Beekeeping Training Module

AFRICAN HONEY BEES

Bees for Development
Using this training resource
This resource material is intended for trainers in tropical Africa when providing beekeeping training courses. It is always useful to assess the needs of the trainees before delivering the training, to make sure that the topics covered meet their needs. We encourage you to combine theory training with practical sessions. Practical training requires more preparation – for example you need to identify a suitable venue and assemble the necessary equipment: this is the most effective way for people to learn. Ideas for group energisers, example test questions and tips for trainers are also provided. Words appearing in bold are defined in the glossary on page 23.

At the end of this module participants will:
• Appreciate the benefits of keeping honey bees
• Have an understanding about the needs of a honey bee colony
• Know about the different honey bees in a colony and their roles
• Be able to identify honey bee forage in the local area
• Be aware of the different forms of beekeeping practised in Africa

Modules in this series
African honey bees
Beekeeping with fixed comb hives
Beekeeping with top-bar hives
Harvesting and processing honey
Processing beeswax

Other resources
A variety of other resources are available from www.beesfordevelopment.org

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INCOME GENERATION
The sale of honey and other bee products generates income, especially where there is good market access. Other people in the community can generate income from secondary products and through trade e.g. making honey wine.

SUSTAINABLE
Beekeeping is sustainable and does not cause natural resource depletion or pollution. Beekeepers plant and maintain trees and forests.

INCLUSIVE AND ACCESSIBLE
Honey bees can be kept by men and women of all ages. People with disabilities can keep bees. Bees do not need daily care and can be attended to as other work allows.

POLLENATION
Honey bees pollinate flowering plants – this activity is vital for life on earth. Adequate pollination is essential for maintaining the yields of many food and cash crops.

USEFUL PRODUCTS
Honey is valued across the world as a healthy food and medicine. Beeswax is used in cosmetics, pharmaceuticals, polishes, soaps, candles and many other products.

LAND USE
Honey bees visit flowers anywhere. Farms, savannah, forests, protected areas and other natural habitats all have value for beekeeping. Beekeeping does not use land that could be used for crops.

LOW COST
Beekeeping can be very low cost. Hives and other equipment can be made locally, and bees are freely available. Bees do not depend upon the beekeeper for food.

PREMIUM PRODUCTS
In areas of Africa where there are abundant natural resources and healthy honey bee populations, there are opportunities to market honey and beeswax as organic or fair trade.

RESILIENT WHEN DISASTERS HAPPEN
Displaced communities can make hives and gain benefit from bees in a relatively short time. It is not necessary to own land or to be settled permanently to keep bees.
A main benefit of keeping honey bees comes from the sale of the honey and beeswax that can be harvested. Income earned can help people to build strong, resilient livelihoods.
WHAT HONEY BEES NEED

Honey bees are wild insects that live where there is natural vegetation. They thrive in environments that have not been damaged by people and where there are plenty of flowering plants. To keep honey bees you must understand what they need to live well, reproduce and produce honey.

HONEY BEES NEED:

- A cavity or container to nest in which is dry and protected from predators. If the space is too small, the honey bees will not be able to establish a big nest; if it is too big, they will not be able to guard the whole area from pests.

- Nectar and pollen from flowers, for food. Honey bees need diverse and abundant floral resources.

- Water to control the temperature inside the hive, and to dilute stored honey before it is eaten. Honey bees can travel up to 2km to obtain water from ponds, streams and dew. Honey bees will often collect water from wells, taps and water containers.

- Environments free of pollution. Toxic chemicals used in agriculture or around homes and gardens kill honey bees. Honey bees will not thrive in polluted and contaminated environments.

*Wild honey bee colonies nesting in a baobab tree, The Gambia.*
PROBLEMS FOR HONEY BEES

PESTS
Ants are particularly damaging to honey bee colonies in Africa. They can infest and destroy a colony very quickly.

PESTICIDES
Insecticides, herbicides and fungicides all kill honey bees, directly and indirectly.

PREDATORS
In some countries honey badgers raid honey bee colonies.

REMEMBER
Honey bees do not need beekeepers! Honey bees live very well in the wild. Beekeepers need to understand how honey bees live and what they need, so that the honey bees choose to live and remain in beekeepers' hives.

Diseases, although present, are rarely a problem for African beekeepers. **However pesticides are a big problem.**
LIFE AND BIOLOGY OF HONEY BEES

The species of honey bee indigenous to Africa is *Apis mellifera*. Honey bees living in tropical Africa have biology and behaviour different from honey bees adapted to temperate zones. Beekeeping methods invented for bees in temperate zones, do not necessarily work well with tropical honey bees.

Honey bees are social insects that live in colonies of 10,000 to 60,000 honey bees. A colony of honey bees comprises one queen honey bee, a few thousand male drone honey bees and many thousands of female worker honey bees. These three different types of adult honey bee (queen, drone and worker) live together in a nest consisting of parallel beeswax combs.

*Left to right: Worker, Queen, Drone*

WORKERS

The majority of honey bees in a colony are workers. They develop out of fertilised eggs laid by the queen. Workers are females that are not sexually developed and cannot mate. They are smaller than the queen and drones.

THE DUTIES OF A WORKER INCLUDE:

- Feeding, covering and warming the brood
- Producing beeswax and building honeycomb
- Keeping the nest temperature constant
- Cleaning the hive and protecting it from enemies and intruders
- Flying out to forage for food
- Collecting pollen, nectar, water and propolis for the colony
- Changing nectar into honey and storing it in cells of the comb
- Searching for new nest sites
The **division of labour** among workers is age-related although honey bees will alter their behaviour according to the needs of the colony. Young worker honey bees are responsible for caring for the brood. As they mature they begin their nest duties and finally their **field duties**. The lifespan of workers is 7 - 8 weeks during the main flowering season when they work hard. They can live longer during dormant periods. Workers collect nectar, pollen, water and **propolis**. They convert nectar into honey to feed the colony during periods when there are no flowers. Every worker has a barbed sting and is ready to fight and die to defend her colony.

**THE QUEEN**

Each colony has a single queen which can live for up to 5 years. She is the only sexually developed female in the colony. She lays eggs within the brood nest. Queens lay up to 2,000 eggs per day. Queens can lay either fertilised eggs which develop into female honey bees, or unfertilised eggs which develop into male honey bees.
The queen is the largest bee in the colony and has an elongated shape due to the developed ovaries in her abdomen. New queen bees develop inside **queen cells** that are especially large, elongated cells hanging down from the comb. Once a new queen emerges, she will fly out of the nest to mate with a male drone. When mated, the young queen will have enough sperm to fertilise all the eggs she will lay in her lifetime. Usually the old queen leaves the colony in a **swarm** before the new queen emerges from her cell.

If a queen dies or becomes unproductive, the workers rear a new queen by feeding young female larvae a substance called **royal jelly**. The workers can raise a new queen in this way only if the brood contains fertilised eggs or young larvae laid by the previous queen.

**DRONES**

A colony will produce a few thousand drones at the start of a good flowering period. They are larger than workers but smaller than the queen and do not have **stings**. They develop from unfertilised eggs laid by the queen. In unusual circumstances, worker honey bees lay eggs that also develop into drones.

The only function we know about drones is that they fertilise queens. They leave the nest and fly with drones from other colonies to a special place known as a drone congregation area. Queens come to this area to mate. Drones are dependent on the workers for food. When food is scarce, most of the drones are chased away from the colony and die. Their lifespan is usually not more than two months.
**BROOD**

Honey bees undergo a four stage **metamorphosis**: egg > larva > pupa > adult. During the development stages, the young are known as brood. Each honey bee develops inside a cell of the comb. When the larva is fully developed, the cell is capped, the larva **pupates** inside a **cocoon**, and is transformed into an adult honey bee. Brood are raised in the centre of the colony where a constant temperature of 35°C is maintained.

**SWARMING**

Colonies reproduce by swarming. This is when the mother queen and about half the colony leave the nest in search of a new nesting place, leaving behind the rest of the colony and a young replacement queen.

The process of swarming enables one colony to become two and is the way honey bees reproduce and colonise new habitats.

Beekeepers need to know when the swarming season occurs in their region. Hives should be baited and sited in advance to attract swarms.
<table>
<thead>
<tr>
<th>Title of session*</th>
<th>Learning objectives</th>
<th>Methods of teaching</th>
<th>Additional training resources</th>
<th>Page(s)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Introductions and overview of the day</td>
<td>Participants introduce themselves and any previous beekeeping experience</td>
<td>Board markers, large sheets of cardboard or paper, exercise books, pens</td>
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<td></td>
<td>• Explain to participants what they will learn from this training</td>
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<tr>
<td>2</td>
<td>Benefits of keeping honey bees</td>
<td>▶ Lecture</td>
<td></td>
<td>4</td>
</tr>
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<td></td>
<td>• Appreciate the economic, social and environmental benefits of keeping honey bees</td>
<td>▶ Group discussion</td>
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<td></td>
<td>• Determine whether beekeeping is an appropriate livelihood option given the individual circumstances</td>
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<tr>
<td>3</td>
<td>What honey bees need</td>
<td>▶ Lecture</td>
<td></td>
<td>6, 7</td>
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<tr>
<td></td>
<td>• Know what honey bees require to live and produce honey</td>
<td>▶ Group discussion</td>
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<td>• Understand that toxic chemicals kill honey bees</td>
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<td></td>
<td>• Appreciate that honey bees have natural enemies that can jeopardise their survival</td>
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<td>4</td>
<td>Life and biology of honey bees</td>
<td>▶ Lecture</td>
<td></td>
<td>8-11</td>
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<tr>
<td></td>
<td>• Understand the four stage metamorphosis process</td>
<td>▶ Group discussion</td>
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<td>• Identify the three types of honey bees in a colony</td>
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<td></td>
<td>• Describe the life cycle of each type of honey bee</td>
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<td>• Explain the roles of each type of honey bee</td>
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*Each classroom session is designed to last 30 minutes. Allocate extra time for practicals.*

<table>
<thead>
<tr>
<th>Title of session*</th>
<th>Learning objectives</th>
<th>Methods of teaching</th>
<th>Additional training resources</th>
<th>Page(s)</th>
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</thead>
</table>
| 5 | Energiser | • Allow participants to reflect on what they have learned  
• Encourage independent thinking and creativity  
• Create enthusiasm and motivate participants  
• Enhance group interaction and the sharing of ideas | ▶ Games  
▶ Role plays  
▶ Discussions in small groups | 19 |
| 6 | Plants for honey bees | • Know why plants are important to honey bees  
• Explain the process of pollination  
• Appreciate the value of forests to beekeepers  
• Know how to construct a flowering calendar | ▶ Lecture  
▶ Activity: field walk  
▶ Activity: the flowering calendar | 14-16, 22 |
| 7 | Honey bees and people | • Appreciate the long history people have with honey bees  
• Recognise the different approaches to keeping honey bees  
• Know the difference between extensive and intensive beekeeping and which is most appropriate for them. | ▶ Lecture  
▶ Group discussion | 17,18 |
| 8 | Assessment | • Assess the learning that has taken place  
• Clarify issues that have not been fully understood  
• Obtain feedback from participants | ▶ Written or oral quiz  
▶ Group discussion and reflection  
▶ Questions and answers | Question sheets or plain paper, pens  
20 |
PLANTS FOR HONEY BEES

Honey bees and flowering plants rely on each other to survive. The honey bees’ food is provided entirely by the plants they visit. Nectar is a food source rich in energy, and pollen is a source of protein for the brood. In return, honey bees play a crucial role in pollination. When they visit flowers to feed, they move pollen from one flower to another of the same species. This enables fertilisation to take place so that the plant can produce seeds.

Some plants require several visits from honey bees to ensure that the flower is well fertilised. If fertilisation is inadequate due to lack of honey bees, not all seeds will develop and they may be of lower quality. The pollination activity of honey bees can have a direct influence on crop yields. Honey bees improve the yields of many crop plants, especially fruits, nuts, vegetables, oil-seeds and coffee.

CONSERVE FORESTS

*no trees - no honey bees: no honey - no money*

In Africa, trees provide important honey bee forage, and forests are essential for the survival of honey bees. Trees provide nesting spaces for wild colonies, protect colonies from extreme temperatures and provide an abundance of floral diversity. Forest degradation is decreasing the number of honey bee colonies in many parts of the world. Conserving forest biodiversity is therefore important for beekeepers.
If clearing is necessary, leave the best honey bee trees in the fields or around the edges. If bush burning is used, this should be done early in the dry season to prevent damaging late-season fires. When enough honey bees are present, they provide better pollination which leads to the improved regeneration of forests.

**BEWARE OF PESTICIDES**

If honey bees are living in agricultural areas they are likely to collect nectar and pollen from cultivated plants. Insecticides, fungicides and herbicides kill honey bees directly through poisoning and indirectly by reducing the food available to them, and by killing bees’ gut flora, make pollen indigestible.

**ENSURING THERE ARE ENOUGH PLANTS FOR HONEY BEES**

Honey bees forage on different flowers in different areas depending on what is available. Most plants bear flowers at only certain times of the year, however honey bees need food over many months, so a variety of plants must be available. It is good to identify which plants honey bees feed on in your area.

Wild plants should be allowed to grow wherever there is space, including inside the **apiary** (provided hive entrances are kept clear from tall grasses and weeds) by the side of roads, near houses and in-between fields. Produce a flowering calendar listing the flowers that are available each month of the year, as shown on page 22.

© Photograph by Sean Lawson

*Bananas are propagated vegetatively and therefore do not need honey bees for pollination. However banana flowers produce abundant nectar, which honey bees love.*
HONEY BEE FORAGE

OBSERVE FLOWERS IN YOUR AREA TO DETERMINE:

- which flowers are visited by honey bees
- the time of day these flowers are visited by honey bees
- whether the honey bees are collecting nectar, pollen or both

Top left: Coffee (Coffea arabica) Top right: Moringa (Moringa oleifera)
Bottom left: Sudan teak (Cordia africana) Bottom right: Sunflower (Helianthus annus)
HONEY BEES AND PEOPLE

Humans have devised many ways to exploit honey bees for their honey and other products. These practices can broadly be defined as honey hunting and beekeeping.

© Photograph by Milan Wiercx van Rhijn

Beekeepers in Mizan Teferi, Ethiopia place log hives high into trees to attract swarms.

Honey hunting is common in countries where honey bees are plentiful, however it can be unpredictable and difficult. People have learnt that by deliberately placing hives, it is possible to know where honey can be found, assert ownership over honey bee colonies and harvest regularly.

The simplest beekeeping consists of placing hives and attracting wild swarms. Beekeepers visit the hives infrequently and crop honeycomb from time to time. This method of beekeeping simulates the way honey bees live naturally and has persisted for hundreds of years. It is practised successfully across Africa.

THIS AFRICAN SYSTEM OF BEEKEEPING IS SUCCESSFUL BECAUSE:

- Hives are simple containers with no complex parts
- Many kinds of container can be used as a hive
- It is a low cost and highly effective system
- A large number of low cost hives is an excellent strategy to suit the mobile behaviour of African honey bee colonies
- Honey bees live as they would in the wild, concerning nest structure and lifecycle, and this maintains excellent honey bee health
- Beekeepers visit hives infrequently - only to install and harvest
- It is sustainable if the trees used for making hives are not harvested faster than the rate of regeneration or re-planting
Not all local systems of beekeeping are the same. Some beekeepers have greater knowledge of how honey bees behave than others, and alter their beekeeping practices accordingly. The level of skill varies too, particularly when it comes to harvesting and making hives. If a beekeeper has many hives, they can harvest a lot of honey by taking honey from only some of them, e.g. half each year. Other hives may be empty or producing swarms to populate new or empty hives.

Some beekeeping systems are designed to give beekeepers more control over the honey bees. To make the change from allowing honey bees to live naturally to a situation where the beekeeper is taking more control, requires a different kind of container - a container which can be opened and re-closed. Top-bar hives and frame hives have been designed to enable the beekeeper to inspect, intervene, manipulate and manage a colony.

When deciding what kind of beehive to use, a beekeeper must decide whether they wish to take an extensive approach or an intensive approach. This will depend on their own circumstances and what they want to achieve. Most honey currently harvested in Africa is harvested using the extensive approach, and this is usually more appropriate given the biology and behaviour of African honey honey bees.

**CHOOSING A HIVE TYPE**

An understanding of the advantages and disadvantages of different hive types is necessary before a hive is chosen. Beekeepers should be aware of the range of options of hive types and encouraged to use the one which is most appropriate for them.
IDEAS FOR ENERGISERS

Energisers are designed to motivate participants and reinforce the key messages. Activities should be relevant to the learning objectives of this module. Instructions must be clear to avoid confusion. Time for group reflection will ensure the intended message has been conveyed.

**Brainstorming** - Participants are asked what they think are the benefits of beekeeping. All participants are encouraged to make contributions. Ideas are called out randomly. No suggestion is silly or unimportant. Keep the flow of ideas coming and save discussion until the end. If needed, use the images below to stimulate discussion.

**Storytelling** - Participants reflect on their previous experiences with and knowledge of honey bees. Participants are encouraged to describe their most profound memory of honey bees, whether that be a story they were told by their ancestors or a personal experience. Stories are shared between small groups or pairs. Selected stories are shared with the whole group.
QUESTIONS FOR ASSESSMENT

At the end of the module it is good practice to assess whether participants have learned what they need to know. This helps them and it helps you too. They will be confident that they have learned something, and you will know whether you have achieved the learning objectives. If participants are unable to answer questions, clarification will be required.

EXAMPLE QUESTIONS

1. Name three reasons why honey bees are important.
2. What do honey bees need to live?
3. How and where do young honey bees develop?
4. What are the three types of honey bee in a colony?
5. How can you identify the three types of honey bee?
6. What are the roles of the three types of honey bee?
7. Why do honey bees need flowering plants?
8. Why do flowering plants need honey bees?
9. How is pollination beneficial to farmers?

FURTHER READING

Fact sheet - The importance of honey bees and other insect pollinators
*Bees for Development Journal Edition 117*

What makes a honey bee colony function?
*Bees for Development Journal Edition 67*

Honey bee colony development and the flowering calendar
*Bees for Development Journal Edition 32*

All of the above can be found at [http://www.beesfordevelopment.org/journal](http://www.beesfordevelopment.org/journal)

1. Preparation is vital. Do some background reading in addition to reading this booklet. Participants often ask questions you do not expect. More detailed information is available from www.beesfordevelopment.org

2. Organise practicals well in advance and ensure that you have all the equipment and training resources needed. Plan your procedures in case of an accident or medical emergency.

3. Learning is enhanced when training is participatory. Ask lots of questions and give participants the opportunity to discuss the subject. Involve participants in practical sessions.

4. Make lessons interesting. Seeing as well as hearing helps participants to understand and remember. Explain things by using examples people can relate to. Share experiences. Humour helps!

5. Adapt resources and teaching style to the training situation. The lesson plan on pages 12 and 13 is suggested only as a guide. Adapt the course content according to the previous experience of the participants. Find out the level of literacy and the preferred language of the group, and adjust your teaching methods to suit.

6. Photocopy sections of this booklet and give them as handouts.

7. Reflect on your teaching. What worked and what did not? You could consider asking similar questions to the participants, possibly in the form of an anonymous training evaluation questionnaire.
ACTIVITIES

1. THE FLOWERING CALENDAR

Draw a flowering calendar as a group - list months along the top of the table and plants down the side. Shade the months when the plants flower. You can use the table below as an example.

<table>
<thead>
<tr>
<th></th>
<th>January</th>
<th>February</th>
<th>March</th>
<th>April</th>
<th>etc.</th>
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<tbody>
<tr>
<td>Coffee</td>
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<td>Shea</td>
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<td>Cashew</td>
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<td>Mango</td>
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2. FIELD EXERCISE

As a group, arrange a walk around the local area and identify important honey bee plants. Consider whether they are native species or crops and whether the honey bees visit them for pollen or for nectar.

© Photograph by Sean Lawson
GLOSSARY

**Apiary**
The location of a number of bee hives.

**Apis mellifera**
The honey bee species indigenous to Africa, Europe and the Middle-East.

**Biodiversity**
Every form of life (plants, animals, fungi and micro-organisms), their communities and their habitats.

**Cocoon**
Protective silk threads encasing a developing bee during pupation.

**Division of labour**
The different activities performed by bees at different stages of their lifecycle.

**Extensive beekeeping**
A beekeeping system that includes many honey bee colonies in bee hives sited across a wide area, with minimal intervention. The main work of the beekeeper is in making and siting many hives and harvesting honeycomb from them. The yield per hive may be smaller than from an intensively managed hive, however the yield from many hives can be significant, with low input costs.

**Field duties**
The collection of nectar, pollen, water and propolis from the local area by worker bees more than 16 days old.

**Forage**
Flowering plants which bees visit to collect nectar and pollen.

**Indigenous**
Originating in and naturally living, growing and occurring in a region.

**Intensive beekeeping**
A beekeeping system in which each honey bee colony is manipulated towards achieving maximum honey harvest by for example, increasing the honey bee population, preventing swarming, and returning frames with empty honey combs to the hive. When successful, the honey yield per hive may be higher, though with higher input costs than incurred by extensive beekeeping.

**Metamorphosis**
A complete change in the form of an animal as it develops into an adult.

**Nectar**
The sweet liquid secreted by flowers. It is a watery solution of sugars.

**Pest**
An animal or plant which is harmful or destructive to another animal or plant.

**Pollen**
Pollen grains contain the male sperm cells of plants.

**Pollination**
The transfer of pollen from the male parts of a flower to the female parts of another flower of the same species. It is an essential process in the development of fruit and seeds.

**Predator**
An animal which lives by eating other animals.

**Propolis**
Plant resins collected by honey bees and used by them to seal cracks and gaps within the hive. It is also used by bees to line the nest and the brood cells - it has anti-microbial properties.

**Pupation (pupates)**
Transformation from a larva to a pupa.

**Royal Jelly**
The substance that is secreted from the glands of a worker and is used to feed brood. Larger quantities are used to feed developing queens.

**Sting**
The barbed, pointed end of a worker bee that pumps out venom when inserted into a victim.

**Swarm**
Bees, including a queen, that have split from one nest and are in search of a new nesting place. Bees typically leave behind about half of the original colony and a young or just emerging queen.

**Toxic**
Containing a poison or toxin which can cause serious harm or death.