Ethiopian ATI
Agricultural Transformation Institute
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HONEY AND BEESWAX PRODUCTION BUSINESS

TRAINING COURSE FOR YOUTH AGRI-ENTREPRENEURS

Ethiopian Agricultural Transformation Institute

ADDIS ABABA, ETHIOPIA
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OVERVIEW OF THIS MODULE

Beekeeping plays a vital role in supporting biodiversity and maintaining healthy ecosystems, while also offering a flexible and accessible source of income, especially in rural communities where employment opportunities are limited. This training module on honey and beeswax production is designed to empower youth—both women and men, by equipping them with the skills and knowledge needed to create dignified employment opportunities in the beekeeping agribusiness.

By engaging in beekeeping, participants can benefit from a sustainable source of income while also contributing to environmental conservation and the well-being of their communities. The module uses an interactive, hands-on training approach, combining lectures, group discussions, and practical field exercises conducted during both day and night sessions.

The training spans ten days, evenly divided between theoretical instruction and practical application, ensuring a comprehensive understanding of the industry. Participants will learn how to select appropriate apiary sites, manage bee colonies across different seasons, and properly handle honey and beeswax to maintain quality and maximize profit.

The module also emphasizes the importance of record-keeping, covering key areas such as colony health, harvest yields, and financial management. These practices are essential for maintaining high standards and ensuring compliance with industry regulations. Furthermore, the module is designed to foster entrepreneurship, enabling trainees to build and sustain successful businesses within the beekeeping sector. Upon completing the training, participants will be equipped with the knowledge and skills necessary to efficiently manage beekeeping operations and produce high-quality honey and beeswax. They will be prepared to enter the market with a strong foundation in both the technical and business aspects of beekeeping. Ultimately, this preparation positions them to contribute to local economic development and environmental sustainability, leveraging beekeeping as a viable and innovative business opportunity.

INTRODUCTION

Beekeeping agribusiness presents a promising and sustainable opportunity for creating dignified jobs for youth (women, and men) and Agri-entrepreneurs. By harnessing the natural processes of bees to produce honey, beeswax, and other hive products, beekeeping supports environmental health while also provides a source of income for individuals and communities. This business module is particularly beneficial in rural areas where employment opportunities may be limited, offering a pathway to economic stability and empowerment.

In addition to its economic benefits, beekeeping promotes gender inclusivity and youth engagement. It requires relatively low initial investment and can be managed flexibly alongside other agricultural activities, making it accessible for women and young people. Training in beekeeping skills can lead to the development of local expertise and entrepreneurship, fostering a sense of pride and ownership. As a result, beekeeping agribusiness serves as a catalyst for community development, enhancing livelihoods and contributing to the overall well-being of society in general and youths in particular.

Training Methodology

Training will be offered online and offline for seven and half days. Training approach includes brainstorming, lecture, group discussion, practical exercise both at day and nighttime and supported by pictorial and audiovisual presentations. materials and equipment used include Flip chart, Marker, Notebooks and Pens, LCD, different beehives and other beekeeping materials and handouts.

Training Participants

Youth (men and women), MSME, Farmers, entrepreneurs interesting in honey and beeswax production business, etc. can participate on this module training.

The Agriculture-focused Dignified Employment for Youth (ADEY) program is implemented by the Ethiopian Agricultural Transformation Institute in partnership with the Mastercard Foundation to enable 611,343 inclusive and dignified work opportunities for young women and men and support youth entrepreneurship, employability, and sustainable livelihoods in the agribusiness sector.

SECTION 1: UNDERSTANDING HONEYBEE COLONY

Overview of the section

Good beekeeping requires, knowing the nature of honeybees, how they develop, work, act together and what they need. The understanding of biology of honeybee assists the beekeepers to able to practice appropriate management techniques. This session acquaints the trainees with brief casts of the honeybee colony and their roles in the colony and development duration of each cast and how honeybees communicate to fulfill their requirements.

Learning Outcomes

At the end of the session the trainees identified casts in the colony, their roles and development cycle and how honeybees communicate each other during forage collection

Duration: 2 hours

Learning question

- What are the casts in honeybee colony and their respective roles?
- How long each cast need to develop from egg to adult?
- How do honeybees communicate?

1.1 HONEYBEE CASTS AND THEIR ROLES

- There are several types of bees, including honeybee and stingless bees. This handout focuses only on honeybees. Honeybees are social insects that live in a colony of about 10,000 to 80,000 of bees in nests.
- A colony of honeybee consists of three castes: a fertile queen (female), a few hundred drones (males) and thousands of workers (sterile females) (Figure 1).

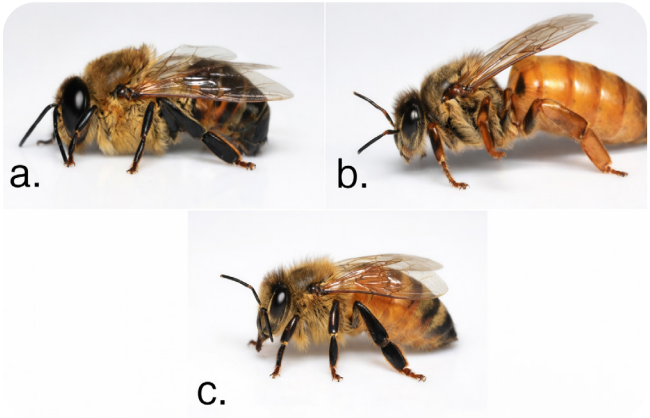


Figure 1. Honeybee castes: a. drone (male), b. queen (reproductive female) and c. worker (non-reproductive female).

1.1.1 QUEEN

- Queen is reproductive female whose job is to lay egg and produce queen substance (pheromones).
- A good queen produces between 1,500 and 2,000 eggs per day during good active season, but after two years, her efficiency of laying declines
- Fertilized eggs hatch into female castes (fertile queens or sterile workers).
- Unfertilized eggs hatch into males (drones).
- The queen can determine the type of egg she is going to lay.
- The queen lays eggs only of the type that she feels the colony needs.
- Virgin queen flies for mating (seven days after hatching) and mates with 7-20 drones.
- New queens mate only once with drones outside the hive.
- She lives for three to five years.
- Finding the queen is not easy, she is recognized by her long & slender body & short wings.
- She has a sting with curved barbs.
- The sting is used in battles against the rival queen

(when there is more than one queen in the colony).
- Queen usually found in a brood nest, especially on combs containing eggs.
- She is fed by the nurse bees with royal jelly, is bigger and lives longer than the other castes.
- Her pheromones (scents) influence the behavior of the other bees and harmonizes the colony's behaviors.

1.1.2 DRONE

- The drones are males and are bigger than the workers.
- Reach sexually maturity in 12-15 days.
- The drone does not work in the hive.
- Its duty is to mate the queen and dies after mating.
- Has no sting
- The drone has big circular eyes covering most part of its head and very long wings.
- The end of the abdomen is blunt and is covered with a tuft of small hairs.
- The number of drone bees in a colony varies seasonally.
- Drones can live up to six months.
- There can be 500 or more drones in a hive, depending on the season.
- Drones are expelled from the hive when food becomes scarce.

1.1.3 WORKER

- Most of the bees in the hive are workers- they are all sterile females.
- Their number varies from 10,000 to 80,000 in a colony depending on season, queen age, availability of nectar and pollen.
- Are smaller in size than drones and queen bees.
- Have unique legs equipped with pollen baskets used for collecting pollen.
- Have glands that produce beeswax and scent necessary for carrying out their many duties.
- Have the stingers that are used for defense mechanism.
- Die after stinging due to intestinal rapture.
- The worker bees' tasks change with age.
- Young worker bees (less than 21 days) clean the hive, feed the young and the queen, produce beeswax, build combs, make honey, and manage hive the temperature.
- Older workers (>21 days old) seek for food, collecting pollen, nectar, water, and propolis.
- The workers are also responsible colony defenses.
- The life span of adult workers varies greatly with activities and time of the year.
- During dearth periods when the colony is relatively inactive, workers may live three months or more.
- However, when the colony is active, the workers live on average for six weeks.

1.2 HONEYBEE LIFE CYCLE

- Each caste of bees passes through four developmental stages in its life: egg, larva, pupa, and adult.
- The first three stages, the eggs, larvae, and pupae are referred to as brood.
- The egg laid by the queen looks like a small grain of rice or hair nit.
- Whether an egg will develop into a queen, drone or worker depends on the type of cell it is laid in.
- It is very important to differentiate the difference between capped brood and capped honey.
- Capped brood is usually dark brown and capped honey is usually white or creamy in color.
- The egg hatches into a white maggot-like larva in three days.
- Newly hatched larva feed on royal jelly for the first days.
- After that, worker's and drone's larva are fed the mixture of royal jelly, pollen (bee bread) and honey.
- The queen larva continues to eat on royal jelly throughout its life.
- The pupae are sealed with a wax capping in the comb.
- After six days, larvae turn into pupae and later emerge as adult bees as shown in Table 1.

CASTE	EGG	LARVA	PUPA	TOTAL DAYS
Worker	3	6	11-12	21
Queen	3	6	6-7	16
Drone	3	8-9	12-13	24

Table 1. The development time of each honeybee caste from.

1.3 COMMUNICATION

- Bees communicate with one another using various types of dances and pheromones.

1.3.1 DANCE

- Using dance, the scout bees indicate the exact location of food and how far away it is.
- The round dance is performed by bees to locate forage within 100 meters from the hive.
- Waggle dance is performed to locate food source beyond 100 meters from the hive.
- Scout bees also perform a unique dance to indicate the new nest to which they aim to swarm.

1.3.2 PHEROMONES

The queen releases queen substances called "pheromones" that serve different functions

These pheromones enable her to:-

- Identify members of the colony
- Inhibit ovary development in worker bees
- Prevent the workers from building queen cells
- Help a swarm or colony to move as a cohesive unit
- Attract drones during mating flights
- The absence of the queen substance (e.g. when the queen dies) produces opposite responses:
- Worker bees begin to develop ovaries
- Build queen cells
- Workers may start egg laying
- A swarm searching for accommodation will not cluster

Post assessment question

1. How many casts are there in honeybee colonies and list their responsibilities?
2. What are the communication methods in honeybee colony and what information delivered by each method?

Key message

Knowledge of honeybee organization, function and communication is important to understand the status of honeybee colonies and implement colony management

SECTION 2: APIARY SITE SELECTION AND MANAGEMENT

Overview of the section

Apiary is a place where honeybee colonies are kept in hives to produce honey and other hive products. Selection of a good site is one of the most important decisions in beekeeping, because beekeeping is more dependents on the natural environmental conditions than other livestock production. If areas are not suitable to bees, skill & technical knowledge cannot make beekeeping successful. This session acquaints the trainees with brief types of apiary sites, parameters used to select appropriate apiary sites and number of colonies in an apiary and how to estimate the colony carrying capacity of the area.

Learning Outcomes

At the end of this section, trainees:

- Defined what apiary is, identified types of apiaries and parameters used to choose appropriate apiary sites.
- Knew the flowering calendar and how to integrate beekeeping with crops and other natural resources conservation
- Managed their apiary well.

Duration: 1 day

Learning question

- What does an apiary mean?
- What are the different apiary sites and parameters used to select appropriate apiary site?
- What are the major activities you should carry out to have well managed apiary site?

2.1 IMPORTANCE OF APIARY SITE SELECTION

- To assess the potentiality of the area for beekeeping.
- To estimate the number of honeybee colonies required to be placed in a selected area.
- To forecast the possible risks in the future (clearing of trees, flood, fire and chemical application)

2.2 PARAMETERS TO BE CONSIDERED FOR APIARY SITE SELECTION

A. Presence of native honeybees

- Bees require their own geographical areas for survival and reproduction
- Honeybees in their original areas have different adaptations,
- Some prefer higher altitude and forest-covered areas
- Some prefer lower altitudes

Therefore, it is good to observe foraging bees or ask the local people for the presence of bees in the area before site selection.

B. Availability of bee forages

- The presence and abundance of natural and plantation plants and cultivated bee forage crops within (economic bee flight range 1.5 to 2 km) distance from the apiary is very important.
- If possible, the natural vegetation should be composed of forest trees, shrubs, herbs, and climbers that provide adequate nectar and pollen for the foraging bees.
- Availability of cultivated crops such as oil crops (Noug, rapeseed, linseed, sunflower, sesame), cereals (maize, sorghum), legumes (pea, chickpea, grass pea), horticultural plants (citrus, mango, avocado, banana, coffee), and forage crops (vetch, alfalfa, Trifolium species) are useful nectar and pollen sources

C. Availability of fresh water

- Water is needed for consumption by the bees, for brood rearing and hive temperature regulation
- Bees need water during all the seasons, but more during the prolonged dry months
- The nearer (within 0.5 km) water source to apiary the better would be for the activities of honeybees
- It is also possible to bring fresh water to apiary using a water bucket

D. Suitable altitude and environmental condition

- Avoid placing beehives in damp or swampy areas. Damp air makes it difficult for the bees to ripen honey and potentially expose bee brood to fungal diseases.
- Avoid low-lying areas prone to flooding. Good drainage is essential to prevent hive moisture issues.
- The altitude affects plant availability and population distribution of honeybees.
- In Ethiopia, altitudes between 1500 to 2400 m.a.s.l is the highly suitable while 1001-1500 and 2401-2800 m a.s.l. are suitable for profitable beekeeping.
- However, 500-1000 and 2800-3200 are less favorable, while < 500 and > 3200 is not at all good for beekeeping.

E. Presence of diseases and pests

- There are many enemies of honeybees
- These include ants, beeswax moth, bee-eater birds, and honey badgers
- These causes great loss to both honeybees and their products
- Hence, in apiary site selection, the area should free from severe pests and disease incidence.

F. Distance from Pesticides

- Avoid areas extensively sprayed with pesticides (insecticides &herbicides), as these chemicals can harm bee populations.
- Establish buffer zones between your apiary and agricultural fields to reduce the risk of chemical exposure.

G. Consideration for neighbors or the general

- Establishing good relations with neighbors, local farmers, landowners, and the general public is an important factor in finding and maintaining a successful apiary site.
- The public is often ignorant and frightened of honeybees:

- Tell about the value of honeybees as pollinators
- Educate about swarms, flight paths, etc.
- Bees have their own behavior to establish regular flight paths to search for forage.
- Neighbor's complaints can result in loss of apiary site of a beekeeper
- As a solutions neighbor's complaints, reduce the visibility of the beekeeping activity by enclosing an apiary with hedges
- Keep only good-tempered bees
- Regularly check and cull bad-tempered stock and replace with more docile strains
- Fence the apiary from livestock which may kick over beehives
- In general, it is not advisable to establish an apiary near schools, hospitals, dairy and poultry farm sites, and marketplaces.

H. Accessibility

Accessibility to the apiary is perhaps the most important factor in the location of an apiary. This is because:

- Beekeeper should visit the apiary throughout the year in all kinds of weather
- Beekeepers carry equipment and heavy supers of honey any distance
- The easy movement ensures beekeeper's routine activities more productive
- Proper placement of an apiary enables the beekeepers to
  - add and remove supers
  - control swarming
  - harvest honey
  - feed bee coloniesd
  - etermining apiary size and colony carrying capacity of the site.

The size of an apiary and the maximum number of bee colonies in one apiary can vary depending

- On the types and abundance of bee forage in each location
- Capital investment
- Purpose of the apiary (commercial, demonstration, research)
- Available skilled human resources
- Placing too many bee colonies at one apiary can lead to:
  - scarce resources competition between the bee colonies
  - higher transmission of bee diseases
  - a high rate of robbing
  - leading to low honey yield

Determining the size of apiary is important to maximize honey production and reduce competition among colonies. Some key points to determine colony number in an apiary are:

- Determine the number of bee colonies based on the honey production potential of the bee forage in the selected site.
- Typically, there should be no more than 35 colonies in a permanent apiary with good nectar flow.
- Space out the colonies evenly within the economic flight range of honeybees (1.5 to 2 km). This helps maximize foraging efficiency and reduces competition between colonies. maintain a minimum distance of 500 meters between sub-apiaries to prevent overcrowding.
- Ensure that there is at least a 5 km distance between the economic flight ranges of honeybees. This prevents overlap and minimizes competition between colonies for forage resources.

2.3 APIARY SITE MANAGEMENT AND IMPROVEMENT

Once selected, apiary must be properly managed. The following points must be given attention for proper apiary management and improvement.

A. Apiary should be cleaned and levelled

- Areas where bee colonies are kept should be clean, and free from growing leafy plants and any unfamiliar or alien materials.

B. Fencing (live fence)

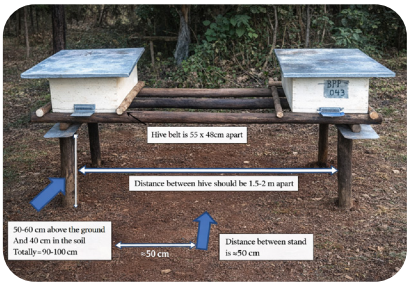
- Fencing secure ownership, and protection of properties properly.
- Keep the flight line of bees above the head
- Serve as wind break
- Protect children, animals and persons from bee stings
- Life fencing help bees to access forage
- Serve as shade for the bee colonies.

C. Proper placement of beehive

- Place the bee colonies on the hive stand with the entrance pointing east or southeast
- However, if the above direction is entry for both humans and animals and facing wind, the beehive entrance must be away from the entry and winds
- The bee colonies should get proper sunshine especially morning and afternoon sunshine
- When beehive is pumped into a site, it should be placed in zigzag or Circle.

D. Hive stand construction

- Beehive stand rises ***50 to 60 cm*** above the ground.
- The bee colonies may be in risk, if a hive stand is too close to the ground.
- Because grass can quickly obstruct the bee colony's exit and entry and bee enemies can easily enter it.
- Hive stand can be designed to seat one or two or more bee colonies (Figure 2)
- Leave distance of ***1.5 m to 2 meters between*** two bee hives to avoid drifting, robbing and disturbance
- The seat of the beehive should be made of hard wood, preferably one that is resistant to termite attack.
- The stand should be 90 to 100 cm tall, with 40 to 50 cm of that height going into the ground and the remaining height remaining to create a bed.
- Equip stands with an ant protection before fixing the atena on the stand's head.
- Lamera (smooth iron sheet) or inner tube can be used to create the Ant protection (Fig. 2)



a.

b.

Figure 2. Hive stands with one seat (a) and two seats (b)

E. Beekeeping Shade Construction

- Building a shade is essential in locations with intense sun, rain, or snow because these conditions seriously harm the bee colonies.
- In the absence of shade, hive temperature rises in sunny areas. such temperature can cause damage by melting the honeycomb and may kill bee brood.
- To control the hive's temperature during this period, honeybees cease gathering nectar and pollen and head to collect water.
- They abandon the hive if the sun's heat becomes too intense
- The worker bees stop gathering food and cluster inside the hive to regulate cold temperature.
- To avoid heat stress, cold weather and rainfall effects, the shade is helpful and create conducive environment for the bees and brood development.
- It is ***not always necessary to construct the shade*** and to place all the colonies under shade.
- Beehives can be kept in an open area if ***no unfavorable*** circumstances are present.

F. Measurement of shade

- Ground to top bim is 2m high
- Above top bim 1 m
- In total the height of shade is 3 m at the center.
- Size of shade is varied based on the number of bee colonies

G. Planting and conserving bee forages

- Bee plants are those plants visited by bees for their nectars and pollen grains.
- Honey plants provide the basic nutritional requirement for survival and reproduction of honeybees.
- Not all plant species are equally good for beekeeping. Those plants that produce and supply both nectar and pollen abundantly are often called honey plants.
- Due to the shrinkage of natural plant habitat, the scarcity of bee forage is one of the biggest problems in the country. Moreover, the forest resources of the country have been declining both in size and quality.
- To address the problems of bee flora scarcity, planting bee forage is vital for sustainable honey production.

- Planting herbaceous bee forages using irrigation is important during dry spells to maintain bee colonies.

2.4 Integrated beekeeping

Beekeeping can be integrated with different agricultural activities. Few are mentioned below

A. Agricultural crops

Bees are critical pollinators for many plants, contributing to the reproduction of a wide variety of species, which helps maintain ecological balance and improve seeds and fruit yield such as:

- Apple
- Coffee
- Niger
- Coriandrum and onion

B. Habitat Restoration

- Encourage the planting of native flowering plants and trees that provide forage for bees. This not only supports bee populations but also helps in reforestation and habitat restoration.
- Establish conservation areas where beekeeping is practiced promoting natural vegetation growth and prevent habitat degradation.

C. Agroforestry Systems:

- Integrate beekeeping with agroforestry systems, combining trees, crops, and beekeeping to enhance biodiversity and improve land productivity.
- Promote beekeeping as an alternative income source to reduce dependence on activities that lead to deforestation, such as logging and slash-and-burn agriculture.

2.5 FLORAL CALENDAR AND BEE KEEPING

- Floral calendar is a timetable that indicates the ***approximate date and duration of the blooming period*** of the important bee forage plants.
- Abundance and flowering period of bee forage vary from one place to another due to variation in topography, climate, and farming practices.
- Seasonal weather impacts upon nectar and pollen resources, which in turn impact on the colony population (performance).
- Reduced food means that the queen lays less eggs and the population of the hive falls.
- Increased food means increased laying and the population increases.
- Understand how the bee colony changes throughout the year because the bee colony can be manipulated to produce more honey.
- Beekeeping in any ***specific area cannot*** develop without an understanding of the floral calendar.
- Seasonal cycles of honeybee colonies are related to the ***calendar of bee plants***

Answering the following questions will give you a good overview of the honey production during the year and help you prepare for the honey flow:-

- What are the plants and trees that bees use?
- When do they flower and for how long?
- When is the swarming seasons?
- Which trees or plants give the best honey?
- When is the right times of the year to expect honey and which are the signs of honey harvesting seasons?
- What factors affect plant flowering?

If the above information is recorded carefully as in table below, it is easy to look ahead and predict which plants will flower when.

PLANT SPECIES	MONTHS											
	SEPT	OCT	NOV	DEC	JANU	FEB	MAR	APR	MAY	JUN	JUL	AUG

Table 2. Recording format of flowering period of bee plants (Floral calendar)

Post assessment question

- How do you know the site is appropriate for beekeeping?
- How do you estimate colony size of an area?
- What is maximum colony size in an apiary? Why?

Key message

Appropriate apiary site is precondition for the productivity and production enhancement of the beekeeping.

SECTION 3: HONEYBEE COLONY AND SEASONAL MANAGEMENT

Overview of the section

Colony management is essential for effective beekeeping and maximizing honey production. It begins with acquiring bee colonies, which can be done through various methods like catching swarms or purchasing colonies. These colonies should be transferred into modern hives during the honey flow season, ensuring optimal population growth and honey collection.

Process of colony transfer involves preparing necessary tools and ensuring the colony is well-settled before transfer. Regular inspections, external and internal, are crucial for monitoring the health and productivity of hive. Indicators such as bee flight, food source intake, brood patterns, and signs of swarming pests help assess the colony's condition.

During active seasons, increasing hive volume and swarm control are important for colony expansion and honey yield. Supering provides additional space for brood rearing and honey storage. Harvesting honey should occur only when it is ripened, typically when 75% of the honeycomb is sealed.

In dearth periods, colony management focuses on survival, reducing hive volume, and providing supplemental feeding with sugar syrup and protein substitutes. These practices help maintain colony strength until natural foraging resources are available again.

Learning Outcomes

At the end of this section, the trainee will be able to:

- Understand the methods of acquiring and managing bee colonies effectively.
- Learn the step-by-step process of transferring bee colonies into modern hives.
- Develop the ability to conduct regular hive inspections and assess colony health and productivity.
- Gain knowledge about swarm control and the importance of supering in expanding hive volume.
- Understand the process and timing of honey harvesting for optimal yield.
- Learn how to manage colonies during dearth periods through volume reduction and supplemental feeding.

Duration: 2 days

Learning question

- What are the major activities should be done during active season?
- How should a colony transfer be carried out to ensure minimal disruption and maximum success?
- When is the right time to harvest honey, and why is it important to wait for the honey to be fully ripened?
- What strategies should be employed during dearth periods to maintain colony strength and survival?

3.1 COLONY MANAGEMENT

- An effective beekeeper establishes a calendar known as a seasonal colony management plan essentially based on his knowledge of the dates when the major honey flows occur.
- Generally, there are four stages for colony management for efficient honey production, which are common to any beekeeping business.

3.1.1 ACQUIRING BEE COLONIES

- The first management step in beekeeping is obtaining honeybee colony in a manageable hive.
- Colony can be obtained through swarm catching, gift from family or friends, purchasing, etc.
- Colonies obtained in nuclei box, or a traditional hive should be transferred to movable frame or top bar hives.
- It is possible to transfer bees from a wild nest or from a traditional hive with fixed combs into movable frame/top bar hives.

3.1.2 TRANSFERRING

A. Season of transferring

- Knowing the season or time of colony transferring is a key step to be considered.
- An ideal time for transferring bee colony is at the start of honey flow season when the plants start blooming.
- Usually, in the first week of the active season.
- This is help the bees to exploit the environmentally available flowering plants and build up their population.

B. Preparations for colony transferring

The following necessary materials should be prepared before starting bee colony transferring:

- Moveable frame/top bar beehives
- Knife to cut the honeycombs from traditional hive
- Bee brush to free combs from bees and guide the bees to the new beehive
- Big dish (bowl) to collect the cut combs
- Water sprayer to avoid the bees from flying up, especially if doing it during the day
- Straw mat, plastic sheet, or canvas to save the bees from falling on the ground/grass

- Frame wire, sisal rope, rubber band, etc. to tie (attach) sealed brood and honey combs to the frames/top bars
- Smoker with good quality smoking materials
- Hand torch as a source of light
- At least two people who carry out the transferring process
- Piece of queen excluder or queen cage
- Fix queen excluder on the entrance of the hive to which colony is transferred to protect colony absconding.
- Bee colony in a traditional hive (do not use weak colony for transferring).

C. Steps for bee colony transferring

- Place the colony to be transferred to its new site at least three days in advance.
- Placing a colony ahead of time helps bees to orient themselves their new environment and foraging direction.
- Fix the foundation sheet on the frames, if the hive to be occupied is the frame beehive.
- Smear the top bars with beeswax if a transitional beehive is used for the purpose.
- Clean the site where the transferring will take place.
- Prepare personal protective clothes.
- Dress in protective clothes properly before opening the beehive.
- Fill the smoker with fire and smoking materials at least 10 minutes in advance.
- Put the new beehive on the top corner of the straw mat (canvas).
- Place the beehive with the bee colony on the bottom part (corner) of the straw mat (canvas).
- Open the beehive with the bee colony in one end.
- Smoke on the bees makes the bees go down to the other end of the hive, thus making it easy to cut the combs out.
- Cut the combs one by one, carefully.
- Brush off any bees from the cut comb.
- After cutting all the combs, drum the hive to draw out the bees in front of the hive to be occupied with bees.
- Take great care not to damage the queen while cutting and drumming the hive.
- If the queen is seen, carefully catch her thorax with the bare hand and put it in a queen cage for a few days (this step is only required if the queen excluder was not fixed at the hive entrance).
- Release the queen from the cage approximately three days later.
- Place at least two frames of broods and combs with stores (nectar and/or pollen) in the middle of the hive
- Ensure bees enter the new beehive.
- Place the new beehive at the place where the original beehive has been removed.
- Take the empty beehive far away and place it in a dark place where bees cannot access it.

Figure 3. Picture showing colony transferring activities

Check for the following once the colony has been transferred:

- **Pest attack:** always undertake external beehive inspection against an attack by ants; monitor the normal in- and out-bees flight.
- **Start comb building:** Inspect the colony internally to check whether the colony has started comb building.
- **Start egg laying:** Observe or examine the egg laid by the queen.
- **Colony progress:** Carry out the necessary hive manipulation for the building up of the colony fortnightly or once a month.

3.1.3 HONEYBEE COLONY INSPECTION

- Once the hive is established, regular inspection is crucial to manage the colony by the bee colony cycle, needs, & expected products from business.
- Beehive or colony inspection is one of the colony management practices that enable monitoring honeybees' activity and ensuring that the maximum strength of the colony coincides with the maximum forage (pollen and nectar) flow to obtain optimum honey yield.

Bee colony inspection can be done either externally or internally.

A. External hive inspection

Important points to be considered during external beehive inspection

I. **Bee flight:** The normal flying in/out of forager bees (high, medium and low corresponding to relatively strong, medium and weak colonies).

II. **Incoming food types:** Types of food source being brought to the hive by foragers (pollen, propolis, nectar, water). This reflects what the colony is doing at the moment.

III. **Beehive entrance condition:** Whether the bees are accumulated on the hive entrance, which can be due to swarm preparation, ants or other enemies attack, or ripening of honey.

IV. **Dead bees:** Whether an extraordinary number of dead bees were found under the entrance of the hive that could be due to starvation or chemical poison.

B. Internal colony inspection

Internal beehive inspection work is possible for top bar and frame beehives only. Internal inspection for fixed comb hive types is not possible. Follow these simple guidelines while carrying out inspection:

- Do not stand in the flight path of the bees.
- Always approach the hive from the side or back.
- Work gently without excessive talking or banging noises.
- Minimize the chance of sting by using proper handling of honeybees and dressing.
- Puff smoke gently around the entrance of the hive to suppress (calm down) the bees and open the lid carefully. Smoke creates a communication barrier between worker bees.
- Before removing the hive lid, wait half a minute for the smoke to penetrate the corners of the hive to ensure that the disorganization of the colony is complete.
- Using smoke also prompts the bees to gorge themselves with honey; under this condition, they are less likely to sting.
- The first step to open the beehive is to remove the cover.
- The bees usually seal the covers with propolis (a sticky resin material).
- Force the chisel into the line of the union between the lid, the adjacent beehive body and the cover to break the propolis seal and open the beehives.
- Force a few puffs of smoke into the open areas as the lid is first raised.
- After removing the outer cover, put up site down alongside the hive, which makes a convenient space on which to place hive or frames.
- As bees come out, smoke across the top of the frames (inducing the bees to go down into the hive body).
- Roll a plastic sheet, sac, or cloth cover gradually from one side to the other (in this way, excessive bee flight is minimized) if any.
- Use a hive tool to detach frames/bars that are glued together by propolis.
- Start the inspection from the frame nearer to the operator/ set it down on one end against the hive until two or more frames are taken out of the hive.
- Keep the frames/bars in the same order and try not to squash any bees when replacing them back to the hive.
- Repeat the same steps with the next frames until all frames are examined.

Please note these precautions

- The queen should not injure or fall to the ground.
- Brood frames should not stay out hive for a longer time.
- The hive must be closed tightly or properly.
- The bees should not be squashed.

Observe the following during inspection:

- **The presence of the queen:** the queen is mostly found in the brood chamber or comb, near the egg laid. She could be recognized by the presence of eggs and newly hatched-out larvae.
- **Brood pattern:** if the brood pattern is solid, the queen is said to be young, good, prolific, or vigorous. If the brood pattern is spotty and full of empty cells mixed with many drone broods, the

queen is said to be non-vigorous.
- **Swarm preparation:** when bees form several peanut-shaped cells, which contain an immature queen while the beehive is quite populous, it indicates swarm preparation.
- **Status of stored food:** when there is no stored food (pollen and/or nectar), the colony needs supplementary food.
- **Health condition:** it is important to observe the presence of any pests and diseases of bees in the hive (wax moth, ants, varroa mite, small hive beetle, lizards and symptoms of various diseases).
- **Enough space:** the colonies might swarm if the beehive is full of bees and brood combs, and the upcoming season is expecting more blossoms.
- **The arrangement of frame contents:** Frames of brood should be placed in the middle of the nest to optimize the proper brood temperature. The honey is naturally stored in the upper portion of the combs or the brood comb; if placed between pollen and brood, it could prevent the queen from expanding the brood nest.

Ripening of honey: honey is said to be ripened when at least 75% of the comb mass is sealed (capped) with a newly secreted beeswax.

3.2 ACTIVE SEASON COLONY MANAGEMENT

This season is crucial for honeybees as they become more populous and actively produce honey and other valuable bee products. To maximize productivity during this period, beekeepers must implement proper management practices. Key activities include increasing hive volume to accommodate growing colonies, controlling swarming to maintain colony stability, inserting queen excluders to ensure efficient honey production, and harvesting honey at the right time to preserve its quality. By enhancing these practices, beekeepers can significantly boost both the productivity and overall production of honey and other bee products

3.2.1 INCREASING HIVE VOLUME

- When forage resources of both pollen and nectar are plenty, the colony is stimulated to produce more brood and thus the colony population increases. It takes about six weeks for an egg to develop into a foraging adult.
- Thus, the preparation of colony populations for a main flow starts six to eight weeks beforehand.
- This is the time to provide additional space for the expanding brood nest to allow the colony to build up to its maximum population for the main nectar flow.
- Providing space for the brood nest also helps to control swarm.
- During the building up season, equalize colony populations by giving brood combs to weak colonies to help them build up quicker.
- Put new frame with foundation sheet adjacent to the brood nest.

A. Indicative conditions to add super

- Clustered bees at the hive entrances
- Bees occupy all combs
- 6-8 combs of brood in each box
- Forage resources of both pollen and nectar are plentiful

B. Procedures for adding super

There are two possible ways of superring these are:

- Simply adding the suppers with foundation sheets from the top
- Putting new frames alternatively with old frames in both base and supper boxes

Top bar beehive: Remove partition board.

3.2.2 SWARM AND SWAM CONTROL

A. Indicators of swarming

Honeybee colonies tend to swarm show different symptoms:

- Production of drones: colonies prepared for swarm first produce several drones
- The production of queen cells: Numerous queen cells will be constructed at the bottom edge of the combs and occupied by the eggs
- The worker bees appear conspicuous: workers fill their honey stomach with excessive amount of honey. This increases the size of workers abdomen
- Decline in foragers activities
- Cluster of bees on hive entrance: due to congestion in the hive bees tend to cluster outside the nest to reduce overcrowding

- Warbling sound: the frequency of warbling sound emitted by colony increased during the course of preparation for swarming

B. Reproductive swarm occurs as the result of reproduction of a colony

- Reproductive swarming is a way of perpetuation of the species and It triggered due to over crowding
- Apart or parts of honeybee colonies move from the maternal nest to the entirely new nest to ensure colony reproduction
- However, since it is a natural phenomenon, it can occur even in non- congested colony and tropical African bees have high reproductive swarming tendencies
- In improved beekeeping reproductive swarming is not accepted because it reduces the population size and lead to total or partial loss of yield

C. Swarm control methods

There are many different reproductive swarm prevention and control methods. The main ones are avoiding congestion and remove queen cells.

Avoiding congestion/overcrowding

Overcrowding can be avoided or minimized in the following ways:

- Increase the hive volume: As indicated above in session 16, the hive volume can be increased by adding supper in movable frame hive, removing the partition boards from the transitional hive and fixing empty traditional hives to fully occupied hive
- Move over-large colonies to site of small one and vice versa (large colony loss and small colonies gain foragers)
- Remove sealed broods, pollen and honey full combs from populous colony and place it in the weak colony and replace it with empty combs (If colonies are healthy)

Remove queen cells

- Inspection for the queen cells every 9 to 10 days during swarming period
- Check whether cells are supersedure (queen cells on the face of comb) or swarming queen cells (formed at the edge of the comb)
- Remove swarming queens that are on the edge of the brood combs

3.2.3 INSERTING QUEEN EXCLUDER

- The idea of inserting queen excluder is to produce brood-free honey in the supers.
- Queen excluder must be inserted 21-30 days before the expected honey harvesting period
- To insert a queen excluder into the hive, open the hive.

Inserting procedures

- 1st force the bees and queen to the base box using smoke and remove the super and place it on the cover
- Take out frames with honey & nectar or sealed brood from the base and super, make them free from bees using brush and place them in empty supper you come with
- Move combs with young brood or pollen from the top to base box
- Then insert the queen excluder on top of the base hive & place the super with honey, nectar & sealed brood combs above queen excluder and close securely

3.2.4 HONEY HARVESTING

- Honey is a reward of the beekeepers for his/her hard work.
- Harvest honey when it is ripe
- Honey is ripe when 75 % of the comb is caped
- The bees cap the honey with a thin layer of beeswax when it is ripe.
- Do not harvest unripe (unsealed)
- Avoid excessive smoking during harvesting since it affects the dour of honey
- Use bee brush to free honey from bees
- Proper handling of honey frames is very important both before and during extraction
- Extract honey as soon as possible after removal from the hives
- Immediate extraction avoids honey granulation in the combs and absorption of moisture

3.3 DEARTH SEASONS COLONY MANAGEMENT

- It is normal that honey harvest is preceded by dearth period
- The removal of honey accompanied by the nectar and pollen depletion
- It is essential to prepare the colony to withstand the dearth period
- During dearth periods the colony population drops, but sometimes the bees remain active
- The beekeeper thinks of the strength of a colony both in terms of the absolute population and the ability of that population to occupy the entire comb in the hive.
- Colony management to have sufficient stores and sufficient bees to cover and protect the comb from wax moth is important
- During the dearth period, the objective is survival of bees, not survival of colonies
- The colony needs less space since the bee population is decreasing
- Protecting colonies from pests is another important aspect of management during dearth periods
- Don't leave too much empty comb in the hive during the dearth periods that causes problems of wax moth damage

3.3.1 DEARTH PERIOD ACTIVITIES

The major beekeeping activities that would be carried out during this season includes reducing the hive volume and feeding honeybee colonies

A. Super reducing

- All combs in base hive must be attended by colonies
- Leaving too much empty comb in the hive during the dearth leads to hive infestation with wax moth
- If the colony does not have enough bees to protect the comb, larvae of the wax moth begin to develop in them.
- Wax moths destroy the comb, leaving behind webbed masses
- Do not leave comb lying around the apiary
- This provides a good rearing site for the wax moth population of the area.
- Remove empty, unused comb from the hive and reduce super(s)
- Render unused wax into blocks instead of storing it as comb.
- Provide shade to help the bee to maintain the internal temperature of colony.

B. Feeding of honeybee colony

- Honeybees are known to collect various powdery substances (flour and sow dust,) in pollen shortage time
- This perhaps helps the beekeeper to know that his /her bees need supplementary feed

Why honeybees need supplemental feeding?

- To ensure continued colony development in places during times of shortage of natural pollen and nectar
- To stimulated colonies to have larger populations at the beginning of active period
- To build up colonies after pesticide losses
- Survive harsh climate (extreme temperature, precipitation, hail, etc.) during the year cause significant reductions in floral resources

What to feed honeybees?

- Carbohydrate in the form of sugar syrup feeding
- Protein in the form of palatable flour
- In what form to feed the syrup?
- Syrup feeding is often used in beekeeping for different purposes.
- Syrup can either be thick or thin
- The beekeeper decides the aim of feeding, as this will influence the preparation of the sugar syrup.
- Thin sugar syrup (50%)
- Thick sugar syrup (67%)
- The thin syrups are used to stimulate foraging behavior in dearth period.
- Thick sugar syrup is fed during critical feed shortage to make up for shortfalls in stored food needed to survive a dearth period and to build colony for queen rearing.

Preparation of sugar syrup

- Preparing sugar syrup requires fresh and clean water and vessel to mix the sugar and water
- Hot water will dissolve the sugar into solution with less effort than cold water.
- One litter of water mixed with one kilogram of dry sugar provides a 50% sucrose solution.
- One litter of water plus two kilograms of dry sugar provides a 67% sucrose solution.

WATER (LITTERS)	SUGAR (KG)	SYRUP (LITTERS)
1	1	1.575
10	10	15.75
100	100	157.5
2	2	3.15
20	20	31.3
200	200	315

Table 3. Guideline to prepare thin sugar syrup

- To work out how much sugar and water you need to mix to achieve a certain quantity of syrup at 50%,
- Divide the amount of total volume of syrup required by 1.575 to get the quantity of sugar needed
- For example, if 200 litters of syrup are required, divide 200 by 1.575 —need to mix 127 litters of water and 127 kilograms of sugar

WATER (LITTER)	SUGAR (KG)	SYRUP (LITTERS)
1	2	2.26
10	20	22.6
100	200	226
2	4	4.52
20	40	45.2
200	400	452

Table 4 Guide to prepare thicker sugar syrup

- To prepare a thicker solution (67%), one liter of water is added to 2 kg of sugar.
- This produces 2.26 liter of syrup.
- The above table provides a quick estimate of the volume of syrup produced f
- To calculate how much sugar and water is required to produce a quantity of syrup at 67%,
- Divide the desired total amount of syrup by 2.26 to calculate the amount of water required and multiply this figure by two to calculate the amount of sugar required.

Protein supplemental feeds for honeybees

- Protein supplement, an inexpensive for beekeepers, encourage population build-up during times of limited pollen forage
- Different local flour, such as, pea flour, bean flour, chickpea flour and soybean flour used as protein supplement diets
- Honeybees collect these flours from outside through humming
- However, none of these protein supplements is a complete to replace the natural pollen
- Several experimental studies demonstrated a causal relationship between pollen supplement and brood production (Figure 4).

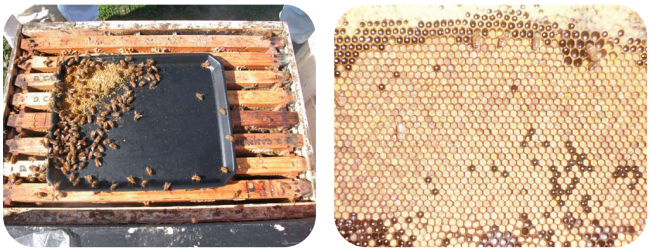


Figure 4. Relationship between pollen supplement and brood production

Methods of feeding honeybee colonies

The feeds can be given to honeybee colonies either externally or internally. Internal feeding is placing the feeding in the hive while that of external is feeding carried out placing the feeds outside of the hive.

External feeding/outdoor

Add the sugar syrup into big mouth container and spread clean leaves or grasses onto the syrup and place it under the shade where all colonies can access. The pollen substitute dry powders or slightly moisten powder can be placed in plate outside for all colonies. This type of feeding requires less time and lobar and can feed all colonies in the apiary. However it has potential to transmit diseases, all colonies cannot utilize the feeds equally, stronger utilize more than the weaker and bees from other place can use the feeds

Internal feeding

The feeding executed using division board feeder (Fig. 5) or friction top pail feeder

Figure 5. Division board feeder

Division board feeder

- Uses division board feeder, which is made of play wood and frame.
- Remove two empty frames combs from the hive
- Fill the division board plated with wax with sugar syrup, spread leaves or grasses on the sugar syrup and put it in a place where frames removed and place back the lid

Friction top pail feeding

- Add sugar syrup into small pail and then spread leaves or grass onto the syrup.
- Open the lid and place the pail on the top of frames and cover it with empty box hive and place the lid back

Figure 6. Friction top pail feeder

Post assessment questions

1. What are the different methods of acquiring bee colonies, and which is the most effective for different contexts?
2. How should a colony transfer be carried out to ensure minimal disruption and maximum success?
3. What are the key indicators to look for during internal and external hive inspections to assess colony status?
4. What strategies should be employed during dearth periods to maintain colony strength and survival

Key message

Mastering bee colony management through strategic acquisition, hive transitions, regular inspections, swarming control, and proper honey harvesting enhances productivity and colony longevity. Sustainable practices ensure reliable income and support honeybee preservation.

SECTION 4: HONEYBEE PRODUCTS, HARVESTING PROCESSING AND POST-HARVEST HANDLING

Overview of this section

Honey and beeswax harvesting is a crucial process in beekeeping, particularly during the peak honey production season. Floral honey is produced by honeybees collecting nectar from various flowering plants, which they process by evaporating water to make ripe, sealed honey. Several indicators signify that honey is ready for harvesting, including the smell of honey, clustering of bees, reduced bee activity at the

hive entrance, increased bee aggression, and 75% or more of the honey in the hive being capped.

The honey harvesting process involves using protective gear and tools such as a smoker, knife, and containers to safely extract the honey. The process differs slightly depending on whether the beekeeper uses transitional hives or frame hives, but both require careful handling to avoid damaging the honeycombs. Honey extraction should occur immediately after harvesting to maintain its quality. This is done using honey extractors for frame hives or pressing methods for traditional hives. After extraction, the honey is strained to remove impurities and stored in clean, airtight containers.

Beeswax is another valuable byproduct of beekeeping, obtained primarily from uncapping wax and old combs. The beeswax processing involves cleaning, melting, and filtering to remove debris, with various extraction methods such as manual squeezing or immersion in boiling water. The result is purified beeswax, which can be refined further and molded into blocks or other forms for sale or use in various products. Proper handling and storage are essential throughout the honey and beeswax harvesting and processing stages to ensure high-quality products.

Learning Outcomes

By the end of this training, participants will be able to:

- Identify the indicators of honey readiness for harvesting.
- Understand and apply proper honey and beeswax harvesting techniques for both transitional and frame hives.
- Demonstrate the use of essential tools and equipment for honey harvesting and beeswax extraction.
- Describe the steps involved in extracting and processing honey and beeswax to maintain quality.
- Implement best practices for safe and hygienic honey extraction and storage.
- Recognize the factors influencing the timing and methods of honey and beeswax harvesting for optimal production.

Duration: 2 days

Learning question

- How do you properly harvest honey from both transitional and frame hives?
- What tools and equipment are necessary for safe honey and beeswax harvesting?
- What are the steps involved in extracting honey and beeswax while maintaining quality standards?
- How can proper hygiene and safety be ensured during honey extraction and processing?

4.1 HONEY HARVESTING, PROCESSING AND HANDLING

- Floral honey is produced by honeybees collecting nectar from various flowering plants
- Honeybees evaporate the water from the nectar and make it to ripe and sealed

4.1.1 INDICATORS OF READINESS OF HONEY FOR HARVESTING

- The smell or scent of honey from the hive
- Clustering of bees outside the hive entrance
- Less bee traffic on the entrance of hive
- Honeybees become more aggressive
- The presence of 75% capped or sealed honey in the hive (Figure 5)

Figure 7. Sealed honey

4.1.2 MATERIALS TO BE USED DURING HONEY HARVESTING

- Protective cloth,
- Knife,
- Chisel,
- Smoker,
- Honey containers,
- Bee brush,
- Super,
- Tray,
- Hand torch,

4.1.3 FACTORS TO BE CONSIDERED WHEN HARVESTING HONEY

- The ideal harvesting time is in the cool of dusk, just before dark
- Don't harvest during the daytime unless the apiary is located far away from public places
- Do not crop honey during rainy weather as the honey draws moisture from the air
- Use a bee suit and a less smoke when harvesting
- Two people are better than one. Don't harvest alone.
- Harvested honey must be ripe (75% sealed)
- Uncapped honey contains too much water and will start to ferment.

4.1.4 THE STEPS IN THE HONEY HARVESTING PROCESS

A. Honey harvesting process from transitional hive

- Prepare the smokers and put on the bee suits
- Smoke lightly the bees and check for combs that are at least ¾ capped or sealed full of honey
- Honeycombs are usually at the back of the hive opposite to the entrance
- Always leave the combs with brood, large portions of pollen, and some honey for the bees.
- Always hold the combs in a vertical position to avoid breaking
- Lift the comb, brush the bees back into the hive with a feather or bee brush
- Cut the light-colored combs away with a knife leaving about 1cm of the comb. This will serve as an orientation line for a new comb building
- Place the capped honey in a clean and dry container with a sealed lid to keep the bees out
- Return the top bar to the hive
- Put combs with little or no capped honey into a separate container
- Separate new honeycombs from the old one.
- A new honeycomb is demanded for table honey and has higher selling price (Figure 6).

Figure 8. Honeycomb

- Separate honey in quality and set quality order classifying it into table honey, honey used for honey wine and so on.
- Make sure there is no dirt or bees in the honey and avoid propolis and too much pollen in the honey
- While harvesting also scrape the propolis off the top bars before replacing them and keep it
- Continue cropping all the ripe combs in the same way but do not crop all and leave some honey combs for the bees.
- Before closing the hive, push the unripe combs behind the last brood or pollen comb and put the cropped top bars behind these
- Move the containers to the place free of bees

B. Honey harvesting process from frame hive

- Prepare the smoker and use it to puff smoke at the hive entrance and under the lid to calm the bees.
- Open the hives and lift a frame from either of the corners using chisels
- Conduct a thorough inspection of the hive to identify which frames are ready for harvesting
- Prioritize harvesting frames with fully capped honey, indicating that the honey has the appropriate moisture content and is ripe.
- Once the bees are removed, place the honey-filled frames in a covered container or box to protect them from contamination and prevent bees from accessing the harvested honey.
- Transport the frames to the honey extraction area quickly and carefully as possible.

4.1.5 HONEY EXTRACTION ROOM

To ensure the quality of the harvested honey, the process of extraction should be done in well situated room as detailed below:

- Free of dust, odor and dried
- It should be intact to maintain high level processing activity
- The wall should be painted with food grade paint, and it should be white
- The windows of the processing room should be insect proof (equipped with mesh wire)
- There should also be water line so that workers can keep clean their personal hygiene
- The extraction room should be free of chemical, dust, or gases

4.1.6. HONEY EXTRACTION

- Honey should be extracted immediately after it is taken out of the hive.
- As soon as the honey is taken out of the hive, it is warm and in a liquid state and this reduces the extra work, and it makes extraction easier.
- To extract honey, it is necessary to prepare the required implements and utensils.
- Equipment to be used in the process should be clean and dry.

Honey extraction from frame hive and straining extracted honey

- Place the frames in an uncapping table while uncapping using fork to catch the wax capping and honey drippings
- Place the uncapped honeycomb in the chambers of the honey extractor for centrifugation (balancing weight of combs while spinning is important)
- Close the extractor with its lid to prevent honey spilling out of the extractor and to retain honey aroma
- Strain the extracted honey using double honey sieve to remove impurities such as pieces of comb, broken wings or dead bees and allow pure honey flow into storage container
- Keep honey in intact container and place it in a cold room

Figure 9. Honey extraction process from frame hives

Extraction of honey from traditional and transitional hive and straining

- Honey presser is used to press honey from traditional and transitional beehives.
- The honey can be processed or pressed by placing the newly harvested honey, in a bag made of nylon cloth and tie the mouth of the bag tightly
- Placed it between the two discs of the honey presser
- Place the honey receiving container under the outlet of the honey presser and then the squeeze honey using the presser
- Allow the honey to go through double sieves or nylon cloth to remove the impurities
- Allow the honey to settle in a clean container for a few hours to let any air bubbles rise to the top.

Figure 10. Straining honey using cloth mesh

4.2. HARVESTING AND PROCESSING BEESWAX

- Collect uncapping, old comb, and beeswax from other sources.
- Clean beeswax to remove impurities.
- Beeswax processing: Melting and filtering beeswax to remove debris. Techniques for refining beeswax into blocks or other forms for sale or use in products are as follows.

A. Manual extraction method (Squeezing method)

- Take the cleaned and sorted crude beeswax obtained from different sources and place it in clean water and soaks it for 24 hours so that any remaining honey, sheath and water-soluble dirt were dissolved in in water.
- Add crude beeswax to pan and add clean water just above the level of the combs and then heat the pan gently and keep stirring all the time.
- The melt wax at 62- 65oc in sufficient boiling water.
- Then pour the wax into sisal and squeezed manually into stain less steel container.
- When the wax ceases to run through, twist the sisal and squeeze it slowly between two horizontal sticks.
- Leave the water and wax mixture to cool and remove the wax block the next day.
- Rinse the wax in cold water to remove any remaining honey residue, and carefully scrape any visible dirt from the base.
- In some cases, the wax may need refining, so re melt it in water and slowly pour the liquid through the fabric and into the bucket.
- The liquefied wax and water will go through, while the debris will be caught in the fabric.

Figure 11. Squeezing Bees wax extraction method

B. Submerged (Immersion) wax extraction method

- Take 10 kg of beeswax obtained from different sources sort, wash and sock it as indicated above
- Then fill the (abujedi) sacks with the wax and tie up tightly with a rope.
- Place the sack timber in the large basin or pan and add water to the pan until it covers the sack
- Gently bring the water to boil to completely melt the combs
- Use a stick to agitate the sack to cause the wax to float to the top and then pour the melted wax from the boiler to strainer placed on top of blocking material.
- Then allow the water and wax mixture to cool and remove wax block next day.

Post assessment questions

1. How does the honey harvesting process differ between transitional and frame hives?
2. What are the key steps in honey extraction from both frame hives and transitional hives?
3. How can the quality of honey be ensured during extraction and processing?
4. What safety and hygiene measures should be taken during honey harvesting and extraction?

Key message

Successful honey and beeswax harvesting requires knowledge of hive management, proper timing, and the use of appropriate tools. By following careful harvesting and extraction processes, beekeepers can maximize the quality and quantity of honey and beeswax while ensuring the well-being of the honeybee.

SECTION 5: HONEYBEE HEALTH MANAGEMENT

Overview of this section

The health of honeybee populations is threatened by a multitude of factors, including diseases, pests, and poisoning. Understanding these challenges is vital for beekeepers striving to maintain healthy colonies and improve honey production. By implementing integrated pest management strategies and adopting best practices for bee health, beekeepers can play a crucial role in safeguarding honeybee populations, which are essential for ecological balance and agricultural productivity. The ongoing efforts to address these issues are vital not only for the beekeeping community but for global food security and biodiversity

Learning Outcomes

- Participants able to identify and describe common honeybee diseases, including their causative agents, transmission methods, and symptoms.
- Participants differentiate between diseases affecting adult honeybees and those affecting brood, understanding their implications for colony health.
- Participants able to identify common pests affecting honeybee colonies, describe their impact on bees, and recognize signs of infestation.
- Participants understand effective management strategies for preventing and controlling honeybee diseases and pests.
- Participants learn about the sources of bee poisoning, including agrochemicals and poisonous plants, and recognize preventive measures to protect bee health.

Time Required: 1½ days

Learning question

- What are the primary diseases affecting honeybees, and how are they transmitted?
- What are the common pests in honeybee colonies, and what are their impacts?
- What integrated pest management strategies can be implemented to minimize the effects of pests and diseases on honeybee colonies?
- How can beekeepers reduce the risk of bee poisoning from agrochemicals and natural toxic plants?

5.1 HONEYBEE DISEASES AND MITES

Honeybee diseases caused by Bacteria (American foul brood (AFB) & European foul brood (EFB)), Fungi (Chalk brood & stone brood), Protozoa (Nosema & Amoeba), Virus (Paralysis, DWV, Sac brood, etc) and Parasitic mites (Varroatosis, Acarine disease). These diseases are transmitted through feeding, swarming, robbing, drifting, infected equipment, and interchanging brood combs or frames between health and diseased colonies.

Depending on the age of the honeybee, bee diseases are grouped into two, i.e., diseases that affect adult honeybees and diseases that affect brood honeybee.

A. Adult Honeybee Diseases

- The presence of two adult honeybee diseases, namely, Nosema (Nosema Apis) and Amoeba (Ameobae mellificae), has been confirmed in Ethiopia.
- Both diseases are known to produce minimum effects during wet and rainy seasons when the bees don't get to fly out to defecate their feces.

Nosema

Caused by protozoa called Nosema Apis, Nosema is an adult honeybee disease. The bee gets infected when Nosema spores are ingested in the spore.

Clinical symptoms

- Bees infected and affected by Nosema do not show visualized symptoms.
- Only, microscopic analysis of the suspected bee abdominal contents confirms the presence spores of Nosema.
- As this disease is confirmed for not affecting local honeybees, control action is not advised.

Amoeba

The other adult honeybee disease reported in Ethiopia is Amoeba.

- Caused by protozoa, commonly known as Malpighamoeba mellificae.
- The disease is known for infecting and reproducing in the intestine (malpighian tubules) of honeybees.

Clinical symptoms

- Bee infected and affected by amoeba doesn't show visualized symptom (only a microscopic)
- It is also confirmed for not affecting local honeybees, and hence no control action is advised.

B. Brood Honeybee Diseases

- Brood diseases are the most severe diseases affecting the immature stages of the honeybee
- They are the most severe because they affect the brood stage of the honeybee, which in most cases, is sealed and difficult to apply chemotherapeutic control approaches
- Honeybee brood diseases are caused by bacteria, fungus, and viruses
- Until this time, there are no reports available as to the existence of bacterial but recent study reported the occurrence of viral diseases and fungal disease (Chalk brood)in the country

Chalk brood

- The existence of chalkbrood disease has been confirmed since 2000
- Chalkbrood is a fungal disease caused by a fungus known as Ascosphoraera apis
- It occurs mostly in colonies expanding during the cold time
- It rarely kills a colony but will weaken it, leading to a reduction in honey surplus

Major means of transmissions

- Using contaminated bee equipment, drifting bees, feed and water, hive cleaning worker bees also play the role of spreading the disease

Major symptoms: The diseaseis characterized by an infected brood, called "mummies".

- Most dead broods look like white chalk from which the name of the disease is derived
- The mummies can vary in color from white to dark gray or black
- Worker bees removed broods, found under the hive entrances of the chalkbrood affected bee colony
- Affected brood among sealed brood and fallen mummies of chalkbrood below hive entrance appear white and black chalkbrood mummies respectively
- The infection of chalk brood enhanced byhigh moisture content (colonies not well ventilated in high humidity)

Figure 12. Symptoms of chalk brood disease affected brood Control

- The disease is a relatively minor disease of honeybees
- Globally, there is no recommended chemical control for chalkbrood
- Requeening with a good hygienic behavior colony that quickly removes the mummies by workers

appears to aid in clearing up the infected brood.
- Providing the affected colony with adequate forage/feed
- Moving bee colony to cold and humid free areas,
- Regular ventilation and cleaning the hive
- Generally, Perquisition
- It is recommended that the beekeepers perform the following activities to avoid bee diseases transmission so that their effects are minimized:

1. Don't use the same inspection material to inspect sick and a healthy colony
2. Don't exchange frames from a colony that carries diseases and place in a healthy colony
3. Don't use beekeeping equipment whose origin is not known or equipment which have been used to handle colonies which carry diseases in healthy colonies
4. Avoid feeding healthy colony by honey and pollen from unknown sources as they may carry diseases
5. Properly arrange beehives to avoid drifting of sick bee drifted by the wind into a healthy colony
6. Avoid communal feeding of several colonies
7. Don't purchase bee colonies from unknown sources (If sick colonies are obtained and mixed with healthy colonies, the disease can be easily transmitted).
8. Don't mix new swarm with existing bee colonies as they may carry diseases

Bee parasites (mite)

- Some mites affect the life and products of the honeybee
- Among the mite parasite, this manual selected varroa mite at least for two reasons
- First, the presence of varroa and its wide distribution in the country has been established
- Second, reports on significant effects, the varroa mite is producing on local honeybee health, are coming from different parts of the country

Varroa mite

- Varroa mite is classified as ectoparasites and the most serious pests of honeybees globally
- The disease is caused by a parasite called varroa destructor
- The mite is dark brown, hairy and its size ranges from 1-1.5 ml
- With eight legs, the mite looks like ticks, and it is big enough to be seen by necked eye
- Varroa mites feed on the hemolymph of immature and adult bees
- Developing drones are more attractive to varroa mites than are the worker brood
- The parasite sometimes positions itself in between the thorax and abdomen and around the head and feeds on these soft parts of the bee (Figure 13)
- The mite shortened the life span of the host bee due to tissue damage, diminished productivity, pupal death, and malformed wings, legs, and abdomens.

Symptoms

- presence of adult bees with deformed wings, crawling near the hive entrance.
- Presence of the mite on brood, particularly drone brood
- Dark brown spots (the mite) on the external body of the young bee

Figure 13. Drone brood, varroa mite on drone pupae and adult honeybee, respectively

Control

- At this stage no chemicals should be used to control varroa as our bees seem same what tolerated the effects.
- Infested honeybee colonies are producing required honey yield.
- However, it is important to control the population of the varroa in the colony by:
- removing drone brood,
- trapping varroa on the bottom of the hive by placing sticky and/or screened board
- dislodge varroas from adult bees by smoking colony with tobacco leaves.

5.2 MAJOR HONEYBEE PESTS AND PREDATORS

Protecting honeybee from pests has been recognizedas one of the vital activities of beekeepers. In Ethiopia, ants, beeswax moth, birds, spiders, mice, death head hawks' moth, honey bagger, lizards, prey-mantis, toads, and beetles are registered as honeybee pests and predators

A. ANTS

Ants cause serious problems to honeybees by killing bees, robbing their products, forcing the bee colonies to leave their nest and initiating aggressiveness

- A strong bee colony resists for some time but
- But in most cases ants cannot be prevented by bees because of the small size and hard integument. Thus, ants outnumber and overrun the bees

Figure 15. Type of local ants known attacking bees while moving in row

Ant prevention

- Honeybee colonies can be protected from Ants attack via management practices and different improved techniques.

Management practices

- Effective ant management in apiaries involves keeping sites clean, removing attractants like spilled honey, controlling vegetation around hives, and ensuring dry conditions under hive stands.

Mechanical techniques

- To subdue the effects of ants on honeybee colonies, three different Ants protection techniques (inner tube of tire, smooth iron sheet and tin filled with used engine oil) were developed (Figure 16)

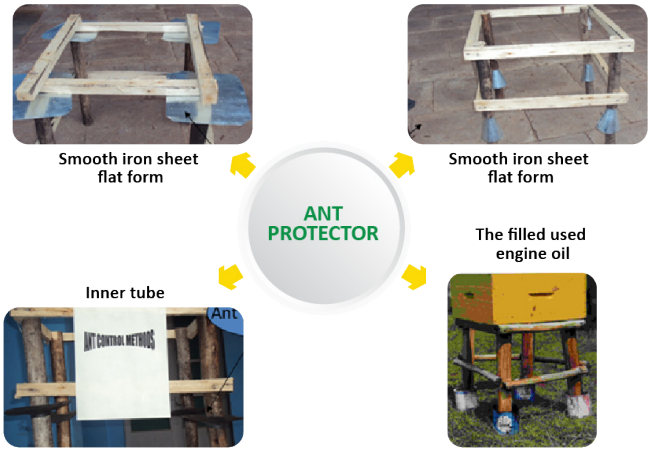


Figure 16. Ant Prevention techniques

Procedures to make the ant protection techniques

This method creates a smooth, slippery barrier that can effectively deter ants from reaching the hive by preventing them from maintaining a grip as they attempt to climb up the stand legs.

Flat Iron Sheet Application:

- Cut smooth iron sheets into 20 cm x 20 cm squares.
- For each hive stand leg, place the flat piece on top of the leg and securely fix it with nails. Ensure the edges are smooth and properly fastened to prevent gaps where ants could climb.

Conical Iron Sheet Barriers:

- Alternatively, cut a flat 20cm x 20cm piece from one edge to the center point.
- Bend the cut sheet around the leg of the hive stand to form a downward-facing cone, creating a sloped surface that is difficult for ants to climb.
- Secure the conical barrier tightly with nails or screws to ensure stability, making sure the top of the cone fits snugly around the stand leg and the broader end faces downward.

Inner tube barrier:

Prepare the Inner Tube:

- Cut a used inner tube into flat square pieces

measuring 20 cm x 20 cm.
- Create a hole in the centre of each rubber piece that fits snugly around the leg of each hive stand. Ensure the hole is just slightly smaller than the diameter of the pole to create a tight fit.

Install the Rubber Barrier:

- Slide the rubber square over the leg of each hive stand, ensuring the inner tube sits flat against the top part of the leg.
- Secure the rubber piece tightly around the pole using strong adhesives, zip ties, or clips to ensure that there are no gaps between the rubber and the stand leg where ants could pass through.

Use of Tin filled with used engine oil:

This method creates an effective, low-cost barrier where ants attempting to reach the hive will be trapped in the oil. It ensures that the hive remains free from ant infestations, protecting the bee colonies with minimal maintenance.

Prepare the Tins

- Select short-sized tins (plastic or metal) with a diameter wide enough to accommodate the legs of the hive stand. Ensure the tins are stable and won't tip over easily.
- Clean the tins if needed, and place them under each leg of the hive stand.

Add the used Engine Oil:

- Fill each tin with used engine oil up to one-third of its height. This depth is sufficient to create a barrier while minimizing the amount of oil needed.
- Ensure that the oil level is deep enough so that ants cannot cross through or climb over the edge without coming into contact with the oil.

Position the Hive Stand Legs:

- Place each leg of the hive stand in the centre of the tin, ensuring that the leg is perpendicular and does not touch the sides of the tin.
- The leg should hover just above the surface of the oil, creating a moat-like barrier that ants cannot cross.

Secure and Monitor:

B. Wax Moth

Wax moths destroys the bees' wax combs where the bees can store pollen, honey & lay eggs. Under severe cases of wax moth infestation, bees stop brood rearing, foraging is virtually suspended, and the colony deserts its home. It is the larvae of the wax moth that causes damage to the beeswax comb.

Symptoms

Silken webs tunnels along the midrib of the combs observed.

- The larvae construct silken tunnels where they can live and grow by feeding on the propolis, pollen, and beeswax (Figure 17)
- The beeswax moth pupae stick to the walls of beehives or on frames.

Prevention/Control measures

Management practices such as feeding during dearth period, reducing the suppers on write time, removing the unoccupied combs, maintaining a strong bee colony and trapping wax moth adults are effective in preventing/controlling. Furthermore

- melt seriously infested combs and replacing with a new one.
- repair any cracks in beehives with beeswax or propolis
- wash wax moth contaminated hive and frames using boiling water before reuse are important measures to reduce infestation of wax moths

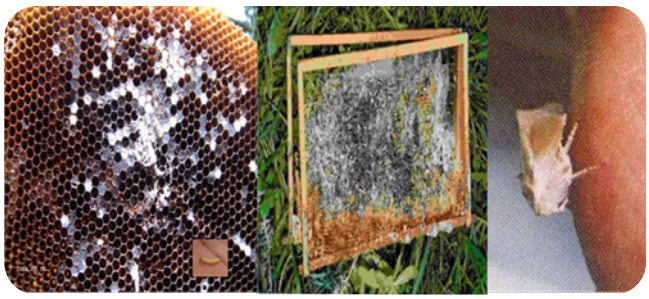


Figure 17. Wax moth affected combs and adult wax moth

C. Small hive beetle (SHB)

- Small hive beetle is honeybee pest native to South Africa
- It is considered a minor pest with south African bees.
- However, it is harmful parasites to European and other African honeybee subspecies.
- The presence of this beetle is confirmed in most parts of Ethiopia.
- Small hive beetle consumes beeswax and honey.
- Moreover, it disfigures and opens the honey to flow out of the combs and ferment stored honey
- The beetle also disturbs the colony and reduces the capacity of the colony to produce honey
- The larvae of this beetle preferably live on pollen and in honeycombs.
- In serious infestation cases, colonies will abscond, and this is usually happening in the beetle's reproduction seasons.
- When the population of the beetle increases, it makes it difficult for the bee colony to defend itself.
- this beetle lives and multiplies within and outside bee colonies.
- The larvae leave the hive to pupate in the earth in front of the apiary.

Figure 18. Adult small hive beetle on comb and pictures of adult and larvae of SHB

Symptoms

- Presence of dark brown to black adult beetles and their creamy white larvae in the hive and honeycombs
- The onset of honeycomb disfigures and ferment honey, change of honey color, and taste due to beetles' larvae and feces and mucilaginous appearance of the honeycomb.

Control

- Manage and maintain strong colonies (defend its nest and remove SHB successfully
- Extract the harvested honey as soon as possible (one to two days)
- Store extracted honey below 10°C or in a dry environment having less than 50% RH.
- Making beehive entrance narrower to prevent beetle invasion
- Cover the ground perpendicular to beehive entrance with a plastic sheet (avoid pupae contact soil)
- Keep apiary sanitation

D. Honey bagger

- Honey bagger (Ratel-mellivora capensis) is a mammal that preys on bees
- It uses its strong claws and forelegs to break beehives and long tails to get access to the hive contents and bees respectively
- Repeated attacks result in colony absconding

Figure 19. Honey bagger on an act of dismantling beehive

Control

- Fence apiary and place thorns around
- Construct a tall hive stand and rap it with a corrugated iron sheet that prevents the badger from climbing up.
- Use guard dogs to scare away the honey badger.
- Tie beehives onto firm objects (mostly fixed hive stand) so that they do not fall when badgers push and brush against them.
- Reduce the size of bee entrance to prevent badger from inserting its tail
- Hang beehives on a tree or two poles and rap the tree with a smooth iron sheet to make it slippery and badgers are not able to climb.

5.3. Bee poisoning

There are two ways in which bees may be poisoned. The first major causes are agrochemicals, and the second causes are natural poisonous plants.

A. Agrochemicals

- Agrochemicals are chemicals used to control plant pests and weeds.
- Bees are poisoned when they collect nectar and pollen from plants to which chemicals are applied.
- Contaminated water is also a source of chemicals poison to the bees.
- Bee poisoning results in the reduction of the honeybee colony population and, hence reduction in honey production in areas formerly known as major honey producers
- The intensity of chemical usage is higher in areas that produce pulse crops, and chat.

Symptoms of poison

- Many dead worker bees are seen in and around the hive.
- The proboscis of the bees protruded out.
- Dead broods are seen out of beehives.
- The colony size of a hive decreases suddenly.

Proclamation to provide for the registration and control of pesticide is available in Ethiopia. However, it is not yet enforced.

If using agrochemicals is unavoidable, the following are some tips on measures to minimize its effects on bees:

- Proper apiary site: Avoid establishing an apiary in areas that heavily use agrochemicals.
- Information exchange: Establish and coordinate information exchange systems between the chemical users and the beekeepers on the time and date of chemical use.
- Arresting the bee colony: arrest colony by covering it with mesh wire, wet cloth, or wet sacks that allow free flow of air on the spray dates.
- Bee colony relocation: Shift location of bee colony until the chemical is neutralized
- Reducing bee entrance: Narrowing bee entrance reduces the damage to some degree.
- Work on agrochemical applicators: Educate farmers on crop protection systems.
- When bees are poisoned, it is necessary to take some of the following measures.
- Merge post damage bee colonies to make up for lost bees and to strengthen them.
- The honeycombs could be contaminated and need to be replaced by fresh ones.
- Provide more feed to the bee colony.

B. Naturally poisoning bee plants

- Honeybees may, accidentally, collect nectar and pollen from poisonous plants and become poisoned.
- It is difficult to manage poisoned bees as there are no symptoms to indicate the poisoned bees.
- If the poisonous plants are known, they should be destroyed before they flower, or plant bee attractive bee forages to prevent bees from visiting poisonous plants.

Post assessment questions

1. Name three common honeybee diseases and describe their primary symptoms and causes.
2. How are honeybee diseases transmitted among colonies? Provide at least three different methods.
3. What are the most effective strategies for preventing and controlling honeybee pests like wax moths and small hive beetles?
4. How do agrochemicals contribute to bee poisoning, and what preventive measures can be taken to protect bee colonies?

Key message

The health of honeybee populations is vital for honeybee products production and biodiversity improvement. Implementing disease control, minimizing agrochemicals, and fostering collaboration, enhance honeybee resilience and productivity.

SECTION 6. RECORD KEEPING

Good records kept by the beekeeper will help him/her to follow the general progress of his/her operations. Two records are particularly important: colony and operational records.

Why should we keep records?

- It is a good idea to keep records during each hive inspection so that you can follow the progress of each colony and monitor their condition. But bear in mind that each inspection should have some purpose and routine examinations should be planned.
- Records can be kept so that you know what was done last time and what to do next time and what equipment you might need.
- Keeping records allows us to identify where we have made mistakes in colony handling.
- Management records are for the beekeeper's individual benefit. Some people like to keep records of all their financial outgoings. From these they can work out when they might recuperate their costs from the sale of the honey or work out how much profit they will get.
- Most of us can remember what is going on if we have one colony but what about 5 or 10?
- All the data collected is useful when the number of colonies has grown considerably, and you want to start selecting the best ones.
- Records are needed to have any chance of success in selecting good queens to breed or in rearing queens.

Duration: 2 hours

6.1 TYPES OF RECORDS

A. Colony Records

- Date/time of last inspection, forage and weather conditions.
- Date of occupation/colonization
- Date of last harvest
- Honey yield per hive
- Colony strength and growth rate (number of combs containing brood)
- Timely manipulation (swarm prevention, feeding)
- Number of honey/stores in hive
- Characteristics of the colony (defensive, calm, productive, poor)
- Swarming record – how often, when and why.
- Pests and diseases
- Hives name and number
- Type of hive
- Remarks

B. Operational Records

- Visits to the apiary site
- Cash flow – how much money spent or earned.
- Purchases
- Labor
- Transport costs
- Servicing of equipment
- Other expenses
- Income

In beekeeping, keeping accurate records is crucial for managing hives effectively and optimizing production. Here are some essential records with key points to be recorded:

6.1.1 HIVE INSPECTION RECORD SHEET

Key parameters to Record:

- Date of inspection: Record the date each hive is inspected.
- Weather Conditions: Note weather conditions at the time of inspection, as it can affect hive behaviour.
- Hive Strength: Assess the strength of the hive, noting population size, health of the queen, and presence of brood.
- Hive Behaviour: Record any unusual behaviour observed, such as aggression or swarming

tendencies.
- Pest and Disease Checks: Document any signs of pests (e.g., Varroa mites or diseases) (e.g., American foulbrood).
- Supers and Frames: Track the presence and condition of supers (boxes for honey storage) and frames within each hive.
- Actions Taken: Note any actions taken during the inspection, such as adding or removing supers, feeding, or treating for pests.

6.1.2 HONEY PRODUCTION RECORD SHEET

Key Points to Record:

- Hive ID: Assign a unique identifier to each hive.
- Honey Flow Dates: Record start and end dates of honey flows.
- Honey Yield: Measure and record the amount of honey harvested from each hive.
- Quality Checks: Assess honey quality based on moisture content, clarity, and taste.
- Remarks: Include any observations about factors influencing honey production, such as weather or hive health.

6.1.3 HIVE TREATMENT RECORD SHEET

Key Points to Record:

- Date of Treatment: Record dates when treatments are administered.
- Treatment Type: Specify the type of treatment used (e.g., botanical pesticides, mite treatments).
- Dosage and Application Method: Detail the dosage given per hive and how it was applied.
- Effectiveness: Monitor the effectiveness of treatments and any adverse reactions observed.
- Withdrawal Periods: Note any required withdrawal periods for honey or wax harvesting after treatment.

6.1.4 QUEEN AND BROOD MANAGEMENT

Key Points to Record:

- Queen Status: Record if the queen is present and laying eggs and note her health and behavior.
- Queen Marking/Replacement: Note if the queen is marked for identification and any queen replacements or requeening events.
- Brood Pattern: Observe and document the brood pattern and any abnormalities (e.g., drone-laying workers).

6.1.5 FEED AND NUTRITION

Key Points to Record:

- Feeding Dates: Record when and what type of supplemental feeding is provided (e.g., sugar syrup, pollen patties).
- Feed Amount: Note the quantity of feed given and any consumption observations.
- Hive Nutrition: Monitor overall hive stores and any deficiencies observed.

6.1.6 EQUIPMENT AND MAINTENANCE

Key Points to Record:

- Equipment Inventory: Keep a list of all equipment, including hives, frames, and tools.
- Maintenance Dates: Record when maintenance or repairs are performed on equipment.
- •New Acquisitions: Document any new equipment purchased or constructed.

6.1.7 FINANCIAL RECORDS

Key Points to Record:

- Income: Track all sources of income from honey, beeswax, pollination services, etc.
- Expenses: Record all expenses, including feed, equipment, labour, and transportation.
- Profit/Loss: Calculate profit or loss periodically to assess business performance.

SECTION 7: FINANCIAL FEASIBILITY

7.1 OVERVIEW OF FINANCIAL FEASIBILITY

Financial feasibility describes whether agri-business is financially viable. It involves determining initial investment (resource) requirements to start the business, estimating production cost, operation expenses, and sales revenue. These are used to determine the initial investment requirement, profitability of the business, break-even point (minimum level of production) to attain the profit zone, and pay-back period (number of years required to recover initial investment). These series procedures are used to make wise decisions to accept or reject the agribusiness investment alternative.

7.2 INITIAL INVESTMENT

- Initial investment is the minimum capital requirement to start the business.
- Example of initial investment requirement to start seed production business includes tools and equipment, seed storage, land, tractor, working capital, etc.

DESCRIPTION	TOTAL COST	REMARK
Tools and equipment		
colony		
feeds		
hives		
Working capital		
Etc		
Total		

Table 5: Template to estimate initial investment requirement for agri-business

7.3 LONG-TERM INVESTMENT

- Long-term investment in agri-business involves all asset requirements for the business which can serve for more than one year.
- Example tools and equipment, tractor, storage, land, etc.

TYPES OF INVESTMENT	UNIT OF MEASUREMENT	QUANTITY	UNIT COST	TOTAL COST
Hives				
Extractors				
Total				

Table 6: Template to calculate total cost for acquisition of long-term investment

7.4 WORKING CAPITAL

Working capital for the planned agri-business includes all payments requirement for day-to-day operating activities such as production costs and operating expenses.

Example

- Production costs include the cost of seed, fertilizer, chemical, labor cost etc
- Operating expenses include administrative salary, sales commission, promotion, etc.

- Working capital excludes long term investments such as warehouse, tools and equipment, land, tractor, etc.

A. Production cost

- Production costs are a key component in agri-business.
- It includes all costs associated with production including value addition to making the product ready for sale.

TYPE OF COSTS	UNIT OF MEASUREMENT	QUANTITY	UNIT COST	TOTAL COST
Sugar	KG			
Wax	KG			
Colony	No.			
Labor cost	Person			
Packing	KG			
Loading and unloading	Qtl			
Transporting	Qtl			
Total				

Table 7: Template for estimating production cost per hive for honey and beeswax production

B. Operating expenses

- Operating expenses are all costs not directly associated with production.
- They are common costs incurred for administrative and selling activities.
- Example administrative salary, promotion cost, sales commission, transport cost to sale, etc.

TYPES OF COSTS	TOTAL COST
Administrative salary	
Utility (electric, water, tele.)	
Interest	
Promotion	
Sales commotion	
Tax	
Etc…	

Table 8: : Template to estimate operating expenses for agri-business

7.5 ESTIMATED PRODUCTION AND SALE REVENUE

- Production volume is the main source of revenue for the agri-business to generate profit.
- Producers should determine the estimated average production volume from the planned production season.

Formula -1
Total production volume = Average Production per hectare X Land size (ha)

- After determining the estimated volume of production, it is possible to determine the expected sales revenue for the planned production.

Formula -2
Total sales revenue = Total production Volume X unit selling price

A TYPE OF PRODUCT	B LAND SIZE (HA)	C ESTIMATED PRODUCTION QT/HA	D TOTAL PRODUCTION QT (B X C)	E ESTIMATED SELLING PRICE/QT	F TOTAL SALES REVENUE (D X C)
Honey	Comb honey				
	Strained honey				
Beeswax	extraction				
	Old combs				

Table 13: Template for estimating volume of production and sale revenue

7.6 PROFIT AND LOSS STATEMENT

- The primary objective of any business is to generate profit.
- Profit and loss statement is the main tool to calculate profitability of the business.
- It is used to accept or reject the investment based on estimated profit.

Formula -3

a. Gross profit = Total sales revenue – Cost of goods sold
b. Net profit = Gross profit – Total operating expenses

DESCRIPTION		
Sales Revenue		
Sale of honey		
Sale of beeswax		
Total Sales revenue		
Cost of goods sold		
Honey production cost		
Beeswax production cost		
Ending inventory		
Cost of goods sold		
Gross profit		
Operating Expenses		
Salary if any		
Utility (electric, water, tele.)		
Interest		
Promotion		
Depreciation		
Tax if any		
Total operating expense		
Net profit		

7.7 BALANCE SHEET

Balance sheet used to know the total resource owned, amount of claim by creditors and amount of owners' equity

- Balance sheet contains assets, liability, and own capital
- Assets are all resources available for use or for sale
- Example cash, inventory, warehouse, land, equipment etc
- Liabilities are all debts obtained from banks, microfinances, individuals or others
- Own equity/capital involves own/member contribution, grant/donation, etc.

Formula -4

Total Asset = Total liability + Total own capital

DESCRIPTION		
Asset		
Current asset		
Cash		
Inventory		
Total current asset		
Fixed asset		
Tools and equipment		
Warehouse		
etc		
Total fixed asset		
Total asset		
Liability and Capital		
Liability		
Loan		
Total liability		
Owners capital		
Own capital contribution		
Grant/donation		
Total owners' capital		
Total liability and capital		

Table 11: Template for balance sheet preparation

7.8 CASH FLOW STATEMENT

Cash flow is all cash inflow and outflow for any purpose in the business operation

Example:

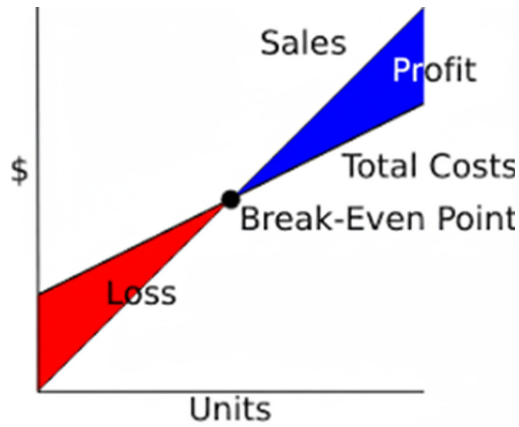
- Cash inflows include sale of seed/seedling, debt obtained from banks, members capital contribution, etc
- Cash out flow includes purchase of input, payment for construction, repayment of debt, payment for salary, etc

Formula -5
Beginning cash balance + total cash inflow = ending cash balance + total cash out flow

DESCRIPTION	AMOUNT OF OUTFLOW	AMOUNT OF INFLOW
Owners' investment		
Debt		
Grant		
Sales revenue		
Warehouse construction cost		
Purchase of equipment		
Purchase of input		
Land rent		
Irrigation cost		
Labor cost		
Cash Operating costs		
Ending cash balance		
Total		

Table 16: Template for cash flow statement preparation

7.9 BREAK EVEN ANALYSIS



- Break even analysis is used to determine the minimum level of production to cover total cost
- At break-even point no profit no loss
- To make profit, the level of production and sale should exceed/greater than breakeven point.
- Fixed costs are fixed in total amount regardless of increase/decrease in volume of production.
- Example depreciation, warehouse rent, administrative salary, promotion cost, etc
- Variable costs varied in total in response to increase/decrease in level of production
- Example production costs, packaging cost, loading and unloading, etc

Formula -6
Break-even point = Fixed cost/(Unit selling price – unit Variable cost)

7.10 PAYBACK PERIOD

Payback period is used to determine the number of years/periods it takes to recover initial investment.

Formula -6

a. When the annual profit of the business is uniform/equal
   Payback period = Initial investment/annual profit
b. When the annual profit fluctuate/vary from year to year
   Payback period = # of year before coverage + uncovered amount/profit of the next year

Post assessment questions

- How can customer segmentation improve demand estimation for agricultural products, and what are some effective methods for identifying these segments?
- What strategies can be employed to create demand for new agricultural products, and why is building customer trust important in this process?
- Explain the role of a reliable distribution network in the delivery of agricultural products and how it impacts overall sales and customer satisfaction?
- How would you calculate the break-even point for an agribusiness venture, and why is understanding this point critical for decision-making?

Key message

- Success in agribusiness depends on understanding and meeting customer needs through strategic marketing and financial planning.

Potential risks and possible mitigation strategies

Beekeeping, like any agricultural activity, comes with its risks. These risks and mitigation strategies are designed to address challenges across all operational objectives, promoting resilience and success in the beekeeping enterprise. It's crucial to continually monitor and adjust these strategies based on evolving circumstances and feedback from the stakeholders involved. Ke risks and mitigation strategies are indicated in the table below.

POTENTIAL RISKS	POSSIBLE MITIGATION STRATEGIES
Bee Stings	• Safety Gear and Training: Always wear proper beekeeping gear (e.g., bee suit, gloves, veil) and ensure that anyone involved in beekeeping is trained in safe practices.
Diseases and Pests outbreak	• Regular Inspections: Conduct frequent inspections of beehives to detect diseases and pests early. • Implement integrated pest management strategies to control pests and diseases. • Queen Quality: Use high-quality queen bees from reputable sources to maintain strong and healthy colonies • Implement strict biosecurity measures to prevent and manage disease outbreaks
Environmental Factors	• Site Selection: Choose a location with good forage and shelter from extreme weather. • Monitor weather forecasts and provide supplementary feeding during periods of scarcity.
Equipment Failure	• Equipment Maintenance: Regularly inspect and maintain beekeeping equipment to ensure it is functioning properly and safely
Failure to comply with local beekeeping regulations and best practices	• Legal Compliance: Understand and adhere to local beekeeping regulations regarding hive placement, disease management, and honey production.
. Cultural Barriers to engage women	• Conduct awareness campaigns to challenge cultural norms and promote inclusivity. • Develop targeted training programs to bridge skill gaps, focusing on building confidence and competence among women and youth
Unfavorable weather conditions	• Monitor weather forecasts and establish contingency plans for adverse conditions
Shortage of honeybee colonies	• Multiply honeybee colonies and have reserve stocks

Table 13. Potential risks and mitigation strategies

Duration: 2 hours

Annex

Record sheet templets

Record sheets help beekeepers maintain organized and detailed information about their hives, enabling better management decisions and improving overall beekeeping outcomes

Hive Inspection Record Sheet:

Apiary site:_____

DATE	HIVE ID	WEATHER CONDITION	COLONY STRENGTH	COLONY BEHAVIOUR	PEST/DISEASE	ACTION TAKEN
D/M/Y	01	Temperature	Strong, good brood pattern	Normal activity/ aggressive	Varroa	Treated with--/ supper added

Honey Production Record Sheet:

Apiary site:_____

HIVE ID/NO.	HONEY FLOW DATE	HONEY YIELD (KG)	QUALITY CHECK	REMARKS
01	15 Oct-30 Nov/2016	20	Good quality, clear	Strong nectar flow in October

Honey Production Record Sheet:

Apiary site:_____

DATE	HIVE ID	FEED TYPE	AMOUNT(G)	CONSUMPTION AMOUNT	REMARKS

Financial Record Sheet

DATE	INCOME SOURCE	AMOUNT(BIRR)	EXPENSE TYPE	AMOUNT(BIRR)	PROFIT/LOSS

Ethiopian ATI

Agricultural Transformation Institute

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