labelled as from a single flora source cannot be blended with other honey (must meet minimum concentration requirements as well).
4. Geographic or topological source. The country region or specific location within a country with corresponding honey characteristics.
5. Species of bee. Most honey is produced by *Apis Mellifera*, but

there are many other species with unique characteristics of honey.

6. Organic, raw (unheated), natural. To be labelled as organic must be based on organic production procedures. As raw honey requires production and storage at, or under maximum hive temperature. The claim of natural honey is always a misleading since all honey is natural.

D. Contaminates

1. Free of heavy metals in amounts that become a hazard to health.
2. Not exceed maximum limits of pesticide and veterinary drugs.

E. Hygiene

1. Follow general principles of food hygiene.

Honey standards criteria

Many of the standards have specific measurable criteria:

1. Composition: moisture content (no > than 20 percent and no > 23 percent for heather honey), glucose and fructose (no < of 60 percent the sum of both for blossom honey and no < of 45 percent for honeydew); sucrose (no > 5 percent for most honeys) and (no > 10 percent for some specific cases and no > 15 percent for others)
2. Type (blossom or honeydew): the conductivity of most of honey should be no > of 0.8 mS/cm.
3. Floral source: pollen analysis
4. The free acidity of honey may be not more than 50 milliequivalents acid per 1000g.
5. The hydroxymethylfurfural content of honey after processing and/ or blending shall not be > than 40 mg/kg. However, in the case of honey of declared origin from countries or regions with tropical ambient temperatures, and blends of these honeys, the HMF content shall not be > than 80 mg/kg.
6. The diastase activity of honey, determined after processing and/ or blending, in general should not be < than 8 Schade units and in the case of honeys with a low natural enzyme content not < than 3 Schade Units.

Certification of honeys

The certification of food products including honey requires the completion of some rules and procedures before it is authorized for sale. It generally includes inspection, analysis and verification on aspects related to good practices for processing, hygiene, HACCP

control, among others. The certification is given by a recognized authority that endorse that the final product is produced in line with defined standards and is verified also by a well known laboratory of analysis in order to authorize the sale of safe products in a competitive market.

Nowadays there are several institutions which are able to provide certification and authenticity of the origins of food and agricultural products and it is of great importance to consumers, as well as local producers. In many countries, foodstuffs including honey, are identified by their location through regulatory means.

Sustainable strategies for the livelihood activity

It is common that programmes devoted to developing beekeeping as a diversification enterprise focus on the production of bee products and related increased yields for such bee products. Increased yields, though, are only justifiable if there are consumers and markets that will buy such excess yields.

An enterprise to be successful and provide sustainable livelihoods for small-scale farmers requires strategies for marketing and appropriate business management. Only if there are markets that will buy and selling prices are above costs will an enterprise be able to earn profits. Profits are important as they are the returns that the small-scale farmer earns for his or her time and labour devoted to beekeeping. Moreover part of the profits made can be re-invested in the enterprise, for example buying new hives that may increase honey yields, and thus increment revenues. It is fundamental that small-scale farmers not only understand what markets require

CASE STUDY 4 **Marketing bee products in Zambia**

The most popular bee products that are sold in Zambia are honey and beeswax. Other hive products such as propolis and royal jelly are not sold in Zambia. There are no reliable figures on local consumption and sales. It has often been assumed that the bulk of the honey (even 90 percent) is used for brewing beer, *mbote*. There is a market for honey beer both in local communities and in urban areas. Only a small portion of the honey reaches the market as table honey and is sold mostly in urban areas. Over the years, honey has gained a reputation as a health food – it has been purported to be effective in bringing down high blood pressure, in managing early stages of adult diabetes and in boosting immunity. It appears that honey is one of the commonly used foods for people suffering from HIV.

Beeswax is sold locally as a floor polish and for making candles. A significant proportion of beeswax is picked up by Tanzanian traders for sale to the cosmetics industry in Eastern Africa.

Source: Adapted from Mickels-Kokwe, G. 2006. Small-scale woodland-based enterprises with outstanding economic potential: The case of honey in Zambia, CIFOR

FIGURE 17 Women selling honey in Egypt
(Photo: FAO/16191/L Spaventa)

in terms of bee products, quantities required and quality, but small-scale farmers have access to such markets and are able to compete with other small-scale farmers who are also selling bee products.

Appropriate marketing of bee products requires small-scale farmers to furnish a constant supply, provide for demanded quantities and importantly have consistency in quality of bee products.

Access to markets

Conducting regular market appraisals helps and supports market access. Small-scale farmers who collect information on consumers, identify local markets in which to sell in and are able to understand what other marketing activities are required will be in a better position to access markets. Many small-scale farmers who sell from farmer markets in a village, for example, are in direct contact with customers and can obtain information from customers regarding, for example, if the quality of products meets customers' requirements, what product is bought most often, and how the quality and price compare to competitors' products.

However access can be constrained by factors which our outside the control of small-scale farmers. Poor road infrastructure, lack of transport, and lack of access to credit for example can all hinder access to markets.

Bee products[2]

Honey

Honey is the natural sweet substance produced by honeybees from the nectar of blossoms or from the secretion of living parts of plants or excretions of plant sucking insects on the living parts of plants, which honeybees collect, transform and combine with specific substances of their own, store and leave in the honey comb to ripen and mature. It is the most popular and traded bee product. When honey has, in the majority of its composition, been made from a single source of nectar i.e. flowering plant, it can be called a monofloral honey. For example eucalyptus honey. When a honey is made from many different sources of nectar it is called mutlifloral honey.

Honey is composed for about 95 percent of sugars, with other elements comprising the remaining 5 percent subdivided into water, organic acids and minerals. Honey has many characteristics. The viscosity of honey depends on a large variety of substances and therefore varies with its composition and particularly with its water content. Viscosity is important for trade as it contributes to the ease of processing and extraction from comb. Density is also another important characteristic for processing and trade as well as the hygroscopic nature of honey. Colour is another important factor in trade as well as honey crystallization.

Honey is sold in unprocessed form, in the honey comb, as well as in the extracted form, in bottles and jars.

Beeswax

There are many waxes that derive from numerous sources other than those of bees. These waxes can come from plants, animals, petroleum derivates and so forth. In the case of beeswax it derives from glands in the workers bee's head that are used to build comb for brood rearing and honey storage. In many tropical countries wax is not accounted for as a bee product, even though it has a good economic potential. Initially wax from *Apis millifera* is white and as it ages become yellow and darker in colour.

[2] This section on bee products has been sourced from FAO.2006a.Value-added products from beekeeping, by R. Krell, *FAO Agricultural Services Bulletin* No. 124, Rome

Pure beeswax from *Apis mellifera* consists of at least 284 different compounds. Not all have been completely identified but over 111 are volatile (Tulloch, 1980). At least 48 compounds were found to contribute to the aroma of beeswax (Ferber and Nursten, 1977). Quantitatively, the major compounds are saturated and unsaturated monoesters, diesters, saturated and unsaturated hydrocarbons, free acids and hydroxy polyesters.

In the past beeswax had a more extended use, but with the introduction of cheaper synthetic wax, its role has changed along with its trade. Commonly beeswax is used for candle making, for metal castings and models, in food processing as an ingredient and not only, in the cosmetic, textile, varnish and polish, and printing industries as well as in medicine.

Pollen

The pollen which is collected by beekeepers and used in various food or medicinal preparations is no longer exactly the same as the fine, powdery pollen from flowers. The hundreds or sometimes millions of pollen grains per flower are collected by the honeybees and packed into pollen pellets on their hind legs with the help of special combs and hairs. During a pollen collecting trip, one honeybee can only carry two of these pollen pellets.

The pollen collected by honeybees is usually mixed with nectar or regurgitated honey in order to make it stick together and adhere to their hind legs. The resulting pollen pellets harvested from a bee colony are therefore usually sweet in taste. Certain pollen types however, are very rich in oils and stick together without nectar or honey. A foraging honeybee rarely collects both pollen and nectar from more than one species of flowers during one trip. Thus the resulting pollen pellet on its hind leg contains only one or very few pollen species. Accordingly, the pollen pellet has a typical colour, most frequently yellow, but red, purple, green, orange and a variety of other colours occur.

Pollen grains range from 6 to 200 m in diameter, and all kinds of colours, shapes and surface structures may be observed. These are usually typical enough to allow species or at least genus identification. Most pollen grains have a very hard outer shell (sporoderm) which is very difficult or impossible to digest. It is so durable that it can be found in fossil deposits millions of years old. There are, however, pores which allow germination and also extraction of the interior substances.

Pollen is used for food, as a medicine, in cosmetics, for mechanical and/ or hand pollination and for monitoring pollution in the environment.

Bee bread

The partially fermented pollen mixture stored in the honeybee combs, also referred to as "beebread" has a different composition and nutritional value than the field collected pollen pellets and is the food given to honeybee larvae and eaten by young worker bees to produce royal jelly. Saying pollen is the perfect food because it is the only food source for honeybees other than honey, their major carbohydrate source, is not only based on a questionable comparison between human needs and bee requirements, but also on misinformation.

Traditional beekeeping cultures with honeybees or stingless bees, usually appreciate the stored pollen, i.e. beebread. Its characteristic sour taste together with brood and honey is a delicacy consumed directly during harvesting. The pollen stored by honeybees undergoes a lactic acid fermentation and is thus preserved. This final storage product is called beebread. Such beebread combs may be sold directly.

Natural and homemade beebread will keep for a considerable time and can easily be transported to the market and served - even in small quantities - as an excellent source of otherwise scarcely available nutrients. It can be sold clean and by itself or immersed in honey to make it more attractive in taste. Small pieces of comb can thus be sold or given away as candy.

The nutritional value of beebread is much higher in places where limited food variety or quantity creates nutrient imbalances. It is particularly children who might benefit the most from regular pollen supplements in their diets.

Royal jelly

Royal jelly is secreted by the hypopharyngeal gland (sometimes called the brood food gland) of young worker (nurse) bees, to feed young larvae and the adult queen bee. Royal jelly is always fed directly to the queen or the larvae as it is secreted; it is not stored. This is why it has not been a traditional beekeeping product. The only situation in which harvesting becomes feasible is during queen rearing, when the larvae destined to become queen bees are supplied with an over-abundance of royal jelly. The queen larvae cannot consume the food as fast as it is provided and royal jelly accumulates

in the queen cells. The exact definition of commercially available royal jelly is therefore related to the method of production: it is the food intended for queen bee larvae that are four to five days old.

Royal jelly is a homogeneous substance with the consistency of a fairly fluid paste. It is whitish in colour with yellow or beige tinges, has a pungent phenolic odour and a characteristic sour flavour.

Royal jelly can be used as a food, as a dietary supplement, in food processing as an ingredient in food processing, in cosmetics and as an ingredient in medicine-like products. Royal jelly can be sold in its fresh state, unprocessed except for being frozen or cooled, mixed with other products, or freeze-dried for further use in other preparations. The fresh production and sale can be handled by enterprises of all sizes since no special technology is required. In its unprocessed form it can also be included directly in many foods and dietary supplements as well as medicine-like products or cosmetics.

Since the assumed benefits of royal jelly have not been sufficiently proven, statements in advertisements and on package labels should be very careful to avoid suggestions which are not well-founded. Any kind of fraudulent or exaggerated statements and claims are in the long run more damaging than any short-term benefit that may be derived from, for example, an increase in the price of a product. Products containing royal jelly should be specially marked or packaged in order to distinguish them from similar products without it.

Propolis

Propolis is a mixture of various amounts of beeswax and resins collected by the honeybee from plants, particularly from flowers and leaf buds. Since it is difficult to observe bees on their foraging trips the exact sources of the resins are usually not known. Bees have been observed scraping the protective resins of flower and leaf buds with their mandibles and then carrying them to the hive like pollen pellets on their hind legs. It can be assumed that in the process of collecting and modelling the resins, they are mixed with some saliva and other secretions of the bees as well as with wax.

These resins are used by worker bees to line the inside of nest cavities and all brood combs, repair combs, seal small cracks in the hive, reduce the size of hive entrances seal off inside the hive any dead animals or insects which are too large to be carried out and perhaps most important of all, to mix small quantities of propolis

with wax to seal brood cells. These uses are significant because they take advantage of the antibacterial and antifungal effects of propolis in protecting the colony against diseases. Propolis has been shown to kill the bee's most ardent bacterial foe, *Bacillus larvae* - the cause of American Foul Brood (Mlagan and Sulimanovic, 1982; Meresta and Meresta, 1988). The use of propolis thus reduces the chance of infection in the developing brood and the growth of decomposing bacteria in dead animal tissue.

The composition of propolis depends on the type of plants accessible to the bees. Propolis changes in colour, odour and probably medicinal characteristics, according to source and the season of the year. Moreover, some bees and some colonies are more avid collectors-generally to the dismay of the beekeeper, since propolis is a very sticky substance which, in abundance, can make it difficult to remove frames from the boxes.

Propolis is used as a food, in food processing, as a traditional medicine and in cosmetics.

Bee venom

Honeybee venom is a clear, odourless, watery liquid. When coming into contact with mucous membranes or eyes, it causes considerable burning and irritation. Dried venom takes on a light yellow colour and some commercial preparations are brown, thought to be a result of oxidation of some of the venom proteins. Venom contains a number of very volatile compounds which are easily lost during collection.

Used in small doses however, bee venom can be of benefit in treating a large number of ailments. This therapeutic value was already known to many ancient civilizations. Today, the only uses of bee venom are in human and veterinary medicine.

No uses for venom, other than medical ones are known. The only legally accepted medical use of bee venom in Western European and North American countries is for desensitizing people who are hypersensitive (allergic) to bee venom. Since the early 1980's, pure bee venom has been used for desensitization. The use of whole body extracts has been largely discontinued after a double-blind test proved the higher efficiency of pure venom (Hunt *et al*., 1978). In Eastern Europe and in many Asian countries bee venom has been used in official medical treatment of a large variety of ailments for a considerable length of time.

The use of pure venom injections and well placed bee stings is increasing in Western countries as an alternative to heavy (and sometimes ineffective) drug use, which is often associated with numerous side-effects. This is particularly so for arthritis and other rheumatoid inflammations.

Application methods for venom include natural bee stings, subcutaneous injections, electrophoresis, ointments, inhalations and tablets (Sharma and Singh, 1983).

Since bee venom has both a local and a systemic effect, correct placement of injections, or stings and the dosage are very important. Therefore, bee venom therapy must be properly learned. Still, relief of some ailments can be obtained by simply applying a sting or two to the affected area, i.e. to some painful, immobile arthritic joints.

Bees

As adult honeybees are the producers of all the primary products of beekeeping, it is unlikely that a small-scale farmer will sell these adult bees when he or she is interested in production of primary products. Honeybees or their brood can however, constitute a primary product, and may be sold directly or be processed for other uses. Beekeepers can make a profit from selling their adult bees, often together with combs of larvae. Depending on market conditions, they can sell their bees in the form of package bees, nuclei or small starter hives and whole, full-size colonies.

Bees can be used for beekeeping, pollination, in cosmetics in medicine and as food. Adult and larval honeybees contain reasonable amounts of protein and are non-toxic. They could therefore serve as a direct food source once the beekeeper has no more need for extra bees or brood, or when undesired colonies have to be removed. Honeybee brood of all ages is eagerly consumed by honey hunters in Africa and Asia and is generally considered a delicious treat. For several cultures, brood is said to form a considerable part of the diet (Hill *et al*., 1984 and Bailey, 1989; as cited in Schmidt and Buchmann, 1992). In the People's Republic of China and Japan, drone larvae are canned for export or, after being covered in chocolate, become a sweet treat. Bee brood is regularly sold alongside honey in markets in many parts of Asia (Schmidt and Buchmann, 1992).

Pollination services

In many local communities beekeeping is perceived by many farmers as being important for their

own crop production. This is because they are well aware of the pollination services that bees can perform on their crops. Pollination of corps is improved by a larger number of foraging bees then nature would provide in a defined area. Pollination services conducted by bees, does not only provide for improved fruiting of fruit trees for example, but increases yields and provides for superior quality of such fruits.

Small-scale farmers who have a beekeeping enterprise can offer pollination services to other farmers in their area. Many times such services are rewarded in kind and not in monetary terms. However this is changing as many small-scale farmers who have witnessed the increases in quality and yields of honeybee pollinated crops are asking more for payment in monetary terms and not in kind. This helps the small-scale farmer cover transport costs of hives from various locations where pollination services are required and increases his or her income that derives from this important bee service.

Marketing channels: local networks

The cost of marketing bee products is an important consideration for farmers, especially if profit margins are small. One of the main costs is transporting bee products to more distant markets. Farmers can contract with transporters to take their produce

BOX 10 **An example of the economic and yield advantages of pollination services for crop farmers**

The beekeeper can hire out his or her hives to a farmer for the duration of one crop cycle. A beekeeper places two hives per hectare in a field of sunflowers. Without bees the farmer yields 500 kg of sunflower seeds per hectare, and with the bees 850 kg, thus 350 kg more. The beekeeper yields 50 kg of honey per colony, which is 100 kg per hectare.The sunflowers yield € 1 per kilo, and the honey also about € 1 per kg, after expenses are deducted.

The farmer earns, therefore, 3.5 times more from the pollination than the beekeeper earns from the honey. The farmer pays the beekeeper € 25 per hive, which is a total of € 50 per hectare. The beekeeper thus earns € 150 per hectare. That is one and a half times what he earns from the honey alone. The farmer earns (€ 350–€50) = € 300 per hectare extra thanks to the bees! This is 60 percent more than the yield without bees.

Source: CTA. 2005b. Bee products; properties, processing and marketing, Agrodok No. 42, Wageningen, the Netherlands

to distant markets, for example, but hauliers have no requirement to safeguard the quality of the foods that they transport, and careless handling can seriously damage products and lead to a reduction in income for farmers. Thus local markets are often a better option: farmers may be able to transport products the shorter distances to market using their own animal driven carts for example. This means that the time spent away from the farm is less; and they retain control over the way that products are handled and their quality when displayed in the market.

The main potential disadvantage of local markets is the likelihood of lower prices compared to those available from both urban markets and other types of buyers (e.g. institutional buyers or food processing companies).

Local markets also are better known by farmers and are far more familiar. Farmers may know many of the consumers, traders and retailers in their local area, are familiar with distance and roads and paths to get to markets and may have knowledge of other competitors in such markets. Moreover farmers in local markets have their own networks derived from selling other farm produce which they produce and can with ease introduce bee products to such a network.

Marketing strategies

Honey is commonly the most popular bee product with consumers. Demand for honey is thus commonly high, both in comb and processed form and finds ready markets. However quality is a fundamental factor for honey as well as for other bee products. Quality is determined in the hive and cannot be changed once the product is harvested, save for attentive and careful following of quality and safety guidelines in processing, so as to avert quality deterioration.

Another strategy is how to sell bee products. Small-scale farmers can sell bee products directly to final consumers at the local village market, or on the road side. It may also be possible to sell bee products to a rural trader, processor or wholesaler or retailer. Importantly what has to be considered here is which method will provide the most advantages for the small-scale farmer. In other words, which method will guarantee the best possible prices for the bee products. For example bee products may in part be sold to a processor, in part to a wholesaler and in part sold directly to final consumers at the local village market. Combinations of selling methods can be many.

Where to sell is another decision that small-scale farmers need to take. For example if the beekeeper

BOX 11 **Selling honey from a road side stall**

Selling honey at a roadside stall can bring the advantages of long opening hours and plenty of passing trade, without the overhead costs of a shop. Since customers will be travelling in a vehicle, maybe they will buy a larger package of honey.

In such a selling location a bold, bright sign, the display of containers as well as the display area being clean are essential. It is also important to combine other products that do not derive from the beekeeping enterprise alone. These products could be fruit from the farm, which combines well with honey for example.

Source: Adapted from FAO.2009. Bees and their role in forest livelihoods, by N. Bradbear, Non-wood forest products No. 19, Rome

wants to sell to a processor, it may be important to find a processor in a good location. This could mean a processor that is nearby, or it can mean a processor that is further away, but may offer better prices. Selling in the local village market may be good, but selling in urban markets may command higher prices. Choice of where to sell must be based around prices achieved for bee products and the costs to reach such a location. For example selling at a village market may cost little in terms of transport and setting up a stall. In urban cities the cost of transport may be higher because it is further away from the business and fees may have to be paid for setting up a stall. In urban markets prices are higher, but also costs may be higher.

Importantly beekeepers must decide when to sell their bee products. For example at harvest time honey prices are usually low. Thus it may be advisable to sell some of the product at harvest time, so as to obtain much needed revenue, but store the majority of the product for later selling at possible higher prices.

Products: value adding

Bee products that are sold in their original form, for example honey in comb, have not been processed and hence no value has been added. Honey can be processed and sold in liquid form in jars. Value has been added and usually there will be a price reward for this (see FAO Diversification booklet No. 4 *Value from village processing)*. Great care must be taken in all processing operations for quality and safety reasons. For example inappropriate honey processing can cause honey fermentation. Moreover further processing can also

occur, for example making candles from beeswax or honey beer (see FAO Diversification booklet No. 5 *Processing for prosperity*).

The main advantages of adding value to bee products are that it can provide the small-scale farmer with more products to sell, it can enable the small-scale farmer to tap into more and diversified markets, it can enable small-scale farmers to have more control over prices they set for their products, it can enable a more stable and regular revenue source, excess produce and/or waste can be used more efficiently and overall can provide the opportunity to earn more profits.

Packaging

Marketing bee products that have been processed requires packaging. Typically in local areas small-scale farmers use whatever they can find, for example recycled bottles and jars. In such cases it is important that not only the packaging is clean and free from odours and consumers can see the bee products, for example the colour of the honey, but it is also not excessively heavy. For example recycled glass jars are heavy and may break if stacked and/or improperly handled. Plastic containers may be preferable, but may be difficult to obtain. Importantly whatever the

FIGURE 18 Honey being sold in plastic and transparent jars, with a logo and label printed on them
(Photo: FAO/19184/M Marzot)

packaging it will have to protect the bee product, keep it clean, uphold the quality of the bee product and be able to withstand handling and transport to final destination.

Labelling is another aspect of packaging that is import for trade in more distant markets, such as town, city and export markets. A label, for example on a honey jar, should provide information to consumers on such aspects as the type of honey (unifloral/multifloral), where the honey comes from (geographic area of origin), the name of who produced it and the date when it was packaged and the expiry date of when it needs to be consumed by.

Producer organization

In producing and marketing bee products small-scale farmers can organize themselves into groups. These can be either formal or informal associations. Pulling resources together can be very advantageous for small-scale farmers. The group may get better lending conditions from financial institutions, get better prices for buying equipment, have a better position in negotiating with rural traders, processors, wholesalers, retailers and exporters, processing operations can be carried out at a larger scale as well as carrying out more value addition and reducing transport costs. Further and importantly associations can carry out marketing research in more distant markets and hence provide more opportunities to sell products.

Such associations can also and importantly organize honey collection centres in rural and remote places. The advantages of honey collection centres are that they can help in collecting honey from remote small-scale farmers, may provide processing and packaging equipment and provide advantages in transporting otherwise dispersed produce to a central location.

Moreover farmers can not only find a place in their vicinity where to sell their products, but importantly traders will be interested to travel to remote areas, being certain of the volume and quality they will be able to collect (FAO, 2009).

Importantly though associations have to be kept in place. Members must avert disagreeing and arguing over decisions taken by other members. This requires that rights and responsibilities are clearly defined at the formation stage of the farmer association. All members must be free to participate and importantly communicate among each other. It is important that the costs of the association are not too high and that the association is created to

fulfil specific goals. For example an association can be formed to carry out borrowing, transporting and selling. Vitally the association should not have to many functions.

Sustainable business enterprise

An enterprise to survive in the long term requires profits. Profits can provide for improved livelihoods: more food security and safety in the long term as well as the ability to pay for needed health care and other farm family expenses. Importantly though profits enable a farmer to re-invest in the beekeeping enterprise, improve it and contribute to making it more competitive. The more a small-scale farmer sees higher returns the more he or she will be willing to invest their time and labour in becoming proficient in both production and marketing. Improved production and marketing skills further enhances competitiveness by reducing costs as small-scale farmers become more efficient and effective in carrying out required operations. Further the more farmers understand that marketing quality bee products brings higher prices and makes products more competitive, the more small-scale farmers will be inclined to provide quality bee products. Improved quality is far more advisable then an increase in yields as higher prices on current quantities sold have a greater impact on profitability then increases in yield.

CASE STUDY 5 **Beekeeping enterprises in the Niger Delta, Nigeria**

An analysis of enterprise costs revealed that fixed cost accounted for 23.15 percent of total costs, while operating costs accounted for 76.85 percent. This shows that entry costs for such an enterprise are low, while running cost are relatively higher. Returns for a beekeeping enterprise were N 31 981.29 ($290.74) per annum which were slightly higher above the Nigerian average per capita income of $280.00. The average rate of return of the enterprise was better than other agricultural enterprises found in the area with value being 163 percent. In short, the production performance of beekeeping in the Niger Delta Area is economically viable and should be promoted further through the formulation of appropriate policies.

Source: Fadare, S.O., Ojo,S.O & Imoudu,P.B. 2008. Analysis of production performance of beekeepers in the Niger delta area of Nigeria, APIACATA, No.43, pp. 37-48

Support services to promote beekeeping

Access to support services

Support services for small-scale farmers involved in beekeeping need to be importantly accessible. Small-scale farmers need to be able to afford using such services, not only in terms of monetary costs, but also in terms of time. Support services must also be in proximity of beekeeping production areas and importantly such services need to be sustainable, both if they are publicly or privately funded. The types and kind of services on offer need to be in tune with the current necessities of small-scale farmers, but also focus on the future and how such services may need to evolve. These future needs should be supported by a long term vision on resources and how these can be used to keep the operation in business. Front line support services that only operate efficiently and effectively in the short term have little or any value in development programmes if they cannot continue as a result of lack of resources. Services need to be seen from a long term perspective and importantly consider the need for constant improvements and updating.

Technical training, equipment and information dissemination

For beekeeping many countries have considerable traditional knowledge and skills. In this respect any interventions to improve local practices need to importantly recognize such skills and build on them in order to increase the likelihood of improving skills and capacity of small-scale farmers. One of the main constraints commonly found in technical training is not only the lack of appropriately trained extension staff, but time devoted by extension workers to small-scale farmers. Typically extension workers need to cover large rural areas and have a full schedule. A method to avert this constraint is to improve interactions between extension workers and famers via group trainings, such as using the Farmer Field School (FFS) methodology. This is a participatory approach for learning beekeeping and improving and building on existing beekeeping skills. Farmers learn directly in the 'field' working with bees and each activity that they carry out involves action, observations, analysis and then taking a decision. The aspects

considered do not only focus on the 'how' but importantly on the 'why'. During training sessions farmers are also encouraged to set their own farmer-to-farmer training from the cadre of initial farmers trained.

Information dissemination through training and extension is one of the fundamental aspects of promoting beekeeping and improving current practices. However dissemination of technical aspects is not easy in rural and remote areas and modern communication technologies can be of support, for example wireless communications. Traditional media can also be very effective in enabling information dissemination as for example radio.

Beekeeping equipment is commonly made locally, ranging from hives, tools and protective clothing. However improved equipment, such as removable frame hives can be an important alternative to consider in terms of increased productivity and resulting yields. The major problem though with this is the 'spare parts' supply chain that is needed after the hives have been bought. Many importers find it far to costly to distribute such spare parts in rural and remote regions as the potential demand for spare parts is low in comparison to distribution costs. It may be the case that locally made spare parts can be furnished, but this needs to be ascertained prior to buying the improved equipment.

Business skills training

Coupled with technical training small-scale farmers will also need appropriate training in marketing as well as in business management. Far too often technical training programmes focus only on improved beekeeping methods that increase yield, but find no ready markets for absorbing such excess capacity. Business management and marketing training need to be integrated into technical training programmes as it provides small-scale farmers a far more comprehensive spectrum of what a beekeeping business is all about. Like with technical training where FFS methods are used, business management and marketing training needs to follow the same approach. Such training requires a 'learning-by doing' method: training is conducted via action, observations, analysis and then taking a decision.

Market information

Beekeepers in rural and remote areas do not have in many instances the skills and opportunities to ascertain market information. They commonly rely on what the local rural trader offers and have little if any idea of

prices paid in larger markets found in towns, cities and export markets. This lack of information can also impede trade between other members of the bee products supply chain and provide for trade inefficiencies.

Collection of market information on a regular basis that focuses on such aspects as prices and quantities traded, for example, and its dissemination in a timely manner, not only supports small-scale famers, but the entire supply chain as well as fosters the development of a more effective and efficient bee products trade. Such information can also provide indicators to small-scale farmers if it is viable to expand, contract or maintain beekeeping production constant. Further and importantly such information and its dissemination also enables a more equitable distribution of returns as supply chain members are more informed and hence have a better bargaining position. Moreover market information can also support and help in terms of reducing trade risk and improve identification of target markets for small-scale farmers.

Transport

For small-scale farmers one of the major impediments to market access is lack of transport and adequate transport infrastructure. In local markets this problem may not be so acute, but especially if attempting to sell in urban and export markets this can become a hindrance. Traders will not travel in and to rural and remote areas, if they have difficulty in collecting honey from widely dispersed producers as a lack of infrastructure and appropriately supported transport systems. Transport infrastructure and systems need to enable trade and not hinder it.

Bee products that are transported inappropriately and require long travel times have a higher risk of damage and loss in quality. This, for example, is especially true for honey, that if exposed to excessive heat and sunlight can start to ferment.

Commonly when transport infrastructure is developed and maintained appropriately in a local area, it does not only favour one enterprise over another, but provides for development opportunities for all farm commodities and products as well as other businesses that may be found locally.

Organizational options

Efforts of small-scale farmers to join together in associations, be it producer, marketing or both, need to be encouraged and supported. Facilitation of association formation

is not only required at the start of the organization, but importantly needs to last over time . For example support is particularly required in terms of business management of producer organizations.

Promoting and facilitating commodity associations, including all interested players in a supply chain (farmers, traders, wholesales, exporters, etc.), will enable better interactions between supply chain members and public institutions and also better understanding of the necessities and requirements of the beekeeping sector. Such associations can also promote voluntary quality assurance programmes among its members, provide information and support in developing national quality standards with the public sector as well as providing promotional campaigns at national level regarding the benefits of consuming bee products.

Quality

Quality in bee products needs to be upheld and standards need to be communicated effectively to those involved in small-scale beekeeping. This supports not only consumer acceptance and trust for bee products, but also facilitates trade transactions. Standards become particularly important for exporting bee products, such as honey for example to the European Union. The European Union requires all imported honey to be certified in terms of it being free from chemical, antibiotic and other residues.

Public organizations need to provide training for small-scale farmers in terms of quality and its related standards. However and importantly the public sector needs to create an enabling environment that allows for private sector quality certification organizations to operate and not only provide training, but packages of interventions to support quality in bee products. Most often producer organizations are preferably targeted as they have the financial capabilities for paying for such services, but also and importantly have the tradable quantities that can justify such costs.

Supporting women in beekeeping

In many countries beekeeping is the domain of women, as often bee hives are kept close to the home stead. In this respect a particular focus needs to be given to women when considering the development of the beekeeping sector. Women face barriers, for example cultural and social, that do not allow them to participate actively in the commercialization of what

they produce. In other instances what they produce is not commercialized at all and used for male –based recreational activities, such as the brewing of mead (honey beer).

Development programmes are required that are women-based, but are socially and culturally acceptable. Introducing the benefits that can be derived from such an activity in terms of improved nutrition and income for the farm family may pose a justification for women involvement in training courses based on improved production practices, business management and marketing. Moreover promoting and facilitating women's beekeeping groups can provide a wide range of benefits that can help them not only improve production know-how, but importantly give them more 'voice' within the sector.

Building trust and linkages

Traditionally traders and other middle men are seen as members of the bee product supply chain that take advantage of their bargaining position and credit availability. Traders, though are an important and fundamental element in bee products supply chains as they perform a number of operations that facilitate trade, reduce risk and contribute to providing consumers with bee products and farmers with income. For example traders collect bee products from widely distributed small-scale farms in rural and remote areas, assemble products, transport them and find markets in which to sell them. Without traders, farmers would not be able to make a living. Traders in bee product chains thus also need to be encouraged and supported and this contributes to the overall development of the sector.

Traders, like farmers need trust to be able to conduct business. On the one hand traders need to be assured that whatever bee product they are buying is of quality and will live up to trade expectations. On the other hand farmers need to know that they will get paid for their efforts in providing such products. In this regard trust and linkages between small-scale farmers and traders need to be supported by promoting commodity associations as well as improving and making the bee product supply chain more transparent and easy for both farmers and others involved to understand.

Institutional role

The role of the public sector is commonly devoted to providing infrastructural services, such as transport, energy, water and communications as well as river, sea and airports to facilitate international

exports. The public sector also has the role of fostering an enabling business environment that supports and facilitates trade and increases new trade opportunities. Further the public sector also needs to provide institutional support and capacity that enables, for example the reduction of paper work for national and international trade. Moreover the passing of legislation and provision of a regulatory environment that favours and supports small-scale beekeeping enterprises and more generally the bee products supply chain and sub-sector is another role that the public sector needs to play.

The public sector, in recent years, has also taken on the role of promoting private sector involvement in terms of infrastructure, institutional support and capacity building as well as in the regulatory environment. For example many privately run organizations provide quality certification schemes to beekeepers. In other instances privately-owned organizations offer business development services in rural areas for many different and varied agriculture-based enterprises.

Role of the advisor

Advisors play a key role in awareness, promotion and support in developing beekeeping as a viable diversification enterprise for small-scale farmers. Advisors play a role not only in developing programmes, but importantly in implementing them. The main matters that advisor can cover to support, develop and implement beekeeping enterprises in terms of small-scale farming are:

- Provide an overview of the beekeeping sub-sector in a country;
- Advise small-scale farmers on the plethora of opportunities that can derive from beekeeping;
- Provide information on the low input necessity of such an enterprise;
- Provide information and training on technical and business management matters related to beekeeping;
- Provide mark information on pricing, marketing channels, sources of market information, etc.;
- Advise on the opportunities, challenges and risks;
- Advise on marketing improvement programmes and plans;
- Facilitate and promote the formation of producer organizations;
- Provide information on related quality standards and pertinent legislation.

Challenges

Bee species, parasites and diseases

Honey bees are subject to many diseases and pests like any other livestock. The major problem in many countries is that honey bee diseases and pests that do not affect *Apis mellifera* are not fully understood and researched adequately. Moreover it is also the lack of understanding on behalf of beekeepers combined with lack of regulations and enforcement that has enabled the increasingly rapid spread of pathogens during the past thirty years (FAO, 2009).

Honey bees' social habit of living in colonies with frequent contact and sharing of work, via for example using their mandibles to pass on nectar, among hive members has also contributed to the rapid spread of diseases and pests. The most important first defense against disease and pests is the bees' hygienic behavior, followed by having strong and vigorous colonies, good hive sighting and elevation from the ground and good management practices carried out by small-scale farmers. Importantly exposure to pesticides should be averted and the use of chemicals to treat infected hives should be kept to a minimum.

Advisors will need to support small-scale beekeepers in terms of providing information on the most common pests and diseases in a geographic area as well as providing training on how to prevent and reduce diseases and pests in honey bee colonies.

Supply chain and market linkages

Small-scale farmers in rural and remote areas will have limited capacity to participate in formal supply chains, become active players within and be able to forge business relationships and linkages. Limited time, skills and resources are all constraints on small-scale farmers to become active players in supply chains. To support supply chain integration advisors will need to provide information on markets, supply chains and information on potential and lasting relationships and linkages.

Quality and standards in local and international markets

Limited capacity and especially limited resources of small-scale farmers pose a challenge in terms of

quality in bee products. This becomes a serious constraint when considering exports markets in particular. Moreover when bee products are value-added in more complex processing activities quality becomes even more a challenge. Training that provides for capacity building in terms of not only quality in production, but also and importantly in terms of processing. In production appropriate management of hives and colonies can do very much to improve the quality of final products. However once bee products are harvested, interventions can be made in terms of conserving the original quality as found in the bee hive of the bee products and preventing deterioration while processing and marketing.

Processing

At farm household level basic processing of bee products may be traditionally managed. However such methods may not be proficient in supporting yields and quality and hence will need support from advisors. For example, in many countries when honey is capped from comb, the wax is disregarded or used for other purposes that do not have any market value. Awareness creation and training should be provided that builds on traditional skills and improves them.

Yet another challenge arises when equipment is required, for example a manual honey extractor, that may not be available in the local area and its cost may be well above farm household possibilities. One option is the creation of honey collection centres where such equipment can be bought collectively and/or the formation of producer and marketing groups. However like all equipment that is non-indigenous appropriate training is required and an appraisal of the 'spare parts' supply chain to maintain such equipment in operation also needs to be carried out.

As value is added to bee products, not only is training required in improved processing methods for value adding, but quality control and quality maintenance training are also required.

Packaging

Packaging can be a major constraint to bee product marketing as mostly this is carried out in rural and remote areas using recycled drinking bottles and other packaging materials sourced locally. However very often these types of packaging materials are unsuitable for wider distribution of bee products to town, city and

export markets. Improved packaging materials, for example new glass jars with lids for honey, are not commonly available in many areas and their cost can be high. Yet again honey collection centres and/or producer organizations can provide the needed funds to buy packaging in bulk and hence reduce its unit costs as well as offering packaging services for its members.

Local skilled trainers

Unfortunately, as a result of public budgetary cuts, it is difficult to find extension staff that has been provided with up dated training in such aspects as improved production methods, treatments for diseases and parasites and so forth. This challenge of disseminating improved technical information and knowledge results in a competitive disadvantage for small-scale farmers. Conducting trainings and distributing training materials in remote and rural areas is a challenge as its costs are high as a result of dispersed small-scale farmers.

Gender

In some countries there are cultural and social barriers to sensitization programmes and training sessions organized for women who tender honey bees. This hampers all attempts to improve production skills, competencies and know-how as well as in marketing bee products.

Honey collection centres and producer organizations

Honey collection centres are a challenge in setting up as they require, not only some form of physical structure like a building and its related costs, but also good management and financial investments by its members. Such an initiative could be consolidated with the formation of a producer group, though the issues and matters to solve remain very much the same. Organizing widely dispersed small-scale farmers in rural and remote areas is not an easy task. It requires some initial funding, meetings to take place among producers, travel time and costs, and good communications among small-scale farmers. It also requires motivation and consistency to be able to keep the organization going once it has been set-up.

Public policy

Laws and regulations that are specifically designed for the beekeeping sub-sector and in particular to support small-scale farmers can be a challenge. Such

legislation may be seen by other players in the supply chain as an attempt to favour only one player (small-scale farmers) in the supply chain. Policies thus need to strengthen and develop local markets with adequate product quality assurance, without undermining the development of large-scale operations and related destination markets.

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Sources of further information and support

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Apiconsult
http://www.apiconsult.com/index.htm

Apimondia
http://www.apimondia.com/

Apiservices
http://www.beekeeping.com/

Basic beekeeping manual
http://teca.fao.org/sites/default/files/resources/Basic%20Beekeeping%20Manual.pdf

Bees for development
http://www.beesfordevelopment.org/

Beekeeping glossary
http://www.beekeeping.com/_menus_us/index.htm?menu.htm&0

International Bee Research Association
http://www.ibra.org.uk/

Liberty Development Foundation (LIDEFO)
http://www.lidefo.org/

Organic beekeeping society
http://thehealingpath.com/OrganicBeekeeping/OBS/index.shtml

Preparing a business plan: An example for beekeepers
http://www.farmcentre.com/File.aspx?id=b44db8ff-c6e2-43ab-8173-33c28e51619c

Small-scale beekeeping
http://www.beekeeping.org/articles/us/small_beekeeping/index.htm

Notes

Notes

There have always been people in communities the world over who keep bees for their products and services that they offer. Bees produce numerous products, the most popular being honey, as well as beeswax. Importantly bees provide for pollination services that not only ensure a good harvest, with increased yields, but quality of the harvested produce. More practically, however, a colony of bees provides food and income for the farm family and not only.

This booklet is intended to raise awareness and promote beekeeping, among people and organizations involved in supporting small-scale farming, as a successful diversification enterprise that small-scale farmers in rural, peri- urban and urban centres can integrate into their farming systems easily.

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