LAKE VICTORIA ENVIRONMENTAL MANAGEMENT PROJECT-II

TRAINING MANUAL IN BASIC APICULTURE PRACTICES

BY

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Introduction

The honey bee, *Apis mellifera* L., is a well adapted insect with great economic importance and exists in different ecological conditions of the world (Ivanova et al, 2010). It is a valuable insect, known for its importance as a pollinator and honey producer (Strauss et al, 2013).

The beekeeping industry is an important component of agriculture and economic enterprise worldwide, generating employment and increasing family income in the rural areas. In addition to the products produced from apiculture such as honey and beeswax, the most important aspect of honey bees is the vital role they play in the environment by pollinating both wild flowers and many agricultural crops as they forage for nectar and pollen. By doing so, honeybees contribute to food security and biodiversity conservation (Chemurot et al, 2016).

SECTION 1

Sub-section 1: Apiary Establishment

An apiary is a place where bee colonies are kept in a neat and organized way. Beekeeping in modern times involves selecting particular places following particular criteria where the bees will be kept and also having specially designed hives in which the bees will stay.

Factors to consider when selecting an apiary site

The ideal apiary site should be;

i. away from play grounds, noisy commercial or industrial areas as well as homesteads.
ii. near a fresh water supply for example a river bank, lake or pond.
iii. near food sources that is melliferous plants for collection of both pollen and nector should be within the apiary site or the vicinity.
iv. fairly dry, away from swampy or flooding valley or any bottom land with stagnant water (humid areas promote fungal diseases and prevent proper maturation of honey.
v. accessible to good roads
vi. away from danger of vandalism and unfriendly neighbours.

vii. have sufficient shade.
viii. away from farmlands where there is constant use of agricultural chemicals.

After the apiary site has been selected and it conforms to the above factors, it should be cleared of unwanted bushes and over hanging tree branches pruned. The cut grasses, tree branches and dry wood should also be removed and burnt as they breeding grounds for a number of pests especially ants.

Sub-section 2: Beekeeping equipment

There are various tools and equipment which are used by beekeepers. These can be classified into protective equipment, hives, inspection and harvesting equipment as well as processing equipment.

a) Protective equipment

These are basically for protecting the beekeeper against getting stung while working with his colonies. They include the bee suit, gum boots and gloves.

i. The bee suit

- This should be made with strong khaki material to avoid bee stings from getting close to the beekeeper's body.
- It should be free size and not body hugging.
- It should have a head veil with netting in front of the face to allow the beekeeper see what he is doing.
- Zips instead of buttons should be used to close off any openings.

ii. Gloves

These should be rubber in nature

iii. Gum boots

These should also be rubber boots.

b) Hives

With the increasing interest in beekeeping and the growing demand for bee products and services, bees can no longer be maintained in their few natural

dwelling places but must be provided with special artificial hollows in the form of bee hives. Bee hives are categorized into traditional and modern.

i) Traditional Hives: These are simple purpose built containers made from locally available materials such as clay, bamboo and grass some of which would otherwise be wasted. They cannot be easily manipulated because bees fix combs to the hive body. Combs cannot be inspected at all and detached combs cannot be easily replaced. Examples are log hives, basket hives, clay pot hives, gourd hives etc.



Figure 1: A log hive

ii) Modern hives: These are hives which use movable top bars or frames in a hive box. The frames/ top bars are arranged in such a way that they can be removed individually without disturbing other combs and without crushing bees, and the sides and bottom of the frame/ top bar provide very good support for the comb. For purposes of this discussion, we shall limit ourselves to the Langstroth hive and the Kenya top bar hive since they are the ones that were supplied by the project.

- **The Kenya Top Bar Hive:** This is a wooden hive box with two trapezoid ends**,** a lid and top bars on which the bees build their combs. Hive entrances can be small round holes of about 8-10mm diameter at the front of the hive to allow free entry and exit of bees. It is a relatively cheap and simple hive that allows beekeepers in the tropics to manage their bees in a more efficient way than with the traditional hives.



Figure 2: A top bar hive

Advantages of the top bar hive

i. It is cheaper and easier to produce than a frame hive. Any semi skilled carpenter can make it, only a few simple carpentry skills are required.
ii. There is little or no need to import anything. All materials required can be obtained locally.
iii. The size of the hive can vary to suit the local conditions.
iv. Hive inspection with this type of hive is simple since the top bars are movable.
v. More bees wax can be produced with this type of hive for which there is a ready market.
vi. There is no need to employ a queen excluder. In practice the bees keep their brood chamber separate from the honey combs. Clean honey can be taken away leaving brood combs undisturbed.
vii. If there are predators, hives can be suspended on wires.
Viii. Honey production can be higher than in the traditional hive i.e. about 30kg of honey annually

Disadvantages of the top bar hive

i. A newly constructed comb and all combs filled with honey and brood need to be handled with utmost care to avoid breakage. It is not advisable

to move a top bar hive occupied by bees and combs on trucks along bad roads.

ii. Honey can only be extracted by destroying the combs using a honey press. Bees have to build up new ones in their place and this takes time, material and resources for the bees.

❖ **The Langstroth hive:** This hive was named after Lorenzo Lorraine Langstroth, its inventor. It is also called a frame hive as it uses frames for comb building by the bees. The frames are arranged in such a way that they can be removed individually without disturbing other combs and without crushing bees, and the sides and bottom of the frame provide very good support for the comb.

It is composed of several hive boxes stacked together, one above another and that the queen can be confined to the lowest (brood chamber) by means of a queen excluder. In this way, the upper chambers (honey supers) can be reached only by the workers and therefore there is no mixing of honey and brood. This makes inspection and other management practices like harvesting much easier as compared to other hive types.



Figure 3: Sited Langstroth hives

Advanatages of using the langstroth hive

i. The comb is fixed firmly to the four sides of the frame. This facilitates easy harvesting and there are minimal chances of damaging the comb.
ii. The strength of the built-in comb allows easy transportation, even over bad roads.

iii. Honey is extracted by means of the centrifugal honey extractor which makes it possible to remove the honey without damaging the comb.
iv. Empty combs can be returned to the hive for the bees to refill with new honey, thus saving the bees from wasting time and energy to construct a replacement comb.
v. The hive is designed with a queen excluder so that the queen and brood are confined in the brood chamber.
vi. The brood chamber isnot disturbed when honey is harvested.
vii. The hive can easily be expanded or reduced through addition or removal of supers.

Disadvantages of using the Langstroth hive

i. It is an expensive hive to purchase.
ii. A high degree of craftsmanship is required to build this type of hive.
iii. Sophiscated equipment like centrifugal extractors, decapping knives etc is needed to extract honey from such hives. This equipment is equally expensive and in most cases imported as is the case in Uganda.

c) Inspection and harvesting equipment

This includes an assortment of equipment like a smoker, hive tool, bee brush and airtight buckets (white in colour)

i) Smoker: Smoke produced calms down bees by masking the smell of the bee alarm pheromone



Figure 4: A smoker

ii) Hive tool: Used for opening bee hives during honey harvesting and inspection. Can also be used to cut honey combs or removing propolis.

Figure 5: A hive tool



iii) Bee brush: This is used to brush off the bees from the combs for proper inspection.

Figure 6: Bee brush

iv) Airtight buckets: Used for keeping honey during harvesting and processing



Figure 7: Honey Bucket

d) Processing equipment

These are used for extracting honey from the combs and processing bees wax. They include;

i. Honey press

ii. Centrifugal extractor

iii. Settling tanks

iv. Solar wax melter







Sub-section 3: Hive Baiting, Installation and Colonization

a) Hive Baiting: Once the beehives and site have been acquired, the hives must be baited so that bees are attracted to occupy them on installation.

- Clean the beehive so that it is rid of any dirt, cob webs or insect which might arrest any scout bee visiting the installed hive in the near future.

- Bait the beehive with any **one** of the following materials; melted bees wax, dry cassava flour, a sweet syrup such as molasses, cow dung (mainly for traditional hives), lemon grass burnt from within the hive etc.

How to bait using bees wax in KTBH

The best bait for attracting bees quickly is bees wax. This is because it retains its properties for longer times especially smell. This property lacks in the other bait materials mentioned above and must be continually replenished or replaced when the old supply is exhausted or destroyed.

Procedure

- Melt a small cake of beeswax in a saucepan.
- Using a spoon scoop the molten beeswax and pour it along the ridged portion of the wooden top bars. This will also guide the bees to build their combs along it.
- Also rub some wax against the inner walls of the hive.
- After this put back all the top bars correctly, cover the hive and it is ready for installation.

b) Hive Installation: This is the placement of hives in the apiary. Various techniques are employed by beekeepers when siting their hives. A hive can be suspended on wires for example between two trees/poles or from sturdy branches of big trees. It can also be installed on a stand. The stand can be constructed with bricks, metallic, wooden or a rock depending on the beekeeper's capabilities. The advantages and disadvantages of the two methods are set out below.

Advantages of hanging beehives

i. It is cheaper to hang a beehive than to install it on a stand.
ii. The lizard, an important hive predator does not seem to pose a serious danger.
iii. Cattle and other grazing animals cannot tip the hive over,
iv. Running water cannot carry away the bee hive.
v. It is easier to prevent ants from reaching the hive than when it is installed on a stand.

vi. A thief really steals a KTB that is suspended especially when it contains honey because it's not east to remove the suspension wires.

Disadvantages

i. A suspended hive can swing and this makes the bees to be under continuous irritation.
ii. Honey harvesting and brood nest inspection can sometimes be difficult when the hive is swinging.
iii. It is not easy to change the location of a suspended hive.

Advantages of installing a hive on a stand

i. It is easier to place a hive on a stand and remove it.
ii. It is easy to move both hive and stand (if not fixed in the ground) to another spot.
iii. The bee hive does not swing about even if the beekeeper is working.
iv. Honey harvesting and inspection are easier.

Disadvantages

i. Grazing animals can knock the hive over
ii. The legs of the stand can easily be used by lizards and rats to reach the hive unless they are protected by rat guards.
iii. It is more expensive and tedious to make a reliable stand than to buy a metallic wire for hanging a hive.
iv. Easy movement makes it to steal hives installed on stands.

c) Hive colonization: After the beehive has been baited and installed, the beekeeper usually waits until a swarm of bees comes to settle in the hive. However, this is not automatic and the time required varies widely depending on location, season and number of feral bee colonies within the locality. Several other approaches have been employed by beekeepers to ensure colonization and these include;

- Swarm capturing
- Removing wild bees from their nest and hiving them
- Division of existing colonies
- Queen rearing

SECTION 2: APIARY MANAGEMENT

Now that our apiary is well established with colonized hives, it needs to be well managed for it to be productive.

Apiary Management is the process of organizing, controlling, directing and supervising all the resources in the apiary to ensure maximum production and sustainability. The resources in the apiary may include all the equipment, the forage, the human resource, land and the bees themselves.

Sub-section 1: Hive / Bee Management

Beekeeping just like any other farming enterprise requires follow up on a number of aspects for it to be a success. It calls for practices which are vital for the survival and well being of every bee colony. For proper management of bee colonies, regular inspection is recommended to help the beekeeper know how his colonies are progressing.

Why colony inspection?

It helps the beekeeper to;

i) Know if honey is being prepared and capped regularly.
ii) Know whether the colony is getting ready to swarm
iii) Know whether the hive has been attacked by pests and diseases
iv) Check for queen presence
v) Check for colony build up and brood rearing

How to examine/inspect a bee colony?

The general rules for hive inspection and honey harvesting are the same and thus can be used interchangeably. This procedure applies to both KTB and Langstroth hives.

- Light the smoker so that it produces good smoke. The fuel used should enough to last the entire operation. Examples of fuel to be used in a smoker are carpenter's wood shavings, dry cow dung, dry leaves and grass.

- Wear protective clothing and cover the body entirely. Ask another person to cross check and ensure all the zips are well fastened.
- Beekeepers should always work in pairs in such a way that as one is operating the smoker, the other is inspecting the combs and the colony generally.
- Puff smoke gently around the hive and through the entrance holes. Wait for around three minutes before opening the hive.
- Using the hive tool or knife, open the lid of the hive and puff more smoke. Using the hive tool or knife, open the top bars/frames starting from the back of the hive (i.e side without entrance holes) as you continue with puffing smoke.
- Remove the top bar/ frame with the first comb and inspect. If it is a brood comb, check to see if the cells have eggs, larvae or sealed pupae and also if the pattern is regular. Presence of eggs confirms presence of the queen even without seeing her.
- If it is a honey comb, check to see if the cells are fully sealed/capped (ripe honey), partially sealed or not unsealed at all (unripe honey).
- Replace the comb the comb even if it is fully capped with honey; it can be removed later during honey harvesting operations when the necessary equipment is available.

Sub-section 2: Management of Bee Stings

Honey bees are feared world over mainly because their painful sting. Even though stings and bee venom can in extreme cases cause death, honey bees should not be considered dangerous. It should also be noted that bee stings can treat diseases like arthritis.

What causes bees to sting?

- Opening hives during the warm part of the day
- Opening hives without smoke
- Visiting the apiary after taking alcohol
- Wearing cosmetics made out bee products like wax and have strong odours
- Standing in the flight path of bees
- Making noise when in the apiary

In case one is stung, smoke the affected area to disguise the alarm pheromone so that other bees do not attack. If unprotected, move out of the apiary as soon as possible. If protected continue smoking as a way of calming down the bees.

Sub-section 3: Bee Forage Management

Many species of trees and shrubs are good for bees. Not only do they provide nectar and pollen but also shade for the bee colonies. It is always important to consider plants that can flower almost throughout the year when establishing an apiary so that your bees have a steady and continous supply of forage. Examples of bee forage plants include Caliandra (*Caliandra calothysus),* Bottle brush, various fruit trees and other seasonal crops like sunflower. However, for the forage to provide enough pollen and nectar proper silvicultural practices must be done and these include;

i. Slashing out unwanted weeds using simple hand tools like a slasher
ii. Pruning the dry branches as this helps reduce the chances of fire out breaks in the apiary

Sub-section 4: Honey Bee Pest and Disease Management

Just like other insects and livestock, honey bees are prone to attack by pests and diseases within the environment. The diseases are mainly microbial and can be bacterial, fungal, viral or protozoan in nature. In Uganda not so much research has been done on honey bee diseases so shall not dwell much on it.

Honey bee pests are quite diverse in nature ranging from arthropods (insects and mites) to vertebrates like amphibians, reptiles, birds and mammals including man.

i) **Parasitic bee mites:** Several species of mite have been found to be parasitic on bees. Examples of these include Varroa mites *(Varroa destructor),* Tropilaelaps mite (*Tropilaelaps spp)* and the Tracheal mite *(Acarapis woodi)*. These mainly weaken their hosts as they depend on them for their nutrition, deformation during growth, spread some diseases and eventually lead to death in extreme cases of infection. Mites are quite difficult to control but it is important to exercise good apiary hygiene practices to avoid spread. Also an integration of various approaches is advised.

ii) **Insect pests of honey bees:** The most common ones include beetles (Small hive beetle), various species of ants, wasps and hornets and the wax moths. Insect pests can be destructive at larval (wax moth larvae) or adult stages

(wasps, ants, beetles etc). Their effects can involve comb destruction, eating up the honey, pollen and brood or even the adult bees themselves as seen with wasps and hornets.

Control of insect pests also involves an integrated approach like mechanical killing and destroyal of their breeding sites, applying grease on stands and suspension wires, burning the affected combs and putting insect and rat guards on stands. Chemical control is usually discouraged as the chemicals used might also be harmful to the bees since they are also insects.

iii) Vertebrate pests of bees: These include;

a. Amphibians: Examples are toads and frogs. They position themselves at the entrance of the hive as they capture incoming or outgoing bees. Continuous predation by toads and frogs can result into loss of colony strength if not prevented. Amphibians can be prevented by placing hives on stands atleast 30cm above the ground.

b. Reptiles: Examples are geckos, skinks and other lizards. These have found on top of the frames or top bars inside the hive. They also position themselves near the hive entrance or on trees visited by foraging bees. Guards should be placed on stands to prevent them from climbing, trapped and killed if found inside the hive, continuous slashing of the apiary to avoid dense bushes and tall grass which are hiding places for the lizard can help control the problem.

c. Birds: Examples are Shrikes, woodpeckers, honey guides etc. These prey upon many insect species and honey bees are no exception. The birds capture the bees as fly in the air. Control here is a bit difficult since predation takes place in the air.

d. Mammals: Examples include man, honey badger, chimpanzee, monkeys etc. These open the hives and consume honey and or brood. As a result frames/ top bars are destroyed and colonies may abscond. Their control can be in form of fencing the apiary with chain link to limit access.

Sub-section 5: Seasonal Management of Honey Bees

Honey bees perform their activities in a seasonal way and in Uganda two such seasons exist. For each season there are four periods and these are Dearth, Build up, Honey flow and Harvesting. Each of these periods requires a beekeeping to perform particular duties in his/her apiary.

Dearth: This period coincides with the dry season and in most cases leads to abscondment of bee colonies. The forages dry up, seasonal crops are harvested, temperatures are very high and water supply becomes limited. This makes the bees to become stressed. To avoid colony losses, the beekeeper should do the following;

i) Provide water for the bees. This can be done through putting water in shallow containers and distributing them to various spots in the apiary.
ii) Put hives under shade so that they don't heat up so much. This helps the bees in that they don't have to spend a lot of energy fanning the hive.
iii) Plant bee forages that can flower throughout the year or flower alternately at different times in a year.
iv) Prune the dry branches off the forage trees
v) Slash the apiary
vi) Put up measures for preventing natural fire out breaks in the apiary.
vii) No honey harvesting should be done as any little that is there is for the bees to feed.

Build- up: This is a recovery period. It is a time when the rains have began and the plants are just regenerating, planting of crops is just starting and thus the bees don't have enough to forage from. The beekeeper is expected to do the following.

i) Plant enough forage plants for his bees
ii) Hive inspection and remove old black combs so that bees get space for construction of new combs.
iii) Continue with the routine management practices
iv) Provide shade to protect the hives against extremes of weather i.e heavy rain

Honey-flow: This is the time when most of the crops are flowering and there is plenty from which the bees can forage. There is an observed increase in hive population and as such there are high chances of swarming. The rains are not so heavy and the bees have plenty of time to forage. There is storage of honey in combs within the hive. The beekeeper should;

i) Procure harvesting equipment if not yet there.
ii) Starting looking for market of his hive products and check out their prices
iii) Continue with routine apiary management practices
iv) Inspect the colonies to see if bees are storing honey and also its maturity

v) Control swarming

Harvesting: This is the time for harvesting mainly honey and bees wax. By this time, honey should have matured and sealed off by the bees. The beekeeper should;

i. Harvest only those combs that are more than ¾ sealed. Unsealed honey should not be harvested as this affects the quality.
ii. Leave atleast two full honey combs in the hive for the bees to feed on as they move into dearth.
iii. Process the honey and also do bees wax rendering to avoid attacks by the wax moth
iv. Continue with routine apiary management practices

N.B: Depending on when these periods happen in a year, a beekeeping calendar can be developed for a given region. This will guide beekeepers on what to do and when.

SECTION 3: HIVE PRODUCTS HARVESTING AND PROCESSING

Various bee products can be got from the hive depending on the beekeeper's interests. These include honey, bees wax, propolis, bee venom and royal jelly. Each of these requires specialized equipment and expertise for their harvesting and processing. For this manual, we shall limit ourselves to honey and beeswax.

Procedure for harvesting honey and bees wax

i. It is always advisable to work in pairs during harvesting.
ii. Put on full protective gear as it is suggested for inspection.
iii. Approach the hive from the side
iv. Puff smoke into the entrance holes and around the hive to calm the bees. The beekeeper is however advised to use less smoke during harvesting to avoid the smoky taste and smell in the honey. This reduces quality.
v. Open the hive after the bees have come docile
vi. Starting from the back of the hive, remove one top bar / frame one at a time and examine the comb to see if it has ripe honey. A comb with ripe honey is that which has been sealed. If the honey is not sealed then it is not ripe and the comb should be put back and move to the next.
vii. For a top bar, if the honey is ripe cut the comb off with a hive tool into the bucket and cover it. If it is a Langstroth hive, remove the frame and place it in an empty hive body. Continue with same procedure till when all the hives in the apiary are exhausted.

After harvesting is done, cover the buckets tightly as honey is hygroscopic before taking for storage.

Honey Processing

Various equipment and methods can be used for honey processing depending on which type of hive it was harvested from. These include a centrifugal extractor, honey press or even a simple sieve cloth and bucket.

a. **Drip and settling method:** This is a very simple method of honey processing in which a sieve cloth and a clean bucket are used. The sieve cloth is tied tightly on top of the bucket, honey combs broken into smaller pieces, placed on top of the sieve cloth and left to stand overnight. The honey will drip out of the combs through the sieve cloth and into the bucket. The clean honey is the removed and

taken for storage or packaged for sell. The empty combs can then be removed and processed into wax.

b. **Honey press:** Just like the name, combs are pressed and honey is squeezed out. Honey comb pieces are placed in cloth of light material and placed inside the press. The combs are then squizzed by the pressure from the press and honey drips out. It is the collected in a bucket placed below the press. After all the honey has been pressed out, the combs are removed and used to process wax.
c. **Centrifugal Method:** This requires the use of a centrifugal extractor and is suitable for combs on frames from a Langstroth hive. It is designed in such a way that honey is extracted without destroying the comb hence making it reusable.

   Combs with honey are first decapped with a decapping knife and the fixed into the extractor. The extractor is then rotated manually or by electricity and the honey is removed from the comb by the generated centrifugal force. After all the honey is removed, the frame together with its comb can be taken back to the hive for further filling. The honey is the removed, sieved and kept in a settling tank till packaging.

Processing Bees Wax

After honey has been extracted, combs should not be kept for long as this attracts the wax moth. They should instead be processed into bees wax and kept in that form.