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A GUIDE TO BEE KEEPING

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"If the bee disappeared off the face of the Earth, man would only have four years left to live."
Albert Einstein



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Definition of Terms

- i. Beekeeping – This is the art and science of managing bees and plant resources for the purpose of acquiring bee products for food, medicine, income, and job creation.
- ii. Apiary – A place set aside for hives and for keeping bees.
- iii. Apitourism – A travel concept that combines bees and beekeeping with memorable destinations for stakeholders to enjoy and learn.
- iv. Swarming – Natural colony division during plenty of food and queen laying a lot of eggs resulting to overpopulation, leading to division of the colony. To avoid this, farmers are advised to harvest honey in time.
- v. Absconding- When bees run from the hive due to unfavorable conditions such as diseases and pest infestation/ disturbance.
- vi. Migration- Movement of bees from unfavourable conditions to favourable conditions.
- vii. Apitherapy – This is a branch of medicine that deals with treatment of diseases using bee products.

CHAPTER ONE: INTRODUCTION

Bee keeping is gradually becoming a preferred enterprise among many farmers in Kenya and beyond. It is an enterprise with numerous benefits including crop pollination, job creation, increased food and nutrition security, increased household income among others. Unfortunately, only a few beekeepers enjoy the full range of these benefits due to insufficient skill and knowl-

edge and lack of access to affordable inputs and markets. This manual features practical information on why one should consider bee-keeping as an income generating enterprise. It is a practical guide to production, processing and value addition of honey and other bee products including bees wax, propolis, pollen and bee venom

1.1 Why Choose Bee Keeping

Bee keeping has several advantages compared to other forms of livestock farming. Beekeeping helps in sustainable agriculture and the conservation of the biodiversity. Bees can be used as an affordable integrated approach to protect natural resources.

The following are the benefits of bee keeping:

- i. Bee keeping does not require much space.
- ii. Bees contribute to increased production of wild and agricultural crops through pollination.
- iii. Bee keeping enhances biodiversity conservation.
- iv. It provides job opportunities.
- v. Bees do not compete with other domestic animals for food.
- vi. Income generation for improved livelihood.
- vii. The bee products are a source of food.
- viii. Bee products are used for medical purpose known as Apitherapy.
- ix. There is no age limit in beekeeping. Anyone can practice bee keeping regardless of age as long as they have the skill.
- x. Bees have no foraging boundaries, unlike poultry and other domestic animals. Bees can traverse land bound areas to look for nectar, pollen, resins and water.
- xi. They require minimal management compared to other enterprises such as livestock rearing.
- xii. Bee keeping promotes ecotourism (Apitourism) and research opportunities.
- xiii. It contributes to conservation of different cultures and traditions by use of bee products such as honey.



Interacting with most farmers, who are involved in bee keeping, one will realize that the most popular product from this enterprise is honey. However, there is so much that can be derived from the venture, if only farmers are equipped with knowledge and skills on how to produce and handle various products. Farmers have in many occasions forfeited material that can be further processed or used in their raw form to generate income unaware of this possibility.



1.2 Products of Bee Keeping

From bee keeping, a farmer can generate income from a variety of products including; honey, bees wax, Propolis, bee pollen, royal jelly, bee venom and bee colonies.



Honey – It is a sweet and viscous fluid produced by honeybees and derived from the nectar of flowers. Bees lay down honey as a food source containing carbohydrates, sugars, dietary fiber, fat, protein and water. Honey is a mixture of sugars and other compounds. With respect to carbohydrates, honey is mainly fructose and glucose.



Propolis – This is a mixture of various amounts of beeswax and resins collected by the honeybees from plants, particularly from flowers and leaf buds. The bees usually scap the protective resins of flower and leaf buds with their mandibles and then carry them to the hive like pollen pellets on their hind legs. During the process of collection and modelling, the resins are mixed with some saliva and other secretions of the bees.



Bees wax – It is a large variety of substances from the honey combs comprised of a mixture of various long-chain fatty acids. Each wax has unique physical and chemical characteristics which are exploited in a multitude of applications. Honeybees wax has an extremely wide spectrum of useful applications and occupies a very special position among waxes. Eight wax glands on the underside of the abdomens of the young bees secrete small wax platelets. These are scraped off by the bee, chewed and masticated into pliable pieces with the addition of saliva and a variety of enzymes. Once chewed, attached to the comb, and re-chewed several times, they finally form part of this architectural masterpiece, a comb of hexagonal cells, a 20g structure which can support 1000g of honey.



Royal Jelly – This is a secretion by the hypopharyngeal gland of young worker bee, to feed young larvae and adult queen bee. Royal jelly is always fed directly to the queen or larvae as it is secreted; it is not stored. This is why it is not a traditional beekeeping product. The only situation in which harvesting becomes feasible, is during queen rearing, when the larvae destined to become queen bees are supplied with an over-abundance of royal jelly.



Bee Pollen – This is a fine to coarse powder consisting of microgametophytes (pollen grains), which produce the male gametes (sperm cells) of seed plants. The pollen grain with its hard coat protects the sperm cells during the process of their movement between the stamens of the flower to the pistil of the next flower.



Bee Colony – These are the producers of all the primary products of beekeeping. A beekeeper can produce the colony to sell to others or use them to increase the size of the apiary. Bee colonies can be obtained through colony multiplication activity.





BEE FACTS

Honey bees have 170 odorant receptors and have a sense of smell 50 times more powerful than a dog.



Bees have 2 stomachs – one for food, and one for storing nectar and processing it into honey.

CHAPTER 2: CRUCIAL ASPECTS OF BEE KEEPING

Key aspects of bee keeping are as follows:

- i. Site selection
- ii. Equipment, tools, and structures
- iii. Apiary establishment and management
- iv. Colony management
- v. Harvesting

2.1 Site Selection

What to consider when selecting an apiary site:

- Select a site with nectar producing plants (the trees should be within a radius of 2km from the hives)
- Clean water should be available within a radius of 1km. Where there is no natural source of water, the farmer can provide.
- The site should be free from pollution (away from chemical, air and noise pollution).
- Far away from social amenities (markets, schools, churches). The distance in this sense can be **enhanced through artificial barriers like bee house construction or establishment of natural fence that anyone cannot see through or bees cannot pass through easily.**
- Fence the apiary with a hedge, a fence or establish a bee house.
- Plant wind breakers where necessary.
- The site should have enough sunlight and not too much heat.
- Avoid areas prone to fire break outs.
- Apiary should be cited away from livestock.
- The site should not be prone to floods; avoid swampy areas.
- The site should be easily accessible for frequent monitoring/inspection.
- Consider the carrying capacity of the site (how many hives can a given apiary hold? This should be determined by the availability of forage, other apiaries in the vicinity and the aggressiveness of the bees.) It is advisable to start with few beehives and add gradually in reference to the production levels.



2.2 Equipment, Tools and Structures

Beekeeping equipment, tools/accessories and structures are divided into production and processing.

Production equipment, tools/accessories and structures include:

1. Beehive (traditional and modern)
2. Protective gear (veil, overall, gloves and gumboots)
3. Catcher box
4. Smoker
5. Bee brush
6. Hive tool
7. Bee lure
8. Bee venom collector
9. Pollen trap
10. Venom collector
11. Feeder box
12. Propolis collector
13. Torch



Processing equipment, tools/accessories and structures include:

1. Food grade bucket/ drum (non- metal lic as honey is acidic and can corrode metals, they should be airtight as honey attracts moisture.
2. Weighing balance
3. Centrifuge machine /honey extractor
4. solar wax melter
5. uncapping knife/folk
6. Uncapping tank/tray
7. Settling/ bottling tank
8. Honey warmers
9. Refractometer
10. Honey jars
11. Honey strainers
12. Wax mold

2.3 Choosing a Beehive

The hive is the bees' home. There are two major types/categories of hives commonly used in bee-keeping.

- a) Traditional hives: Fixed comb hives like log, basket, pots and guards.
- b) Modern hives: Movable frame hives/bars like Langstroth hive and Kenya Top Bar Hives

a) Traditional beehives or fixed comb hives:

These are hives that were constructed or made with locally available materials by traditional bee-keepers. The materials that were used included logs, clay/mud, reeds or twigs. Traditional hives include log, pot, basket, and guard hive. The bees build their nest filling all available space with combs from top to bottom, making hive inspection difficult. To harvest honey and other bee products from such hives, one must cut out the combs and, in the process, some brood combs and bees are destroyed.

Advantages of traditional hives;

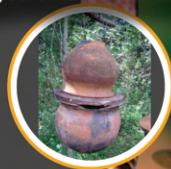
- They are cheaper to acquire or make.
- They give plenty of beeswax and Propolis.
- They provide natural habitat for the bee.

Disadvantages of traditional hives;

- They are not durable.
- It is difficult to manipulate bees in them.
- It is difficult to distinguish ripe or unripe hive from outside.
- They are always heavy and can only be handled by men.
- They are always hanged high up on trees making it inappropriate for women to handle them.
- Controlling pests in traditional beehives is difficult.

Images of Traditional Hives

1.



2.



3.



4.



2.3 Choosing a Beehive

b) Modern hives

These are hives that have been constructed to make it easy to manipulate bees and handle the bee products easily. Modern hives contain movable frames or top bars that can be removed and returned easily without damaging the combs. They allow users to freely move the combs during inspection. They include Kenya Top Bar Hive (KTBH), Langstroth hives, Flow hives, among others.

Advantages of modern hives:

- They are easy to open.
- They are easy to stock with bees.
- They are easy to remove honey from and leave other combs undisturbed.

i) The Kenya Top Bar Hive

This was designed and developed in Kenya. It has 26 pieces of Top bars, and each is treated with beeswax, to guide the bees on where to attach the combs. Each bar carries one comb. Careful handling of top bar hives is recommended to protect the combs from breaking off the top bar.



Figure 12. Kenya Top Bar Hive

Advantages of The Kenya Top Bar Hive

- The combs are arranged in a way that they can be accessed with ease and independently without disturbing the others.
- Top-bar hives are inexpensive and easy to make. However, when making ensure that the standard width of the top-bar is kept the same as the natural comb made by the bees, which is at 3.2-3.5 cm depending on the type of bee.
- Colony splitting and multiplication is easy.
- Control of swarming is possible.
- Easy to inspect to know the condition of the colony.

- Harvesting is easy and possible to select sealed combed (ripe) honey.
- Materials for construction are available.
- They are durable.
- High colonization rate when baited.
- Are affordable as compared to Langstroth hives.
- More beeswax is produced as compared to Langstroth hive.

Disadvantages of The Kenya Top Bar Hive (KTBH)

- It requires high skills and technology to manufacture as compared to traditional hives.
- It is expensive for an ordinary person to afford as compared to traditional hives.
- The bees take long time to build combs after harvesting honey.
- Combs can easily break while in transit
- Harvesting is done once in a season. Honeycombs are destroyed during harvesting, and this means the bees must work hard to build again.

ii) Langstroth hives

Langstroth hive is a bit more complex than the Kenya Top Bar Hive. It is made up of the floorboard, brood chamber, wired frames both for brood chamber and supers, super (honey chamber), queen excluder and the cover. The super is for honey production and the brood chamber is for building the colony number and where the queen stays. The brood chamber should be installed alone first for the bees to occupy then super to be added when the colony has grown during the build-up period in readiness for the honey flow season.

In Langstroth hive, the bees build honeycomb into frames – wooden rectangles designed to hold a comb, which are slotted downward into grooves from the top of the hive and can be easily lifted out. The frames are set at a fixed distance from each other, which is calculated to prevent bees from attaching honeycombs where they would connect adjacent frames or connect the frames to the walls of the hive.

The queen is usually excluded from the super chamber using a queen excluder to allow combs that contain honey only. The queen excluder must be of the right dimension to prevent the queen from climbing up the super to lay eggs. Both the brood chamber and the super are designed to take ten frames, but in general the super is not as tall as the brood chamber. When colonies are small or weak and cannot build combs on all frames, individual frames can be replaced with a dummy board, which is solid and can't be used to build a comb. The dummy board fills the empty space and helps the colony to keep warm.

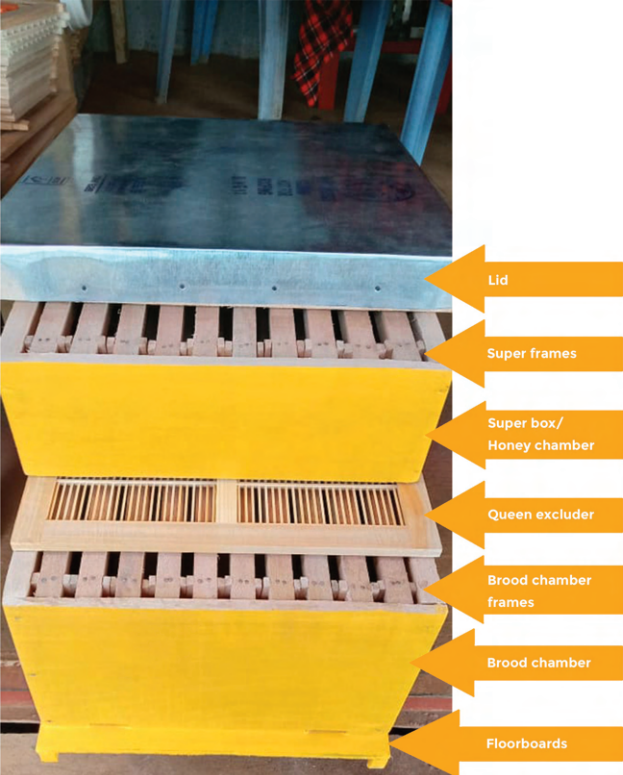


Figure 13. Langstroth hive

Advantages of Langstroth Hives:

- i. They are portable.
- ii. Honey can be harvested twice in a season. Only honey is extracted then the frames are returned for the bees to pack more honey.
- iii. Inspecting them and harvesting honey from them is easy.
- iv. It is easy to control swarming in Langstroth hives.
- v. Bee breeding and queen rearing is possible in Langstroth hive.
- vi. Langstroth hives are long-lasting.

Disadvantages of Langstroth Hives:

- i. They are more expensive as compared to KTBH.
- ii. Some of the materials required to construct them need to be imported.
- iii. High skills and technology are required to construct them.
- iv. Production of other hive products such as wax and Propolis is very minimal when using Langstroth hives.
- v. Langstroth hives require technical management skills to maintain and handle.
- vi. One requires a honey extractor to process honey. This comes with an additional cost.

Since each type of beehive has its advantages and disadvantages, farmers are advised to choose the type of hive to install on their farms depending on their preference and consideration of their respective benefits and limitations.



Figure 14. Beesuit with veil, overall, gloves and boots



Figure 15. Gloves to protect the hands when you wear a beesuit



Figure 16. Smoker



Figure 17. Bee brush



Figure 18. Hive tool



Figure 19. Feeder box



Figure 20. Catcher box

2.4 Apiary Establishment

An apiary is a place where hives are kept for the purpose of rearing bees. Bees forage in a radius of 3 kilometers from the apiary.

Choosing a good site to hang or place your hives is very important. It is important to take note of the following:

- If you choose a poor site, people and animals may be stung.
- If the site is insecure honey and hives will be stolen.
- If you live in a hot area, your hives will need shade as well as water.
- If you live in a cold area, the bees will be cold and damp.

An ideal apiary site would be:

- Away from human/ livestock dwelling areas, roads, and public places.
- Safe from strong direct sunshine, windy areas, and theft.
- Accessible to water and plants that produce nectar, pollen, and resins.
- Away from swampy areas and smelly places.

Steps to set up an apiary after identifying a suitable place:

1. Clear the site.
2. Fence the area (you can install an artificial fence or plant a hedge).
3. Set up the hives (hives can be suspended on trees, or placed on the hive stand, which are metallic or wooden. You can place them on tables, benches or hang them on wires. Place a rat guard on the stand poles to protect the hives from predators).
4. When placing the hives do not have the openings facing each other, as the bees can be aggressive against each other.
5. The entrance of the hives should face the direction of the sun rise to alert them for foraging and for the bees to receive some sunlight. Protect the bees from strong heat.
6. Where there are no wind breakers, have the entrance of the hive face away from direct wind.

2.5 Apiary Management

Apiary management is key in ensuring productivity of your enterprise. The following are tips of apiary management:

- a) Observe phytosanitary measures – Clear bushes around the apiary, oil and grease the wires and stands to keep pests such as ants away. Place rat guard on the stands to keep away rats, lizards, honey badgers, snakes, and other predators.
- b) Keep empty combs for processing wax.
- c) Remove all infested combs from the hive. Do not throw or bury empty/ infested combs in the apiary. Ensure to burn them. Burying them will lead to multiplication of pests in your farm and recurring infestation of the apiary.
- d) Clean, scrape and pass over fire any infested hives to kill the eggs of any pests that may be there.
- e) Avoid dumping organic waste in or near the apiary.
- f) Destroy termite nests and ants' nests, that are near the apiary.
- g) Avoid lighting fire near the apiary.
- h) Provide water in the apiary. Bees need as much water as pollen and nectar, and a colony requires up to several litres of water a day. In case there is ~ no natural source of water the bee keeper must frequently provide fresh water for the bees by filling a shallow tub with fresh water and placing some straw or twigs inside so that bees have something to land on and can access the water without drowning. With a source of water near the apiary, the bees do not waste much energy searching for water, but instead save it for sourcing more nectar and pollen.
- i) Cultivate pollen and nectar producing plants and crops.
- j) Make regular inspection of your apiary, to check the following:
 - Check on the strength of the colony by observing the brood: eggs, larvae and pupae.
 - Is the queen present? If she is hiding, the newly laid eggs can prove that she is present.
 - Is the queen laying enough eggs?

Apiary inspection tips:

- Avoid visiting the hive in the warm part of the day-about six o'clock in the evening is a good time.
- Always wear light coloured clothes. Ideally, protective clothing should be worn. The protective gear comprises of veil, overall, gloves and gumboots to protect the whole body.
- Use a hive tool or knife to separate bars that are glued together by propolis.
- Keep the bars in the same order and try not to squash any bees when replacing them in the hive. Squashed bees release a smell (alarm pheromone) that sets other bees on the attack.
- Make sure the top bars are pushed together as they are replaced, so that no gap exists.
- Finally, gently replace the lid on the hive.
- Always extinguish the smoker immediately after use.
- Pay regular visits to your apiary for familiarity with the bees.

- k) Bees are threatened by ground vibration so avoid activities that disturb the ground around the apiary.
- l) Maintain records of your apiary. This should include:
- Hive identification (mark your hives)
 - Day and time of hive establishment
 - Production of the bees
 - Clearing
 - Signs of attacks by predatory pests and animals. Behavior of the bees can give information on their status. Bees can act defensive, calm, productive or poor. Crowding outside the hive could mean that they want to abscond due to overpopulation, too much heat in the hive, attack by pests, etc.

2.6 Colony Management

Once you have established the apiary, the next step is to colonize the hives. The following are steps to colony establishment and management:

- (i) Hive stocking** – Hive stocking can be done in two ways. One is trapping the bees into the hive using comb starters, bees wax, attractants and lures. If the hive is not colonized as anticipated after a while, a farmer can undertake swarm transfer using a catcher box (a mini-top bar hive).

Swarm transfer process:

Follow this procedure to transfer the bees into an already set up hive, that is yet to be colonized:

- Ensure the queen is among the bees you are targeting.
- Attract the bees into a close and tight catcher box to avoid disturbance.
- Close the box at night when all the bees are inside.
- Close the box with a wire mesh for air.
- Transfer the box 3-4 weeks after colonization.
- Do not transfer the colony on a sunny day, do it at night.
- Leave bees in a dark and calm place to stabilize before transferring to the stand.
- Use net to cover the catcher net for transporting.

NB:

- Do not use a treated mosquito net to cover the swarm.
 - Use a standard catcher box to avoid mismatched frames during transfer to the hive.
- i. Let the bees stay in the catcher box for 2 to 3 days in a dark and calm place to stabilize.
 - ii. Put the catcher box on the stand where the hive will be hosted for two weeks to acclimatize.
 - iii. Finally transfer the swarm into the hive.

The other option of stocking the hive is colony division. Colony division is done when the hive has sufficient food, broods, eggs, and bees. It involves dividing the colony of an already colonized hive into two. Colony division is done by experienced farmers who have clear records and an in-depth understanding of their hives.

You can also buy bees in an already colonized hive from an expert or a fellow farmer.

(ii) Feeding – The first step of feeding bees is to establish bee forage. This is done by planting trees that produce nectar and pollen near your apiary to provide forage for the bees. Some of the fast-growing plants favorable to bees include bananas, avocados, croton, sunflowers, passion fruits, among others. Local knowledge on trees and their floral seasons is critical. Learn from farmers within your locality on this knowledge.

Sugar syrup, honey, rice flour, mango peel, watermelon can be provided to supplement their feeding during low forage seasons for maintenance only. Use a feeder box to feed them. You can use empty combs to feed the bees with syrup inside the hives. When giving water and syrup, ensure there are stones and leaves, to protect them from drowning.



(iii) Colony inspection - A beekeeper should regularly inspect their hives, to assess the status of the nest. The farmer should have a hive card for each hive, to keep records during inspection. During inspection, check for:

- The presence of the queen; the presence of eggs and brooders indicate the queen's presence.
- Whether the queen is laying eggs efficiently.
- Check the pattern of laying eggs. Empty cells in the brood is a sign of inbreeding. You need to change the queen.
- The presence of pests, on the worker bees, on the food comb or in the drone and queen cell.
- For diseases, a farmer can take samples to the lab for identification. Some diseases cause mass death of bees.
- The strength of the colony is shown by the occupancy of the chambers. A well occupied chamber (three quarters of all frames occupied) shows a strong colony.
- Occurrence of queen cells. This is when they construct many queen cells or drone cells. Queen cells show that the colony is likely to undergo swarming, or the queen is about to be replaced. Destroy some and provide more room (as long as the queen is present).
- Check on food stores (honey and pollen).
- Is honey ready for harvesting? The honey is ready for harvesting if the honey cells are capped. The comb should be capped/sealed on both sides.
- Is the room enough for the bees? If not, remove some of the brood combs and unite with a weaker colony and replace with empty bars.
- Check for signs of swarming.
- For Langstroth hive, check whether the brood chamber is filled three quarters so that you can add the queen excluder and introduce the super frames. (7/10 rule).

2.7 Pests and Disease Management in Bee Keeping

Common pests and predators:

- a) Man: Human beings steal hives and honey.
- b) Small hive beetles: They eat the stored pollen, and feed on the colony while the larvae of the small hive beetle feed on honeycombs and reproduce on the colony.
- c) Large hive beetles: They destroy the brood combs.
- d) Wax moths: They destroy the combs and make webs that trap and kill the bees.
- e) Monkeys: They eat the honey.
- f) Honey badgers: They destroy hives, and feed on the honey. They leave a bad odour in the hives that causes the bees to abscond.
- g) Birds (bee eaters): They feed on honey and bees.

- h) Snakes and lizards: They feed on bees and honey.
- i) Varroa mites: They feed on the bee and transmit deadly viral diseases in the bee.
- j) Wasps: They build nests on the entrance of the hive, causing the bees to abscond.
- k) Tracheal mites: They kill the bees.
- l) Termites: They eat up the hive. To manage them you must destroy the nest by digging them out and kill the queen.
- m) Bee lice: They feed on the bees.

Diseases

Below are common diseases affecting bees:

- a) European foulbrood bacterium affects the bee brood and causes larvae to die. It causes bees to have a yellowish-brown appearance.
- b) American foul brood is a bacterium disease that causes bees to exhibit bad smell and produce slimy larvae. It is caused by poor hygiene due to contaminated water, tools, and environment. These can result from use of infested materials and purchase of infested colonies.
- c) Chalk brood disease is a fungus disease. The larvae die and shrink to a chalk like mummy. This disease affects mostly the brood.
- d) Nosema affects the queen bee, worker bee and drone. It causes bee diarrhea.
- e) Deformed wings virus disables bees in a way that they cannot fly for forage. Eventually they die.
- f) Black queen virus kills the queen that is developing.



Deformed wings virus



A group of dead bees

General Control of Diseases in Bee Keeping

To manage diseases in the apiary, beekeepers are advised to:

- a) Observe general apiary hygiene.
- b) Burn the whole brood colony and pass the hive material on fire.
- c) Promote very strong colonies in apiaries.
- d) Perform regular colony inspection to remove infested combs.
- e) Promote colonies with good grooming and hygienic behaviors.
- f) Avoid or minimize buying used hives or if used, disinfect them before setting.
- g) Minimize cracks and crevices to avoid predator entry.
- h) Remove old wax and combs.
- i) Procure colonies from farms that are disease free.
- j) Avoid inbreeding as it weakens the immunity system of the colony.
- k) Promote good forage for the bees.

CHAPTER 3: HARVESTING AND PROCESSING OF BEE PRODUCTS

3.1 Honey

Honey is a natural sweet substance produced by honeybees from the nectar of flowering plants which honeybees collect, transfer and combine with specific substance of their own, store and deposit in the cells of the combs to ripen and mature. Natural honey has physical characteristics that distinguishes it including but not limited to;

Viscosity - Freshly extracted honey is a viscous liquid. Honey's viscosity depends on a large variety of substances and therefore varies with its composition and particularly with its water content.

Hygroscopicity - Honey has a tendency to absorb and hold moisture from the atmosphere and therefore it is very important to store honey in an airtight container.

Crystallization - This is a natural phenomenon that occurs in temperate climates. It occurs due to oversaturated sugar solution that results from the formation of monohydrate glucose crystals, which vary in number, shape, dimension and quality with the honey composition and storage conditions.

3.1.1 Harvesting honey

The first step in honey harvesting is assembling the tools and equipment. The equipment include protective gears, smokers, bee brush, hive tool, bucket (food grade plastic or stainless steel), honey-comb tray (to carry the frame that has honeycomb) and spotlight.

Honey harvesting should be done after the honey flow season. A beekeeper must understand the seasonal cycle and the stages of the colonies for proper management. There are four seasons, and these may occur more than once in a year:

- **Dearth** - During the dearth season, not much nectar is being collected due to bad weather and poor forage.
- **Build-up** - In this season, there are many bees forage plants, and the weather is favourable hence the colony expands.
- **Honey flow** - Many plants provide nectar and flower at the same time.
- **Harvesting seasons** - Most plants have stopped flowering and honey is ready for harvesting. This occurs immediately after the honey flow period.

During the harvesting season, inspect your hives for signs of maturity for harvest. A gentle knock along the length of the hive producing a solid sound is an indication that combs are filled with

honey; a hollow sound is an indication that combs are empty. Honey should be harvested from capped honeycombs only showing a whitish wax cover. In these combs the honey is completely sealed from outside air, has a low moisture content, and stores well for a long period.

Steps to Harvest Honey

The first step to harvesting honey is to light the smoker. The smoker is used by pumping a bellow that puffs out smoke from a canon. The smoke comes from burnt material such as semi dry grass, wood shaving, coffee husks, maize comb, bean husks, millet husks, dry cactus, dry pawpaw stem etc. Avoid contaminant materials like cow dung.

How to light a smoker

- Put glowing charcoal on the sieve in the canon chamber.
- Add any of the recommended materials above three quarters of the canon.
- Fill the remaining quarter with fresh green grass or leaves.
- Pump the bellow gently to exude smoke.

After lighting the smoker, the next step is to put on protective gear. Protective gear used in honey harvesting include the following:

A bee suit which is made of an overall and a veil. The net of the head veil is made out of strong black nylon material to have good vision and ventilation. The veil is attached to the overall with a double zip and can be detached. The overall should cover whole body right from the legs, arms up to the neck with a long jacket zipper from the fry up to the neck. The overall should be fitting loosely (not tight) with provision of pockets; at least 4 pockets - 2 at the chest and 2 around the thighs. There should be elastic at the wrist and ankles. Gloves made from soft leather material or latex and reaching up to the elbow with an elastic to clasp the overall are part of the gear. To protect the legs, wear white gumboots, or if unavailable improvise with any polythene bags that cover up to the knee and can be tied to avoid loose openings.

With the protective gear on and armed with a lighted smoker, move to the apiary and follow the following procedure:

- Identify the hive to harvest.
- Start with the less aggressive and finish with the most aggressive.
- Smoke the hive starting from the behind then sides and then the front side. Smoke disrupts communication. As the bees sense an invasion, they consume too much honey in readiness for the impending attack, which makes them heavy and calm, with minimal aggression. Do not over smoke the hive since too much smoke affects the aroma of the honey.
- Open the hive lid using the hive tool.

- v. Smoke the bees again from the top after opening the hive.
- vi. Use the hive tool to remove the hive frames starting with the central one or side frame.
- vii. Check the combs for maturity. If capped to 75-90 percent and whitish in color, it is mature and harvestable honey. If not capped, it is immature and should be returned to the hive.

Note: Ripe honey is yellow capped - this should not be confused with the capped brood.

- viii. Do not harvest honey stored in the brood chamber.
- ix. Put honeycombs in clean honeycomb trays, use bee brush to remove the remaining bees.
- x. Transfer the combs to the extraction/processing room. Avoid living rooms as honey may attract bees which can cause harm to people.
- xi. After extraction return the empty frames to the hive.

3.1.2 Processing Honey

Processing honey entails preparing the honey for the market. Once the honey in the combs has been put in a bucket, you need the following: a stainless-steel table, centrifuge machine, honey press machine, uncapping tray and fork.

Processing honey from Langstroth hive and the Kenya Top Bar Hive takes different procedures. Note that when processing honey from the Langstroth hive, you must protect the combs, but when processing honey from the KTBH, one can process wax from the combs.

Extracting honey from Langstroth hive:

1. Place the honey frames on the uncapping tray, then uncap them using the uncapping fork or warm knife.
2. Place the uncapped honey frames inside the centrifuge and manually or automatically extract the honey. Store the empty frame combs safely to avoid damage as you will need to return them to the hives later.
3. Open the centrifuge tap to drain the honey into a holding bucket, through a sieve.
4. Preheat the extracted honey using honey warmers. If you do not have honey warmers, you can use a water bath (use warm water between 60 and 70 degrees Celsius.) Avoid heating the honey directly as it affects its nutritional value and color. Preheating helps in reducing the moisture content to avoid crystallization and fermentation depending on the environmental conditions.
5. Use a refractometer to measure the moisture content. The moisture content should be 20% and below. If it surpasses this level, it means the honey was harvested immaturity and can easily ferment.

6. Let it cool overnight and let it settle for one to two days then remove any wax or pollen that may settle on the top.
7. Analyze the quality of the honey through a credited body such as Kenya Bureau of Standards (KEBS) for accreditation.
8. Package in plastic bottles or glass jars and seal.
9. Label to indicate the brand name, source, the content of the product, packaging date, the type of honey, expiry date, the plants it is made from, and the quantity packaged in the container.

The honey is now ready for the market.

You must inspect the hives to ensure that the bee activity is normal, then place the empty comb frames in the super box.

Processing comb Honey

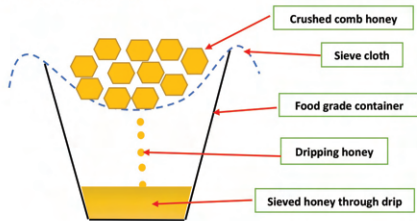
Crushed comb honey can be processed either by using dripping method through a sieve or by using honey press machine or through water bath method then sieving.

(i) Dripping method:

Materials required:

- Bucket
- Clean nylon/cotton net
- 2 sieves
- Knife

Honey Dripping Method



Processing procedure:

1. Tie the sieve on top of the bucket.
2. Cut the honeycombs into small pieces using a knife.
3. Place the crumbled combs on top of the net overnight, and the honey will drain into the bucket gradually.
4. Put the combs with any remaining honey in a separate bucket and smash to extract the honey.
5. Place the smashed combs on top of the net to further drain the honey, you can squeeze the honey out of the combs by pressing.
6. Preserve the already drained honeycombs in a bucket for processing wax later.
7. Leave the extracted honey in the bucket to settle for 24 hours.
8. Then remove the scum or impurities that settle on the top using a spoon.
9. Strain the honey using a double strainer sieve.
10. The honey is now ready for packaging.

(ii) The honey press machine method:

Equipment required:

- Honey press machine
- Uncapping tray
- Uncapping fork
- Double sieve
- Honey jars



Figure 21. Honey pressing machine

Procedure:

1. Put the uncapped honeycombs into the honey press machine.
2. Press the honeycombs, manually or automatically to extract the honey from the combs.
3. Preserve the already drained honeycombs in a bucket for processing wax later.
4. Open the tap of the press machine to drain the honey into a honey vessel.
5. Strain the honey using a double sieve or muslin cloth into a food grade container.
6. Leave it to settle for 24 hours.
7. Remove the scum using a spoon and package the honey appropriately for the market.

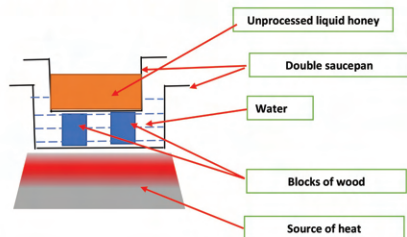
(iii) The water bath method

Equipment required:

- 2 sauce pans/ cooking pots of different sizes
- Unprocessed honey / crushed comb honey
- Water

- Source of heat
- 2 blocks of wood
- Double sieve/ sieve cloth
- Food grade bucket/ container
- Honey jars

The Water Bath Processing



Procedure:

1. Light or put on the source of heat.
2. Pour water in the larger saucepan / cooking pot.
3. Pour unprocessed or crushed honey in the smaller saucepan/ cooking pot.
4. Put the smaller saucepan/cooking pot to stand on block of wood in the larger saucepan/cooking pot.
5. Stir the honey gently as it warms to allow the heat to evenly spread in honey.
6. Put the sieve cloth or double layered sieve to cover the food grade container.
7. Pour honey into the food grade container through the sieves.
8. Allow it to settle for about 24 hours.
9. Remove the scum on top of the settled honey in the food grade bucket.
10. Pack into the jars for the market.



Figure 22. A food grade bucket with a muslin cloth for sieving honey



Figure 23. Centrifuge machine/ Honey extractor



Figure 24. Uncapping fork



Figure 25. Uncapping knife

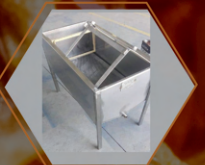


Figure 26. Uncapping tray



Figure 27. Stainless steel double sieve



Figure 28. Food grade bucket



Figure 29. Settling/ Bottling tank



Figure 30. Honey refractometer

3.1.3 Value Addition and Use of Honey

There are various marketable forms of honey:

- i. **Extracted honey (filtered honey)** - Honey that has been finely sieved. Sieved honey may be obtained from extraction or after going through warming



Figure 31. Filtered honey in a jar

- ii. **Comb honey** - This is honey that has been harvested direct from the hive and has not been interfered with. It may be broken into pieces for processing or cut into different shapes and packed as per the preference of the customers. Comb honey can be consumed before any processing and in this state, it is more nutritious since nutrients therein have not been interfered with.



Figure 32. Comb honey from a KTBH.



Figure 33. Comb honey cut into square shape and packed for the market

- iii. **Blended honey** - Honey from different ecological zones from different nectar sources mixed together. This can either be bitter honey mixed with sweet honey or dark coloured mixed with light coloured honey.



Figure 34. A wide range of honey of different colours and from different nectar sources

- iv. **Crystallized honey** - Honey that has solidified. This is a sign of good quality honey. Good quality honey crystallizes in cool weather. To reliquify, stand the container in warm water for the honey to become liquid again.



Figure 35. Crystallized honey in a jar

- v. **Crude honey** - Honey that is crushed before filtering/ sieving, and which still contains impurities.



Figure 36. Crude honey in a food grade bucket

- vi. **Creamed honey** - Crystallized honey that has been crushed.



- vii. **Chunk honey** - Liquid honey and comb honey that has been mixed/ put together in a container



Uses of honey:

The following are common uses of honey: -

- 1) As food
- 2) As a substitute of sugar in cooking and bakery
- 3) It is also used in making alcoholic beverages.
- 4) Used as a drug e.g. cough syrup.
- 5) As a sweetening agent in drugs.
- 6) Used in animal feeding.
- 7) In cosmetics as an ingredient in hand lotions, facial cleansers, etc.
- 8) It is used as a preservative.
- 9) For cultural purposes.



3.2 Processing and Value Addition of Bees Wax

Wax is the material used by honeybees in the construction of their combs. It is secreted by glands possessed by worker bees only. A beekeeper can obtain beeswax for sale by melting whole combs and squeezing them. Combs are melted after honey has been removed. Virgin beeswax immediately after being secreted, is white. It becomes darker with use inside the hive as pollen and larval debris are inadvertently incorporate. Rendered, but untreated beeswax comes in varying shades of yellow. Pure white beeswax on the market has always been bleached. Beeswax is an inert material with high plasticity at a relatively low temperature.

3.2.1 Processing beeswax

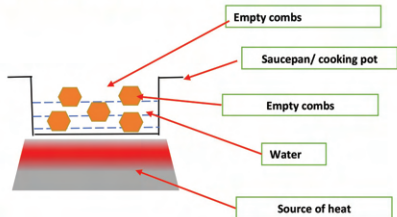
There are three ways of processing beeswax; heating method, solar extraction method and steam melting method.

- a) **Heating method:** This is a process through which combs are heated in water, then the liquid solution is sieved through a cotton bag and left to cool/ solidify.

Equipment & materials required:

1. Empty combs
2. 1 cooking pot/ saucepan
3. Holding bucket
4. source of heat
5. Water
6. cotton bag
7. Two round wooden logs
8. unscented bar soap

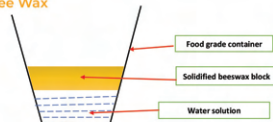
Wax Processing Heating Method



Procedure:

1. Wash the empty combs using fresh cold water; avoid salty water. This is to remove any honey remaining in the combs. Empty combs from the hives after inspection can also be used for the extraction.
2. Squeeze them using your hands to remove water, wash them again and squeeze them to remove water. This water can be used as a supplement in making nutritional porridge, syrup for the bees or traditional drinks.
3. Place them in and add water to submerge the combs.
4. Light a fire and heat the combs inside the water. If you want to clean or mould it, use the double pan method.
5. Stir the combs in the water in one direction consistently. The boiling water will heat the cooking pot with the combs and the water until the combs melt into liquid.
6. Sieve the melted substance using the cotton bag, draining it into a bucket. Hold the cotton bag with wooden sticks to avoid being burnt. You can as well use a double sieve.
7. Leave the sieved liquid in the open bucket for 12 hours to settle.
8. After 12 hours, the liquid will have separated into two layers. The topmost layer is wax, yellowish in color, the second layer is water. If the melted liquid is not completely cleaned of impurities through straining or double sieving, a third layer of scum will be formed at the bottom. The water can be used to supplement the bee food. The scum is usually a black sticky substance, remove all the impurities, then mix with paraffin or glycerin to make a black shoe polish. The scum can also be fed to poultry or used with water as livestock feed supplement.
9. In case the wax still has some debris, re-melt it completely and then use a double sieve to filter the fine wax liquid into a clean vessel.
10. Pour the fine liquid wax while it is hot in molders that have been oiled. You can use containers but ensure to apply oil on their surface before pouring in.
11. Once cooled in the molders, the wax will have solidified. Remove it from the molder and wash it with cold water to remove the oil, then leave it to dry.
12. The wax is now ready for use.
13. Package in materials such as grease proof papers, polythene, jute, or sisal bags.
14. Label to indicate the name and address of the dealer, name and type of the wax, net content, and origin.

Sttled Bee Wax



- b) **Solar melting method:** This is a method where an equipment called solar wax melter is used to extract wax directly from the combs. This method is easy since the process involves putting the combs in the equipment, then taking them out in the sun to melt. The wax is collected from the equipment into a container of choice.



Figure 37. Solar wax melter

- c) **Steam melting method:** This is a method whereby combs obtained from honey processing or empty combs from the hives are taken and placed inside the steam melter machine. It has a compartment where water is placed which produces steaming during heating process and in the long run melts the combs into wax. Below the combs, wood shavings are placed to act as sieve. The machine can be heated by electricity, gas, charcoal or one can be locally fabricated to use firewood. During the melting process, a container which is smeared with soapy water is placed near the outlet to collect the liquid wax and some water from the vapour.



Figure 38. Steam wax melter

3.2.2 Value Addition and Use of Bees Wax

Bees wax can be used to make a variety of household items including the following:

- i. Candle making is the largest use of bees wax as raw material. Candles made of bees wax burn longer, have a nice aroma and are environmentally friendly. There are three types of

candles:

- Ornamental candles
 - Insect repellent candles
 - Aromatic candles
 - Others: Batiks (in clothing and upholstery industries).
- ii. Cosmetics industry: Cosmetics such as lipsticks, lip balms, skin creams, soaps, deodorant, mas cara and hair creams, nail polish, eye pencil, ointments are made from bees wax.
 - iii. Leather industry: Shoe polish, waxing threads are made from beeswax.
 - iv. Bee keeping industry: In bee keeping, wax is used as a starter, comb foundation, lure attractants and is also used in making queen caps.
 - v. Textile industry: Wax is used in designing patterns on fabrics in dyeing boutiques and kiteenge.
 - vi. Food processing: Bees wax is used as a preservative; to protect cheese and some fruits from moulding and further drying.
 - vii. Pharmaceuticals: Bees wax is used in pharmaceuticals to make capsules, pills, drugs, surgical bone works, apitherapy.
 - viii. Making carbon papers.
 - ix. Waterproofing and making crayons.
 - x. Treatment of cracked hooves of livestock.
 - xi. Modelling and statue making.
 - xii. Other uses include making chewing gum, ink, electric insulators and adhesives, as an oil stabilizer, floor and furniture polishes, grafting of trees to stabilize wood glue.

3.3 Propolis

This is a mixture of various amounts of beeswax and resins collected by honeybees from plants, particularly from flowers and leaf buds. It is very difficult for one to distinguish from which plants the bees collect the resins from. It is assumed that in the process of collecting and modelling the resins, they mix with some saliva and other secretions from their mouths and with wax.

These resins are used by worker bees to line the inside of the nest cavities and all the brood combs, seal small cracks in the hive, reduce the size of hive entrance, seal off inside the hive any dead animal or insects which are too large to be carried out and perhaps most importantly, mix small quantities of Propolis with wax to seal brood cells. The bees use the Propolis in such manner due to the advantage of antibacterial and antifungal effects they possess in protecting the colony against diseases.

The composition of Propolis depends on the type of plants accessed by bees. Propolis has different colour, odour and medicinal characteristics due to different sources and the seasons of the year.



Figure 39. Raw propolis

Propolis can only be acquired from the Kenya Top Bar Hive, log hives, box hives and other traditional hives. Very little can be obtained from Langstroth hives.

Equipment required in harvesting propolis from traditional hives:

- i. Hive tools
- ii. Bucket
- iii. Knife
- iv. Propolis trap mat
- v. Smoker
- vi. Bee suite
- vii. Bee brush

Harvesting procedure:

- Light the smoker- ensure you have enough fuel such as wood shaving. Avoid contaminant materials like cow dung.
- Wear protective gear.
- Identify the hive to harvest.
- Start with the less aggressive and finish with the most aggressive.
- Smoke the hive starting from behind then sides and then the front side.
- Open the hive lid using the hive tool.
- Smoke the bees again from the top after opening the hive.
- Scrub the propolis using the hive tool.
- Put them in a bucket and take to the processing room.

Propolis can as well be harvested by using the Propolis screen. The screen is placed under the inner cover of a Langstroth hive, left for some time for the bees to propolize after which the beekeeper removes the propolis screen from the hive and scraps the propolis into a container.

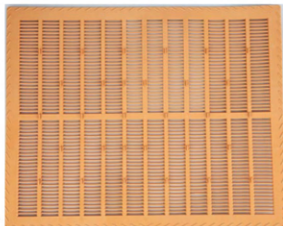


Figure 40. Propolis collector

3.3.2 Processing Propolis

Requirements:

- i. Water
- ii. Source of heat
- iii. Sieve
- iv. Buckets
- v. Propolis

It is advisable for farmers to preserve the propolis in its raw form to maintain its content quality.

Procedure:

- Place the harvested propolis in a cooking pot and add clean water to cover the propolis.
- Heat over a hot water bath until it liquifies while stirring.
- Remove from hot water bath while in liquid form.
- Sieve to remove impurities.
- Leave it to cool for some hours until it forms two layers with water on top layer and propolis at the bottom and in soft form.
- Drain the water layer for further use. It can be used as feed supplement for poultry and dairy and as cough syrup in humans.
- The propolis is then preserved in a dark container placed in cold water, fridge, or freezer to solidify.

3.3.3 Use of Propolis

Propolis is used in the following areas:

- i. Cosmetics: It is used in making dermatological creams such as those applied to enhance tissue regeneration and renovation, anti-aging and antibacterial/antifungal body creams.

- ii. **Medicine:** Propolis is used in dental care; as a deodorant, wound healing, treating respiratory infections/colds, making propolis tincture and tablets, treating burns and external ulcers and treating stomach ulcers.
- iii. **Bee keeping:** As a swarm lure and as an antibiotic in beehives.
- iv. It is used as a food additive and preservative.
- v. It is also used in tree grafting.
- vi. It is used in mummifying human bodies as a preservation measure.

3.4 Pollen

Pollen grains are small, male reproduction units formed in the anthers of the flowering plants. Each pollen grain carries a variety of nutrients and upon arrival at the stigma, it divides into several cells. These cells grow a tube through the often very long stigma of the flower. The pollen is transferred onto the stigma of a flower (a process called pollination) by either wind, water or various animals (mostly insects).



Figure 41. Pollen grains collected by honeybees

Pollen is valued as a health food; it contains 30% protein, 30% carbohydrates, 5% fat and many minor constituents, so it is potentially a useful source of nutrition. The pollen which is collected by beekeepers and used in various food or medicinal preparations is no longer exactly the same as the fine, powdery pollen from the flowers. The pollen grains per flower are collected by the honeybees and packed into pollen pellets on their hind legs with the help of special combs and hairs. During the pollen collection trip, one honeybee can only carry two of these pollen pellets.

The pollen collected by honeybees is usually mixed with nectar or regurgitated honey in order to make it stick together and adhere to their legs. The resulting pollen pellets harvested from a bee

colony are therefore usually sweet in taste. Certain pollen types however, are very rich in oils and stick together without nectar or honey. A foraging honeybee rarely collects both pollen and nectar from more than one species of flowers during one trip. Thus, the resulting pollen pellet on its hind leg contains only one or very few pollen species. Accordingly, the pollen pellet has a typical colour, most frequently yellow, but red, purple, green, orange and a variety of other colours also occur.



Honey bees covered with pollen grains



3.4.1 Harvesting/Collection of Pollen

Pollen is relatively simple to harvest from the hive using a pollen trap fitted to the hive entrance. When the bees pass through the trap, a grid knocks the pollen out of the pollen baskets on their back legs and it falls into a tray from which it is collected.

Extreme care should be taken that pollen is not contaminated by bees collecting from flowers treated with pesticides. Since a pollen pellet is collected from many flowers, even small quantities of pesticides per flower can be accumulated rapidly to reach significant concentration.

Pollen pellets are removed from the bees before they enter the hive. There are many designs of pollen traps whereby some are easier to clean and harvest, others are more efficient or easier to install. Bees are ingenious in finding ways to avoid losing their pellets, like small holes or uneven screen and may even rob pollen from the collecting trays, if access is possible. Under some circumstances, pollen collection methods and regimes may interfere with normal colony growth or honey production. Therefore, pollen collection should be for a short time then the pollen trap is removed to allow the honeybees to take the pollen inside the hive for broods and the colony.

Required tools and equipment:

- i) Beesuit
- j) Smoker
- k) Pollen trap
- l) Screws and screwdriver

Procedure of pollen harvesting/collection

- a) Light the smoker using the right fuel like wood shavings. Wood shaving can be from Cyprus tree or pine.
- b) Properly put on a bee suit and ensure there is no opening that will allow the bees to pass through.
- c) Identify the hive to harvest pollen from.
- d) Fix the pollen trap and ensure that there is no other opening except through the trap. Ensure that the bees are collecting pollen during the installation.
- e) Smoke the hive starting from behind then sides and then the front side. Avoid over smoking the bees.
- f) Leave the pollen traps on the hive for few days then come back later to pick the trap and transfer the pollen pellets into a clean dry container and cover tightly.



Figure 42. Smoking the bees to calm before fixing the pollen trap



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Figure 43. Fixing a pollen trap at the entrance of the hive

3.4.2 Processing Pollen

Processing of pollen entails drying of the grains to less than 10% moisture content as soon as possible after harvesting. A simple method uses a regular light bulb (wE and 110V or 20W and 220V) suspended high enough above a pollen carton or tray so that the pollen does not heat to more than 40 or 45°C. For solar drying, the pollen itself should be covered to avoid direct sunlight and overheating.

After drying, the pollen needs to be cleaned of all foreign matter. A tubular tumbler made out of a wire mesh with a fan can clean considerable quantities of pollen pellets.

3.4.3 Uses of Pollen

- As medicine** – Pollen is used for treatment of various prostate problems. It is usually prescribed in its dry pellet form as collected by the bees.
- As food** – Pollen has been used as food or food supplement.
- In cosmetics** – Pollen has been included in some cosmetics for rejuvenating and nourishing effects for the skin.
- For pollution monitoring** – Experiments have shown that pollen collected by honeybees reflects environmental pollution levels when examined for metals, heavy metals and radioactivity. Contaminants can be quantified and sampling may be cheaper than most standard methods currently in use.

3.5 Bee Venom

Venom is considered as poisonous as it may lead to death in case of bites or stings. In case of insects, the venom causes pain when injected in the skin. Besides all these bad characteristics, the venom has many useful applications. The honeybee has sting through which it injects venom in the body of the enemy.

Honeybee venom is produced by two glands associated with the sting apparatus of worker bees. Its production increases during the first two weeks of the adult worker's life and reaches a maximum when the worker becomes involved in hive defense and foraging. It diminishes, as the bee gets older. When a bee stings, it does not normally inject all of the 0.15 to 0.3 mg of venom held in a full venom sac. The bee only loses its sting when it stings an animal with tough skin like human and with its whole sting apparatus, including the venom sac, muscles and the nerve centre. These nerves and muscles however keep injecting venom for a while, or until the venom sac is empty. The loss of such a considerable portion of its body is usually fatal to the bee.

Honey bee venom is a clear, odourless, watery liquid. When coming into contact with mucous membranes or eyes, it causes considerable burning and irritation. Dried venom takes on a light yellow

colour and some commercial preparations are brown, this is thought to be due to oxidation of some of the venom proteins.

Venom contains a number of very volatile compounds which are easily lost during collection. The bee venom is composed of enzymes, proteins, peptides, physiologically active amines, amino acids, sugars, phospholipids and volatile compounds.



Figure 45. Bee venom collector

3.5.1 Harvesting/Collection/Extraction of Bee Venom

One must take utmost precautions during the bee venom extraction. Extraction or collection or harvesting of bee venom requires high skills and equipment and therefore not to be done by any beekeeper. High level training and the right infrastructure should be considered.

Different extraction or collection methods result in different compositions of the final product. Venom collected under water to avoid evaporation of very volatile compounds seems to yield the most potent venom.

The bees get shocked, irritated and release venom by inserting the sting into a thin nylon cloth below the copper wires. Venom is deposited on a glass plate placed below the nylon sheet. The venom on drying is scrapped from the glass plate.

Venom collected from surgically removed venom sacs showed different protein contents from that collected with the electroshock method.

The various trap designs stimulate bees by applying a mild electric shock through wires above the collecting tray. The most widely used designs are modified.



Figure 46. Collection of bee venom from a colony

3.5.2 Processing

After collection of bee venom, there is no further processing that takes place except putting it in a dark bottle in a dark place. The bee venom should be stored refrigerated or preferably frozen.

Dried bee venom can be kept frozen for several months, but should not be kept refrigerated for more than a month.

Liquid venom and diluted venom can be stored for similar periods if maintained in well-sealed dark glass containers.



Figure 47. Royal jelly extraction machine

3.5.3 Uses

Bee venom is generally used for medicinal purpose.

Application methods for bee venom include natural bee stings, subcutaneous injections, electrophoresis, ointments, inhalations and tablets.

3.6 Royal Jelly

Royal jelly is secreted by the hypo-pharyngeal gland of young worker bees, to feed young larvae and the queen bee. Royal jelly is always fed directly to the queen or the larvae as it is secreted, it is not stored. This is why it is not a traditional beekeeping product. The only situation in which harvesting becomes feasible is during queen rearing, when the larvae destined to become queen bees are supplied with an over-abundance of Royal jelly. The Queen larvae cannot consume the food as fast as it is provided and Royal jelly accumulates in the Queen cells.

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



Figure 49. An image showing production of Royal jelly production.

3.6.1 Harvesting/Collection of Royal Jelly

Royal jelly is produced by stimulating colonies to produce queen bees outside the conditions in which they would naturally do so (swarming and queen replacement). It requires very little investment but is only possible with movable comb hives.

Expert personnel are required, who are able to devote considerably more time than is commonly required for the production of other bee products. Without this prerequisite it is possible to only occasionally collect the contents from cells of natural swarms – and this amounts to no more than a gram or two per hive.

A well-managed hive during a season of 5 to 6 months can produce approximately 500gms of Royal jelly. Since the product is perishable, producers must have immediate access to proper cold storage in which the Royal jelly is stored until it is sold or conveyed to a collection centre. A special hive modification may facilitate the work according to preferences, and centrifugal extractors for Royal jelly may be used for large scale production. Feeding with sugar syrup (1:1 in sugar to water) increases cell acceptance, even when flowers are available.



Figure 50. Extraction of Royal jelly from artificial queen cells

Requirements in royal jelly extraction:

- Movable hives
- Queen excluders
- Queen cups (made from wax or plastic)
- Transfer needle
- A spatula or suction device to remove Royal jelly
- Dark glass vials and
- Refrigerator.

Steps in Royal jelly extraction:

- Put on protective gears (bee suit).
- Pull out one of the frames and sweep away the bees.
- Take the frames somewhere away from the beehives (probably in the processing room).
- Use a knife to cut the open narrow part of each of the cells.
- Pull the larvae out of the cells using tweezers or small forceps.
- Remove the remaining royal jelly from the cells with a small spatula.
- Place the royal jelly into a glass storage container.

3.6.2 Processing/Extraction of Royal Jelly

Royal jelly is usually processed in a very hygienic condition and facility. Mature queen cells with 3 days old larvae must be brought quickly into the extraction room.

The open narrow part of the cell is cut to facilitate and speed up extraction.

The larvae is then removed with a pair of soft forceps, taking care not to harm them and contaminate the jelly.

The Royal jelly is then extracted by emptying each cell with a small spatula, by sucking it up with a

special mouth operated device, with a pump-operated device or by centrifugal extraction. Following extraction, the cells are immediately returned for another rearing cycle.

3.6.3 Uses of Royal Jelly

Royal jelly is used as:

- A dietary supplement
- An ingredient in food products
- As ingredient in medicine-like products
- An ingredient in cosmetics.



CHAPTER 4: MARKETING OF BEE PRODUCTS



Marketing involves promoting and selling products. This involves market research to identify existing opportunities for consumption of these products, advertising to communicate to potential buyers of the availability of the products and their benefits. For beekeepers to enjoy the benefits of their enterprise maximally, they must be aware of the industries that use the products they make out of this enterprise, and network to channel them to these industries, for a consistent market. The following are the industries that use bee products as a raw material, cosmetics, leather, batik, medical and food industries.

As already analyzed in previous chapters, bee products are usable in an array of industries in Kenya and most African countries. Research shows that honey produced in Kenya is not enough for these industries and large amounts are imported to supplement the available amount. The question is, why are local farmers shy of venturing in beekeeping enterprise yet, there is evident that the market is available.

The following are the gaps identified that present challenges for beekeepers in Kenya especially in marketing:

Challenges in marketing honey and other bee products:

- Most farmers lack knowledge on major production and processing procedures of bee products.
- People fear handling the bees, hence leaving the critical decisions to hired apilary attendants, who hold beneficial information from the farmer for their own benefit.

- There are few bee experts.
- There are no regulations on pricing that has contributed to high costs of bee products.
- Farmers are getting low market deals in the market.
- Farmers are not in cooperatives which limits their access to stable markets.
- The majority of the farmers sell bee products in crude forms.
- The accessibility of packaging bee products is a major problem to farmers because of lack of knowledge and capital to buy food grade containers.
- Poor branding of honey and other bee products for the available markets.
- Lack of market regulatory systems in the beekeeping industry.

Opportunities: Marketing of other bee products including bees wax, propolis, pollen, bee venom, royal jelly, bee colonies, value added products (yoghurt, juices, cakes, medicines.) Value added products from basic bee products can increase household incomes.

Marketing of Bee Products

A. Honey:

Currently there is a very high demand for honey both at home and overseas. Good quality honey can fetch a high price. Any farmer who has the good fortune and the skill to obtain honey will have no trouble selling it. In general, if the honey is presented to the consumer in a clean, unspoiled condition, the price will be higher. Beekeepers should aim for the highest grade of honey to maximise returns from beekeeping.

Packaging and labelling:

Package honey in either food grade plastic or glass jars which should be clean and dry. 454g jars are available in Kenya from suppliers in Nairobi and other major towns as are plastic trays for selling comb honey. (see appendix 5 for the contacts of suppliers).

Labelling must include:

1. The net weight of honey,
2. The name and address of the producer,
3. The country of origin (Kenya) and
4. A description of the contents, e.g 'Pure Honey'.

Initially, you can draw out a simple label by hand or on a computer. This can be photocopied. Later you can have a more attractive label printed, but this is costly and requires a lot of jars to be produced to spread the cost.

Kasuku/Kimbo plastic containers or tree top bottles (700mls) are often used to sell honey. **Metal Paint tins** (*Mikebe ya rangi*) should be avoided. Honey is acidic and can erode the metal and spoil the honey.

Where to sell the honey:

You can sell your bottled and labelled honey direct to shops. Try and build up a name for supplying the right quality, in the right quantity at the right price on time.

Many beekeepers develop a reputation for beekeeping and people flock to the beekeeper's home to buy the honey. If you are enterprising you can even set up a shop of your own selling bee products. Then you could also buy and sell honey from other beekeepers. A shop (or kiosk) located in the right place such as the market or along a busy route can attract a lot of customers.

You can also consider the option of forming a beekeeping association to market the bee products of farmers in your area. An example is the Kakamega Forest Beekeepers Association or the Transmara Association of Beekeepers (TAB).

Also, you can consider the option of starting a co-operative. An example of a successful beekeeping co-operative is Rual Beekeeping Co-operative Society, Naru Moru, (see appendix 5) which markets 8 tonnes of honey collectively per annum.

The advantage of farmers marketing together is that if such fixed costs as transport are required, then these costs can be spread over a larger quantity of honey hence, reducing the cost. Collective selling gives farmers access to further away higher priced markets such as Nairobi.

In summary, whatever type of honey you produce you can easily find a market for it in Kenya and the price you will receive compares favourably with prices available elsewhere in the world.

B. Beeswax

Unfortunately, in Kenya most wax combs are thrown away on harvesting or after honey extraction. This is because beekeepers in general do not know its value. Local village uses for beeswax in Kenya are limited to such things as shoemakers repairing shoes. Some Kenyan companies such as Bata shoe company and Kiwi shoe polish purchase beeswax from beekeepers or honey processors.

Baraka College (address in appendix 5) buy clean beeswax cakes among other buyers. You can also use your beeswax to make some of the recipes in appendix 4 such as candles.

C. Propolis

Export markets for propolis do exist (see appendix 5 for the address of a buyer). Propolis is used as a medicine and is sold in capsule form, as an ointment or as a tincture (dissolved). Propolis can also be chewed raw as a medicine for the throat and is on sale in very limited quantities in this form in major towns. When harvesting simply scrape off the propolis and store it in an airtight container. You can also try making some medicine from propolis such as propolis ointment.

CHAPTER 5: STARTING A BEEKEEPING ENTERPRISE - COSTS AND PROFIT

The figures are based on 20 KTBH hives per farmer. Equipment costs are based on the National Beekeeping Station's bee equipment workshop, Nairobi (Nyuki newsletter, December 2005).

The farmer can add significant value if he/she sells honey in Jars or bottles. This is realistic in many parts of Kenya where there is a very strong local demand for honey with high prices. In other parts of Kenya where the local production is high sale of semi-refined honey in bulk at a lower price to middlemen is the norm. In remote areas of the country honey prices tend to be low but hive numbers are much higher – in particular in semi-arid areas where individuals can own hundreds of traditional fixed comb hives.

An average production figure of 20kgs per occupied hive is an achievable figure for most farmers. However this could increase to 30kgs or more per hive depending on the area and the management of the bees. In particular if swarming is controlled and production of honey maximized. An occupation rate of 80% would mean 16 hives out of the 20 are in production which is a good occupation rate by Kenyan standards. Having said that there is no reason why 100% occupation rates cannot be achieved with some effort on the part of the farmer to ensure hives are occupied.

In this example we take an average farmer with 20 KTBH hives with an 80% occupation rate producing an average of 20kgs per occupied hive. The farmer harvests and sells the honey in bulk at a price of 100Ksh per kg with no value addition. This example is not the best farmer or the worst but an average situation.



Table 5: Costs of starting a 20 KTBH beekeeping business

A. Expenditure:	Cost (Ksh)
Cost of buying 20 Kenya top bar hives @ 1,650 each	33,000
Cost of buying a bee suit @ 2,370	2,370
Cost of buying a smoker @ 500	500
Cost of hanging posts (25) @ 150/post	3,750
Labour @ 5ksh/kg harvesting 20kg/hive/16 occupied	1,600
Cost of grease and other miscellaneous	500
Total Expenditure:	41,720

- Estimated honey production from one colony = 20Kgs
- Total honey production from 16 occupied hives = 320kgs
- Estimated price of one Kg of honey in 2006 = 100ksh/kg
- Estimated income from 16 occupied hives = 32,000Ksh

Net Income year one = 32,000 - 41,720 = (9,720) A negative of nine thousand seven hundred and twenty.

Equipment will have a life span of 5-10 years or more depending on maintenance so in second and subsequent years capital costs have been paid and net profit from the enterprise will be much higher as seen below. The question is how do poor farmers finance the capital costs to get started? The important thing in beekeeping is that a farmer can start beekeeping using simple hives made from local materials (such as the mud stick hive/or simple box hives/pots etc). Therefore, it is not necessary or advisable for a farmer to take a loan to get started (unless you are absolutely sure you can make the hives produce for you – this certainty comes from experience). Start slowly, learn as you go along and once you have learnt the ropes, then you can expand. Many farmers in Kenya who have purchased expensive frame hives on loan have ended up repaying the loan from other means as the hives hardly produce enough to cover all costs on the start. With the recent promotion of the Langstroth hive – there is a belief that the hive will automatically produce honey and lots of it – **BE WARNED THIS IS NOT THE CASE!!** The Langstroth will only yield well with good management.

Gross Margin Analysis:

The following is an analysis of beekeeping versus a major other source of livelihood in Kenya, maize production. The figures for maize production are from the Mount Elgon District Farm Management Guidelines (Obino 2004). The figures used for beekeeping are from an apiary in Nakuru District Kenya.

The table below looks at the same beekeeping enterprise above minus the capital costs. It also looks at the enterprise at different production levels – low, medium and high. Low is 10kgs per occupied

hive/annum. Medium is 20kgs per occupied hive/annum and high is 30kgs per occupied hive/annum. The sale price of honey is estimated at 100ksh/kg. This price can easily be increased through value adding to the honey by packaging. Indeed, many farmers in Kenya can sell honey in raw form for 150Ksh per kg or more to their neighbours – e.g. beekeepers in Lare area of Nakuru District.

Table 6: Gross Margin analysis of beekeeping

Description	Production Level		
	Low (10KGS)	Medium(20KGS)	High(30KGS)
A. Production			
a) Yield per hive x 16	160	320	480
b) Price per Kg honey	100	100	100
Gross Output (a x b)	16,000	32,000	48,000
B. Variable costs			
Labour	1,000	1,500	2,000
Grease and other Miscellaneous	500	500	500
Total Variable Costs	1,500	2,000	2,500
Gross Margin/16 occupied hives	14,500	30,000	45,500

Table 7: Gross Margin for a Hectare of Maize (Pure Stand): (Obino 2004)

Description	Production Level		
	Low	Medium	High
A. Production			
a)Yield of maize (90kgs bag)	20	50	87
b) Price of maize	1,100	1,100	1,100
Gross Output (a x b)	22,000	55,000	95,700
B. Variable Costs			
Total variable costs	18,111	26,273	50,707
Gross Margin/Hectare	3,889	18,728	44,994

Source: Kenyan Ministry of Agriculture

From the above comparison a beekeeping enterprise of 20 KTBH hives compares very favourably with returns from a hectare of maize (in particular at low levels of efficiency in maize production). In addition, a beekeeper has the option of value adding to his/her honey to increase returns while a maize farmer is more at the mercy of market forces where gluts in production frequently depress prices.

Organic Certification of Honey Production

The organic market, whether certified or not, will require the implementation of the following requirements:

- Use natural wax only (from own production) that is free of any residues for your hives.
- Work with a reasonable number of apiaries, depending on the availability of labour and forage.
- Avoid installing the apiary near agricultural areas with intensive use of synthetic pesticides and fertilizers and with GMO crops such as maize and soybean.
- Use natural substances only to paint the hives and make sure all treatments are according to the standards.
- Use natural and organic feed only for supplementary feeding of the bees.
- Refrain from practices that modify the natural behaviour of the bees, e.g. clipping the wings of the queen.
- Protect the hives from direct sunlight, rain and excessive heat.
- Minimise the risk of contamination and adulteration by clearly separating organic and non-organic honey and ensure traceability by properly labelling all batches.
- Use only stainless steel or food grade containers for storage.

For honey producers, who want to be certified, the specific national or international organic standards define additional requirements for production and processing of organic honey. The national organic movement or organic certification bodies operating in the country can provide further guidance and support for organic certification.



CHAPTER 6: REGULATIONS IN BEE KEEPING

Beekeeping in Kenya is regulated through various policies in the agricultural sector. Some of these include:

- Draft Livestock bill 2021
- Sessional Paper number 2 of 2022 vet policy
- Vision 2030
- Agricultural sector, transformation, and growth strategy
- Animal diseases act
- Agriculture act
- Customs act
- County Integrated Development Plans (CIDP).
- Sessional paper number 7 of 2013 on national bee keeping policy

References

- i. FIBL African Organic Beekeeping Training Manual
- ii. Beekeeping Training for Farmers in the Himalayas
- iii. The National Beekeeping Training and Extension Manual

Resourceful Institutions on Beekeeping:

- i. National Bee Keeping Institute
- ii. State Department of Livestock (County and National)
- iii. Apiculture Platform of Kenya (APK)
- iv. National Museums of Kenya
- v. KALRO ABIRI (Apiculture and other Beneficial Insects Research Institute)
- vi. ICIPE
- vii. KEFRI
- viii. Kenya forest services (KFS)
- ix. Biovision Africa Trust – Infonet Biovision

