



THE UNITED REPUBLIC OF TANZANIA

MINISTRY OF NATURAL RESOURCES AND TOURISM

FORESTRY AND BEEKEEPING DIVISION

THE NATIONAL BEEKEEPING TRAINING AND EXTENSION MANUAL

BEEKEEPING FOR IMPROVED LIVELIHOOD



JUNE, 2021



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PREFACE

One of the major responsibilities of the Ministry of Natural Resources and Tourism is to ensure that natural resources are managed and utilized in a sustainable manner. For decades since the inception of the National Beekeeping Policy of 1998, the Forestry and Beekeeping Division under the Ministry of Natural Resources and Tourism have taken steps to ensure that this noble goal is realized by putting in place tools to ensure smooth running. The National Beekeeping Policy of 1998 was followed by the National Beekeeping Program of 2001, Beekeeping Act No. 15 of 2002, Beekeeping (General) Regulations of 2005, Guideline for Quality Assurance of Honeybee products in Tanzania of 2007, and the National Beekeeping Training and Extension Guideline (NBTEG) of 2020. The NBTEG was put in place to guide beekeeping training and extension services provisioning in Tanzania in order to bring about effectiveness. In the National Beekeeping Policy, lack of effective beekeeping extension services was considered to be one of the impediments that hindered the development of beekeeping sector.

However, having the National Beekeeping Training and Extension Guideline alone was not enough. Experience shows that putting forward areas of focus makes extension provisioning not only intensive but also most importantly efficient and effective. Consequently, a room for easy monitoring and evaluation of the created awareness, knowledge and skills shared is created. This National Beekeeping Training and Extension Manual of 2021 again denote the importance the Ministry accords to the Beekeeping sector. Success of this sector not only will contribute to improved socio-economic status of the over two million people that depend entirely or partly on beekeeping but will also contribute to conservation of agro- and natural biodiversity in Tanzania. Extension service is the only realistic way where knowledge and skills are passed from experts to rural and urban players who use them to improve how they conduct their business.

Once again, the Ministry of Natural Resources and Tourism encourages different stakeholders to use this and other tools that are available as means of ensuring the increased contribution of Beekeeping to livelihood.



Dr. Allan H. J. Kijazi

Permanent Secretary

Ministry of Natural Resources and Tourism

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Finally, to all readers and users, we welcome your feedback.



Dr. Ezekiel E. Mwakalukwa
Director of Forestry and Beekeeping Division
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DEFINITIONS AND GLOSSARY

Terms	Explanations
Abscinding Apiary	<ul style="list-style-type: none"> - this occurs when all honeybees leave the hive or nest. - means a place where a colony or colonies of bees are kept, as a stand or shed for beehives or a bee house containing a number of beehives.
Meliponary	<ul style="list-style-type: none"> - the site where a number of stingless bee colonies are kept.
Apiary inspection	<ul style="list-style-type: none"> - routine observation of what is going on in and around the apiary.
Apiary product	<ul style="list-style-type: none"> - includes live bees, broods, beeswax, honey, cut comb, comb sections, bee combs, honey dew, bee collected pollen, bee venom, propolis, royal jelly, or any other substance declared by regulations to be an apiary product as per beekeeping Act No. 15 of 2002.
Apitherapy	<ul style="list-style-type: none"> - is an alternative therapy that relies on the usage of honeybee products, most importantly bee venom (BV) for the treatment of many human diseases.
Bee broods Beekeeping	<ul style="list-style-type: none"> - it includes eggs, larvae and pupa in a comb. - is the maintenance of bee colonies (both stinging and stingless bees) in hives located in apiaries for production of honeybee products including pollination services.
Bee house	<ul style="list-style-type: none"> - a house specifically designed with holes on the walls that are connected to the hive entrances.
Branding	<ul style="list-style-type: none"> - is a promotion of a particular product or company by means of advertising and distinctive design to customer eyes.
Diversification	<ul style="list-style-type: none"> - means to produce other honeybee products than commonly known honeybee products – honey and beeswax.

- Extension services** - is an informal educational process directed towards the rural population that offers advice, information and skills to help them solve their problems and improve their standard of living.
- Honeybee colony** - a group of honeybees living together comprising of a queen, drones and worker bees.
- Honeybee products** - all harvests and services obtained from honeybees that include honey, beeswax, propolis, bee venom, bee pollen, live bees, royal jelly, bee broods, apilarnil and pollination service.
- Honey processing** - is the act of getting honey out of the comb.
- Livelihood** - a set of activities essential to everyday life that are conducted over one's life span.
- Nectar** - sweet fluid secreted by nectarines of plants commonly in flowers that helps attract bees and is the raw material from which honey is made.
- Siting hive** - is the act of placing hives in a suitable place to attract or keep bees.
- Value addition** - a process of changing or transforming a product from its original state to a more valuable state.

ACRONYMS

BTI	Beekeeping Training Institute, Tabora
EIA	Environmental Impact Assessment
FBD	Forestry and Beekeeping Division
GDP	Gross Domestic Product
IPM	Integrated Pest Management
TBS	Tanzania Bureau of Standards
KTBH	Kenyan Top Bar Hive
TCDC	Tanzania Co-operative Development Commission
TMDA	Tanzania Medical Devices Authority
TCH	Tanzania Commercial Hive
TFS	Tanzania Forest Services Agency
TTBH	Tanzania Top Bar Hive
UDSM	University of Dar es Salaam
URT	United Republic of Tanzania
MNRT	Ministry of Natural Resources and Tourism
NBP	Nation Beekeeping Policy
NBTEG	National Beekeeping Training and Extension Guideline
NBTEM	National Beekeeping Training and Extension Manual
10-HDA	Trans-10-hydroxy2-decenoic acid
SUA	Sokoine University of Agriculture

1.0 INTRODUCTION

1.1 BACKGROUND OF THE MANUAL

Beekeeping also referred to as Apiculture is the art and science of maintaining honeybees in a manmade domicile for the purpose of harnessing their products and services. Meliponiculture is the art and science of keeping stingless bees. The most common honeybee products are honey and beeswax, but honeybees also produce propolis, bee venom, pollen and royal jelly. Honey and pollen are food but mainly honeybee products are used in food, cosmetics or pharmaceutical industries. The importance of honeybees however goes beyond their use as food or industrial inputs. Honeybees and beekeeping contribute to peoples' livelihoods as they benefit society by increasing household food, income and ecosystems maintenance through pollination. It is estimated that in Tanzania more than 2 million people are employed along the beekeeping value chain.

At local level the contribution of beekeeping sector continues to be below 1% of GDP which is too low when compared to the existing potential. It is estimated that honey and beeswax production potential is about 138,000 tons and 9,200 tons per annum respectively (NBP 1998). More than 50% of natural plants in Tanzania produce nectar or pollen or both which are fodder for honeybees. Honeybees also collect nectar and pollen from cultivated crops such as sunflower, leguminous, citrus trees, sisal, coffee, bananas and maize. The current production of honey and beeswax is around 30,393 tons and 1,843 tons of honey and beeswax, respectively. This is just over 20% of the existing potential. In relations to honey production potential, the Ministry of Natural Resources and Tourism (MNRT) categorized the country into three categories namely; high producing areas, medium producing areas and unexploited areas (URT, 2001).

Figure 1 presents the estimated potential and the recent actual production in high production areas. At a close-up the current production trend is not appealing when compared to the potential. Other factors that explain the

lower contribution of beekeeping sector to the GDP is limited diversification and limited value addition. Majority of beekeepers are still unable to harvest other mostly valuable beekeeping products namely; pollen, propolis, bee venom, and royal jelly due to limited awareness and lack of the needed technology. In addition, pollination service offered by honeybees is not valued because beekeepers do not sell this service to farmers as done in developed countries. Generally speaking, the problem is not only low productivity but also the quality and safety of products are still low, the number of beekeepers is still small, and beekeeping has remained activities of old men though it offers opportunities for all groups of people and gender. Inadequate beekeeping extension services have also contributed to limited public awareness on honeybee products-based industries which could employ many people and improve their livelihood.

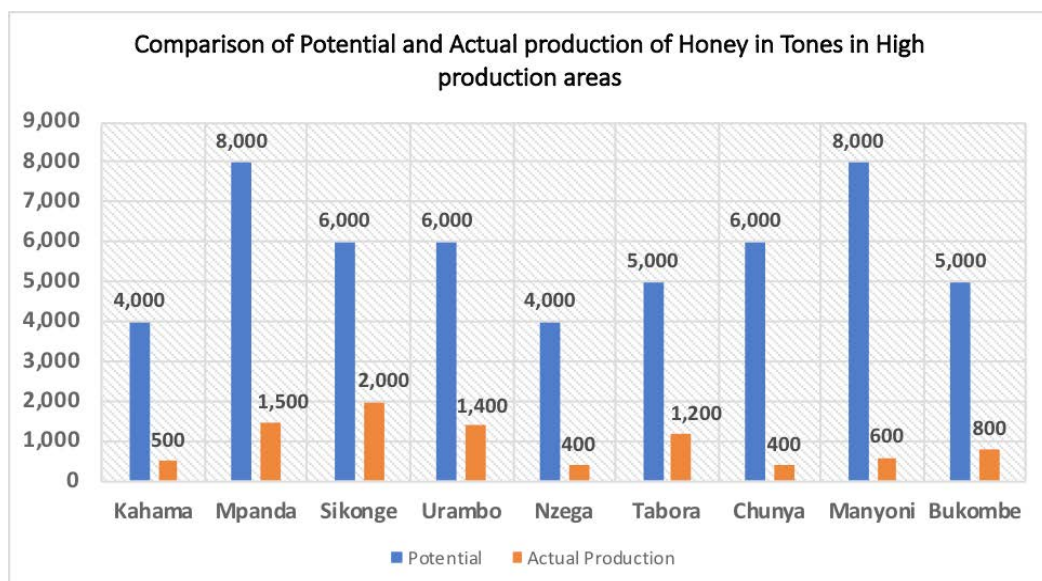


Figure 1: Comparison of Potential and Actual production of Honey in Tones in High production areas.

This unacceptable state indicates that beekeeping extension service is not effectively reaching beekeepers, processors of honeybee products, manufacturers of beekeeping equipment and buyers and sellers of honeybee products. Experiences suggests that where extension is offered efficiently the knowledge and skills of people have improved and production of the sectors in

question has also improved. Extension services accelerate technological transfer which consequently remove the knowledge and technological gaps and help beekeeping actors to become good managers.

1.2 THE PURPOSE OF THE MANUAL

A beekeeping extension agent is a change agent in the beekeeping sector. His/her responsibility is to catalyze change, create awareness, facilitate knowledge exchange, and technology adoption among beekeepers and other practitioners along the beekeeping value chain. In reality, extension service provisioning is the only means through which beekeeping actors' access relevant knowledge and skills that they require to improve how they carryout beekeeping activities. A well planned and executed extension services has a strong contribution to improved livelihood of the targeted community. Inadequate extension services provisioning and lack of guiding tools for service delivery, are some of major causes of low performance of beekeeping sector observed in Tanzania.

This manual is an assemblage of key themes that need to be understood by beekeeping stakeholders for them to improve their knowledge and techniques they use to carryout beekeeping activities. Proper use of the manual will result in making actors better informed of appropriate knowledge, skills and innovation that are vital for their daily endeavor. Delivery methods and required equipment are proposed to ensure maximum adoption of the intended knowledge and technology by participants of each theme.

1.3 SCOPE OF THE MANUAL

This manual is not a reference document but rather a benchmark tool intended to assist beekeeping extension agent to plan and deliver extension services efficiently and effectively. It provides the backbone based on which extension messages are to be formulated preferably in an interactive approach to allow focusing on beekeepers' problems. For each theme the manual provides the expected learning outcomes that refer to an improved state of the knowledge and skills of the participants of the extension services. A summary of the intended message is provided followed by the learning contents. The most effective and

efficient method of delivery, required material, teaching aid and equipment are proposed. Duration required and number of participants is also estimated to allow better understanding. It needs to be said here that the proposed situation is not a hard rule, conditions vary from one place to another and therefore it might be necessary for the extension agent to adjust a few things for better results. Note, however only adjustments that will not ruin achievement of the expected learning outcomes can be made.

1.4 DEVELOPING THE MANUAL

The Forest and Beekeeping Division of the Ministry of Natural Resources and Tourism developed this manual as part of ongoing efforts geared towards improving the people's livelihoods through application of appropriate knowledge and skills along the beekeeping value chain. The manual has not only taken into consideration knowledge and skills but the environment on which to operate. Developing the manual thus took cognitive of important frameworks on which beekeeping sector in Tanzania is built. To this effect the National Beekeeping Policy, National Beekeeping Program, National Beekeeping Training and Extension Services Guideline, the National Beekeeping Policy Implementation Strategy, Beekeeping Act and Beekeeping Regulations were used. The Ministry coordinated professionals from the Forest and Beekeeping Division (FBD), Tanzania Forest Services Agency (TFS), University of Dar es Salaam (UDSM), Beekeeping Training Institute –Tabora (BTI) and retired extension provisioning experts to make this job done. Input from stakeholders along the value chain were thought during the preparation through personal contacts of key stakeholders and through stakeholders' workshop.

1.5 HOW TO USE THE MANUAL

Themes in this manual are not arranged in any sequential order; therefore, selection of a theme will depend on the challenge at hand. That is to say prior knowledge of a particular theme is not a prerequisite for a participant to participate in a particular theme though may be advantageous in some instances. The best approach that readily improves skills and knowledge is participatory because it allows problem solving. Participatory principles enhance participants'

motivation, commitment, and ownership of the process. After selecting the theme, the standard way of using the manual is first to understand the expected learning outcomes. Where necessary the extension agent may discuss about the expectation of the training with participants and make adjustments based on the results of the discussion. Care must be taken however to ensure that the agreed change do not lead to reducing the required knowledge and or skills to perform required beekeeping activities. Extension agent then needs to go through the learning contents because these are the key issues that need to be covered in order to attain the knowledge and skills that is expected in the outcome of the training. The agent then reads the summary provided because it is the basis of the extension message intended under each theme. Key areas link the expected outcomes to the learning contents to assist the extension agent not to miss the intended coverage. During the training the agent is advised to use participatory learning methods, practical hands-on approach, visual presentations and simple statements as they maximize understanding. Prior to teaching therefore, the extension agent should prepare all material and equipment that are required. As indicated under the scope of this manual some relevant methods are proposed under each theme. To be able to use this manual effectively, the extension agent must be acquainted with beekeeping knowledge, and technologies and skills of providing extension services. Extension agent must be able to translate relevant knowledge and technology from research findings, engage other players, and to assess the outcome of the intervention to avoid negative consequences. Ability to gather relevant indigenous knowledge and technology that may be used to improve beekeeping activities will be an added advantage.

1.6 MAXIMIZING THE IMPACT OF TRAINING AND SELECTION OF TRAINING PARTICIPANTS

The number of participants that can be accommodated in a single training session may go up to 30. This number is proposed to ensure maximum interaction between learners and extension agent making the learner attain effective and active learning. It is also proposed that it is important to observe certain criteria to ensure that the intended target group obtains the intended benefits. The following criteria may be used to guide selection of participants:

- ◆ Focus on the most disadvantaged beekeepers and those who are most likely to benefit from the training, including the entrepreneurs.
- ◆ Give priority to beekeepers experienced in traditional beekeeping and wishing to improve or extend their approach. Individuals who are planning to start beekeeping as a new enterprise should come second.
- ◆ Participants should be active beekeepers and entrepreneurs who will directly apply the knowledge and skills obtained to improve their projects outcome.
- ◆ The participant group should include a mixture of participants, both men and women and people from different socioeconomic groups, with a similar level of knowledge about beekeeping. Give special attention to women because they generally have fewer opportunities to participate in training events as a result of institutional and social barriers.

To increase the impact of training, the trainers should also consider among others; encourage sharing participants' experiences, group discussions, field excursions, field days, attending exhibitions, discussions and question and answer sessions.

2.0 TRAINING AND EXTENSION THEMES

2.1 THE HONEYBEE, BEHAVIOR AND GEOGRAPHICAL DISTRIBUTION OF RACES

2.1.1 EXPECTED LEARNING OUTCOMES

At the end of the training participants should be able to:

- i. understand the honeybees, races and their distributions;
- ii. understand the life cycle of honeybees;
- iii. understand the social organization of the honeybees and the roles of each caste in the colony;
- iv. recognize various behavioral patterns in managing and handling honeybees; and
- v. understand how to manage and deal with bee sting accidents.

2.1.2 SUMMARY OF THE THEME

The type of bees, along with ecological and social factors, influences the bee-human relationship in an area. Therefore, a good understanding of these factors important for the bee-human relationship is necessary to decide upon an appropriate way of keeping bees and capable of adjusting ways of doing it accordingly to suit both bees' environments and beekeepers plan. As social insects, honeybees live in colonies. Tanzania has one species of honeybee called *Apis mellifera*. This species has three races namely; *Apis mellifera scutellata* (the lowland bees), this occupy the lowland areas and occupy the large part of Tanzania, *Apis mellifera monticola* (the mountainous bees) occurs in mountainous areas and *Apis mellifera litorea* (the coastal bees) these occur on Coastal areas. Each race exhibits some behavioral and morphological differences.

Honeybee colony consists of three castes that is the queen, worker and drone. The queen and worker are female bees and drone is male. Each caste is adapted to do a specific task according to the colony requirement.

Honeybees are true social insects which exhibit real division of labour, have overlapping generation, cooperate in brood care and use common nest. Honeybee exhibits unique behaviors which include; defense, swarming, absconding, thermoregulation, foraging organisation and mating. Living as a colony necessitates communication among members. Communication in honeybees is done mainly through dances and pheromones.

2.1.3 LEARNING CONTENTS

- i. Honeybees geographical distribution and its adaptive features for different races in Tanzania;
- ii. Division of labour in a honeybee colony;
- iii. Mating behaviour;
- iv. Developmental stages of each caste in a honeybee colony;
- v. Temperature regulation in honeybee;
- vi. Nest construction and structure in honeybees;
- vii. Foraging activities;
- viii. Communications and learning behavior in honeybees;
- ix. Factors influencing swarming and absconding in honeybees; and
- x. Defensive behavior of honeybees.

KEY AREAS

The honeybee races and their distribution in Tanzania, the characteristics and role of individual honeybee castes in the honeybee colony, the life cycle of honeybees, honeybee colony reproductive swarming, absconding and defensive behaviour in response to internal and external stimuli.

2.1.4 METHODS AND MATERIAL

Methods of delivery

Discussion, demonstration, practical, question and answer.

Teaching Material

Honeybee colony, Flip chart or chalkboard, pictures of bees, observation hive, honeybees, specimen of castes, Projectors, handouts, protective gears, Video.

Duration: 8 hours.

Number of participants: Maximum of 30 participants.

2.2 THE BEEHIVE

2.2.1 EXPECTED LEARNING OUTCOMES

At the end of the training participants should be able to:

- i. understand types of beehives both for stinging and stingless bees;
- ii. understand appropriate materials for hive construction;
- iii. understand proper dimensions for a standard beehive; and
- iv. be able to construct and /or supervise construction of standard beehive.

2.2.2 SUMMARY OF THE THEME

There are different types of hives used to keep honeybees. They vary from fixed comb hives which are also called traditional hives (clay pots, reed baskets, tree backs, and hollowed logs) to movable comb hives (Top Bar and Frame Hives) often called box hives. Each of these hives has own advantages and disadvantages. Most traditional hives have limited space and their combs are immovable a character that limits undertaking of intensive beekeeping management operations. In Tanzania, the use of bark hives is prohibited by law.

Advancement of box hive beekeeping is the result of bee space discovery which led to frame spacing. In Tanzania both types of hives are used. The most common movable comb hive used in Tanzania is Tanzania Top Bar Hive (TTBH), Kenya Top Bar Hive (KTBH), Tanzania Commercial Hive (TCH) and Langstroth (frame hive). Performance of movable comb hive depends on the adherence to the dimensions especially the bee space. Movable comb hives that are not

constructed following the required dimensions will not have the advantages over fixed comb hives. That is to say, the Tanzania top bar hive, the Kenya top bar hive, the Tanzania commercial hive and Langstroth hive must be constructed according to standards dimensions. However, stingless beehives have different features all together.

2.2.3 LEARNING CONTENTS

- i. Hive as a principle tool for beekeeping;
- ii. Types of beehives;
- iii. Features of different types of beehives for both stinging and stingless bees;
- iv. Advantages and disadvantages of each type of beehive;
- v. Materials for hive making;
- vi. Advantages and disadvantages of different materials used for making beehives;
- vii. Important points on box hive construction; and
- viii. Paints and painting of beehives.

KEY AREAS

Explain a beehive, the types both for stinging and stingless bees, important features for an appropriate beehive with emphasis on the bee space, standard dimensions for respective hives, how to make it, advantages and disadvantages of different hive type, selection of appropriate materials for hive making and other important points for consideration in choosing a hive to use.

2.2.4 METHODS AND MATERIAL

Methods of delivery

Presentations, practical, demonstrations, discussions, illustrations, Video

Teaching material

Handout, different types of beehives, flip chart or chalkboard, computer, projector, woodworking machines and carpentry tools

Duration: 20 hours

Number of participants: Maximum of 30 participants

2.3 APIARY ESTABLISHMENT

2.3.1 EXPECTED LEARNING OUTCOME

At the end of training participants are expected to be able to:

- i. understand objectives of setting up an apiary;
- ii. select suitable areas for establishing an apiary;
- iii. choose appropriate apiary layout in relation to the apiary site;
- iv. understand criteria for stocking levels in the apiary;
- v. understand bee forage species and their flowering period;
- vi. understand types of apiary; and
- vii. understand beekeeping calendar of the area.

2.3.2 SUMMARY OF THE THEME

An apiary is a place where beehives are kept. Successful beekeeping and the production of honeybee products depend on proper establishment and maintenance of an apiary. Beekeeping requires a well-planned and suitably located apiary that offers adequate supply of forage and access to clean water for the bees. Adequate and diverse bee forage supply and their flowering time is the most important aspect for selecting an apiary site. However, there are many other factors that demand attention when selecting an area for apiary establishment. Apiary sites should also be free from: floods and diseases, bee predators and pests, areas with pesticides application, areas prone to wildfires, public areas and livestock disturbances, areas with wet and extreme weather conditions.

After selecting an apiary site, a beekeeper is then required to decide on the type of the layout and the methods of stocking the hive. The choice of each method depends on the merits of the selected approach over the others. Proper apiary layout is required as it facilitates easy and safe movement of apiary attendants and reduces drifting of bees. Stocking of beehives with bee colonies is a timing activity, thus beekeepers should be acquainted with knowledge about the beekeeping calendar in the respective area.

2.3.3 LEARNING CONTENTS

- i. Criteria of selecting suitable sites for apiary establishment;
- ii. Advantages and disadvantages of each apiary type;
- iii. Developing a beekeeping calendar;
- iv. Nectar producing plants and their flowering period;
- v. Methods of siting beehives and their advantages and disadvantages;
- vi. Criteria for selecting types of stands to be used;
- vii. Material for siting hives;
- viii. Types of apiary layout; and
- ix. Advantages and disadvantages of each apiary layout.

KEY AREAS

Explain the features for consideration when planning for establishing an apiary. Consider factors that qualify or disqualifies an area. Discuss issues related to bee fodder, health of honeybees and danger to humans. Similarly, discuss the different apiary types and layout. Explain beekeeping calendar in relation to planning establishment and beekeeping management.

2.3.4 METHODS AND MATERIAL

Methods of delivery

Presentations, practical, field visits, demonstrations, discussions.

Teaching Material

Hives, swarm catcher, baiting materials, stands, wires, flip chart, chalkboard, marker pen, computer, projector, protective gears, hive tool, ropes, bee smoker, illustrations.

Duration: 10 hours

Number of participants: Maximum of 30 participants

2.4. MANAGEMENT OF HONEYBEE COLONIES

2.4.1 EXPECTED LEARNING OUTCOMES

At the end of the training participants should be able to:

- i. understand the qualities of a good honeybee colony and capability of maintaining it;

- ii. carryout different honeybee colony management operations at varying seasonal and conditions to maintain its best performances;
- iii. maintain different colony records;
- iv. control honeybees swarming and absconding and;
- v. stock hives with bee colonies.

2.4.2 SUMMARY OF THE THEME

Hives are stocked with honeybees using different methods. Once the hive is occupied and the bees are busy, then the hive is said to be colonized. To monitor bee colony performance, it is important to understand the value of regular inspections. Bee colony inspection involves observing the condition from the outside even before opening the hive. Sometimes outside observation is enough to give some indication of the bee colony status inside the hive. Newly stocked hives should be checked regularly to observe its performance before it is left to establish. During inspection different observations are made ranging from activities of worker bees to the performance of the queen.

Colony management goes beyond colony inspection. It also involves a number of operations that includes honeybee colony uniting and division as well as feeding, swarm management and queen rearing. Management operations go according to the beekeeping calendar of the area. Moreover, successful honeybee colony management requires proper record keeping.

2.4.3 LEARNING CONTENTS

- i. Honeybee colony inspection;
 - a) presence of queen and her performance
 - b) brood nest
 - c) food stores
 - d) space for the bees to store food and queen to lay eggs
 - e) signs of pests and diseases
 - f) hive floor
 - g) foraging activity and others
- ii. Feeding honeybee colonies and feeds;
- iii. Stimulate production of new queens;

- iv. Tools and equipment used in management of honeybee colonies;
- v. Dividing and uniting honeybee colonies;
- vi. Manage honeybee swarming and absconding;
- vii. Relocating bee colonies;
- viii. Honeybee colony record keeping, and
- ix. Methods of stocking beehives with bee colonies and their advantages and disadvantages.

KEY AREAS

Explain the qualities of a good bee colony and discuss how to maintain it. Ensure that participants can easily differentiate between a weak and strong colony and methods of strengthening weak colonies. Demonstrate colony division and how to unite colonies. Discuss and demonstrate how to carry out different bee colony management operations at varying seasonal conditions to maintain its best performances. Demonstrate record keeping and methods of stimulating queen rearing.

2.4.4 METHODS AND MATERIAL

Methods of delivery

Presentations, practical, demonstrations, discussions, illustrations

Teaching material

Bee colonies, handout, beehives, flip chart or chalkboard, computer, projectors, protective gears, bee smoker, hive tool, video, feeders and feeds.

Duration: 10 hours

Note: Queen rearing is taken as special skill which is dealt as a special theme.

Number of participants: Maximum of 30 participants

2.5. MANAGEMENT OF APIARIES

2.5.1 EXPECTED LEARNING OUTCOMES

At the end of the training participants should be able to:

- i. understand different apiary management operations; and
- ii. carry out different apiary management operations.

2.5.2 SUMMARY OF THE THEME

Despite having knowledge of maintaining colonies of bees, the beekeepers require knowledge of managing apiaries. An apiary is a location of beehives with or without colonies in them. Apiary management is a set of routine activities in an apiary depending on weather or seasonal changes and the initial objective of setting up apiary. It is important for a beekeeper to know and adopt good practices in his or her apiary for obtaining maximum yields and quality products. However, appropriate knowledge (including indigenous knowledge) on bee flora and its abundances is pre-requisite for successful management of the apiary. In addition, when necessary the beekeeper should have the ability to relocate bee colonies to areas having more favorable conditions during the year. The management of an apiary encompasses all operations in an apiary including the management of the entire environment where bee colonies are stocked, bee colonies and its seasonal changes as influenced by various factors where honeybees respond to.

2.5.3 LEARNING CONTENTS

- i. Apiary management operations;
- ii. Maintaining apiary records;
- iii. Effects of apiary management on colonization and colony strength;
- iv. Pests, predators and diseases control and management in apiaries;
- v. Managing fire and other environmental calamities;
- vi. Protecting and enriching bee fodder plants;
- vii. Weather changes and its influence on beekeeping;
- viii. Protect apiary against destructive animals and human being; and
- ix. Practicing migratory beekeeping.

KEY AREAS

Explain steps that are taken to ensure that an apiary is appropriately maintained. Discuss and visit a well-maintained apiary from one that is poorly managed. Discuss with participants the consequences of not maintaining an apiary appropriately. Discuss all apiary management operations while stressing the need to maintain the health of the apiary.

2.5.4 METHODS AND MATERIAL

Methods of delivery

Presentations, practical, demonstrations, discussions, illustrations, field visits.

Teaching material

Bee colonies, handout, Beehives, Flip chart or chalkboard, Computer, projectors, video, protective gears, bee smoker, hive tool, fire protection equipment, slashers, weeding equipment.

Duration: 10 Hours

Number of Participants: Maximum of 30 participants.

2.6. PRODUCTION OF BEE PRODUCTS

Honey and beeswax are the common primary bee products produced by beekeepers in Tanzania. Other products that can be obtained from beekeeping are bee pollen, royal jelly, venom and propolis. Production of these products however require specialized techniques. The hive is the principle production tool for honey and all other bee products. Thus, it is important to use hives which allow standard colony management operations.

2.6.1 THE HONEY

2.6.1.1 EXPECTED LEARNING OUTCOMES

At the end of the training participants should be able to:

- i. improve honey production and quality;
- ii. understand composition and properties of honey;
- iii. understand honey harvesting equipment and their appropriate use; and
- iv. understand various uses of honey.

2.6.1.2 SUMMARY OF THE THEME

Honey is a sweet substance produced by the honeybees from the nectar of blossoms, secretions of living parts of plants, or excretions of plant sucking insects on the living parts of the plants, which the honeybees collect, transform and combine with specific substances of their own, deposit, remove water, store and leave to ripen and mature in honey combs. Honey is primarily composed

of sugars and water. On average honey contains about 79.6% sugar and 17.2% water. The primary sugars are fructose (38.2%) and glucose (31.3%), and others are maltose (7.3%) and sucrose (1.3%). Honey also contains acids (0.57%), some proteins (0.26%), a small amount of minerals (0.17%) and a number of other minor components including pigments. Honey has several characteristics that make it the most appropriate for various uses.

The colour of honey varies from clear, colourless to dark amber. The common colours of honey are water white, extra white, white, extra light amber, light amber, amber, dark amber. Honey can be found in form of liquid, semi liquid or completely crystallized. Honey tends to turn lighter as it crystallizes because the glucose crystals are white. Honey is used as food and ingredient in food, pharmaceutical and cosmetic industries.

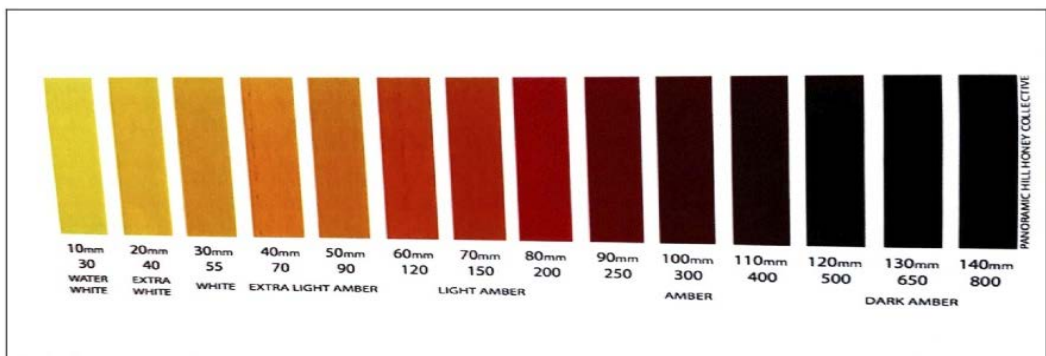


Figure 1. Honey colour grade guide (Source: Panaromic Hill Honey Collective, 2013).

Figure 2: Honey colour grade guide

In order to increase productivity of honey and maintain quality, appropriate beekeeping equipment and techniques should be used following proper beekeeping calendar of an area.

Honey can be harvested as honey flow season progresses or at the end of the season when most of the honeycombs are sealed. In order to maintain quality, harvesting should be done according to standard procedures.

2.6.1.3 LEARNING CONTENTS

- i. Composition and characteristics of honey;
- ii. Preparation of harvesting plan/ calendar;
- iii. Management of bees for honey production;
- iv. Honey harvesting procedure;
- v. Indicators for honey harvesting;
- vi. Honey harvesting tools and equipment; and
- vii. Uses of honey.

KEY AREAS

Discuss all means that will enable beekeepers to increase honey production while maintaining its quality. Show how quality and quantity influences economic gains. Discuss honey properties and composition. Explain in detail how honey is produced by bees and common types of harvesting equipment. Explain characteristics and composition and how they influence quality.

2.6.1.4 METHODS AND MATERIAL

Methods of delivery

Presentations, practical, demonstrations, discussions, illustrations

Teaching material and equipment

Honeybee colonies, different honey samples from different places and seasons, handout, Beehives, harvesting equipment, Flip chart or chalkboard, Computer, projectors, protective gears, bee smoker, hive tool.

Duration: 10 Hours

Number of Participants: Maximum of 30 participants.

2.6.2 BEESWAX

2.6.2.1 EXPECTED LEARNING OUTCOME

At the end of the training participants should be able to:

- i. understand how beeswax is produced by honeybees;
- ii. render and extract beeswax using different methods;
- iii. understand and recognize physical and chemical characteristics of beeswax; and
- iv. use different equipment and tools for beeswax extraction and rendering.

2.6.2.2 SUMMARY OF THE THEME

Beeswax is a valuable product that can provide a worthwhile income in addition to honey. In Tanzania, still few beekeepers have the capacity and right skills to produce surplus beeswax. Most beeswax is wasted or simply left in the field without being processed to obtain wax. Rendering of beeswax is done mainly from old comb abandoned by bees, comb remains after honey pressing and empty combs obtained during beehives cleaning. Rendering of beeswax from wax cappings is practiced by few beekeepers especially those extracting honey by using honey extractor. Number of combs for beeswax rendering depends on the type of beekeeping and/or the objective of the beekeeper. There are different techniques of rendering beeswax which account for the quantity and quality of beeswax recovered.

2.6.2.3 LEARNING CONTENTS

- i. Beeswax description and production by honeybees;
- ii. Condition favoring production of beeswax;
- iii. Methods and procedures for rendering beeswax;
- iv. Characteristics and composition of beeswax;
- v. Advantages and disadvantages of different beeswax rendering methods;
- vi. Equipment and tools for rendering beeswax; and
- vii. Uses of beeswax.

KEY AREAS

Explain beeswax production by honeybees. Demonstrate and explain different methods and equipment used to render beeswax. Explain physical properties of beeswax and factors that affects its quality.

2.6.2.4 METHODS AND MATERIAL***Methods of delivery***

Presentations, practical, demonstrations, discussions, illustrations.

Teaching material

Beeswax samples of different quality, honeybee combs, handout, flip chart or chalkboard, Computer, projectors, wax extractors and other traditional rendering equipment, wax strainers for refining wax, wax molders and wrapping materials for finished beeswax.

Duration: 10 Hours

Number of Participants: Maximum of 30 participants

2.6.3 BEE POLLEN**2.6.3.1 EXPECTED LEARNING OUTCOMES**

At the end of the training participants should be able to:

- i. describe and recognize bee pollen;
- ii. understand the fundamental mechanisms used by honeybees to collect pollen from the field;
- iii. set traps, collect and store bee pollen;
- iv. understand characteristics of bee pollen; and
- v. appropriately use different equipment and tools to collect and store pollen.

2.6.3.2 SUMMARY OF THE THEME

Honeybees gather pollen which is source of protein, minerals, and fats. Nutritionally, pollen is not only used by bees to nourish broods, but also useful food for newly emerged workers. Pollen is collected from certain plants species. The amount of pollen in a bee colony is dependent of the current need. Human

harvests pollen for different uses. Harvesting of pollen may threaten the strength of the colony if not carefully done. Pollen is collected from foragers at the entrance using a pollen trap and traded commercially. Pollen should be stored in a manner that its quality is maintained.

2.6.3.3 LEARNING CONTENTS

- i. Description of bee pollen, composition and characteristics;
- ii. Factors influencing pollen collection by worker bees;
- iii. Methods and equipment used to collect pollen
- iv. Processing and storage of bee pollen;
- v. Pollen producing plants;
- vi. Consequences of harvesting bee pollen to a bee colony;
- vii. Equipment used to dry and store pollen; and
- viii. Uses of bee pollen.

KEY AREAS

Describe pollen collection by bees and important plants for pollen production. Explain and demonstrate how pollen is collected using pollen trap. Explain and exhibit pollen storage standard containers. Explain and demonstrate methods of processing pollen.

2.6.3.4 METHODS AND MATERIAL

Methods of delivery

Presentations, practical, demonstrations, discussions, illustrations, field visits.

Teaching material

Bee pollen from different floral sources, pollen traps, pollen drier, pollen storage containers, handout, flip chart or chalkboard, Computer, projectors, video.

Duration: 5 Hours

Number of Participants: Maximum of 30 participants.

2.6.4 BEE PROPOLIS

2.6.4.1 EXPECTED LEARNING OUTCOME

At the end of the training participants should be able to:

- i. describe propolis;
- ii. set traps and collect quality propolis;
- iii. use equipment for propolis collection;
- iv. store propolis in appropriate containers;
- v. understand characteristics of bee propolis; and
- vi. understand uses of bee propolis.

2.6.4.2 SUMMARY OF THE THEME

Propolis is a sticky, dark-colored apiary product, made by a mixture of beeswax, saliva and resinous material gathered from tree buds, sap flows, or other botanical sources that honeybees collect and is used as a sealant for unwanted open spaces. Honeybees collect resin using their mouths and pack it in their legs and taken to the hive.

Propolis has antimicrobial properties and is used to protect beehive from bacteria, fungi and viruses. It has various medicinal properties which has given it a commercial value. Propolis is harvested by scraping the bars and walls of the hive with a knife or hive tool or using propolis trap. Due to its chemical nature, it requires specific storage conditions.

2.6.4.3 LEARNING CONTENTS

- i. Description of bee propolis, composition and its characteristics;
- ii. Hive condition that favor making of propolis;
- iii. Consequences of collecting bee propolis to the bee colony;
- iv. Methods and equipment used to collect propolis;
- v. Plant species that produces resin for propolis making;
- vi. Equipment for harvesting and storage of propolis; and
- vii. Uses of bee propolis.

KEY AREAS

Describe propolis and explain how it is collected. Demonstrate how to harvest propolis from hive parts and how traps are used to collect propolis. Explain methods of storage and the need of specialized containers. Discuss characteristics of propolis and its use.

2.6.4.4 METHODS AND MATERIAL***Methods of delivery***

Presentations, practical, demonstrations, discussions and field visits to identify potential sources of propolis.

Teaching material

Bee propolis samples, propolis value added products, storage containers, propolis trap, handout, flip chart or chalkboard, computer, projector, samples of plant specimen bees collect propolis from,

Duration: 3 Hours

Number of Participants: Maximum of 30 participants.

2.6.5 ROYAL JELLY**2.6.5.1 EXPECTED LEARNING OUTCOMES**

At the end of the training participants should be able to:

- i. harvest royal jelly;
- ii. know equipment that are required for royal jelly harvesting;
- iii. manage bee colonies for royal jelly production;
- iv. understand royal jelly composition and its properties;
- v. maintain royal jelly quality; and
- vi. understand various uses of royal jelly.

2.6.5.23 SUMMARY OF THE THEME

Royal jelly is another valuable hive product. A whitish secretion produced by young honeybees (nurse bee). In the colony, royal jelly is fed to young larvae during their early days of development, but to the queen throughout her lifetime. Royal jelly can be harvested for commercial purposes but requires specialized

skills and techniques. Its production can be done using several methods all of which activates the colony to rear new queens.

2.6.5.3 LEARNING CONTENTS

- i. Description of royal jelly, composition and characteristics;
- ii. Management of bee colonies for royal jelly production;
- iii. Techniques and equipment used in royal jelly harvesting;
- iv. Royal jelly value added product,
- v. Containers used to store royal jelly; and
- vi. Uses of royal jelly.

KEY AREAS

Discuss ways of managing bee colonies for royal jelly production. Explain and demonstrate how to harvest and store royal jelly. Discuss various uses of royal jelly. Explain characteristics and composition of royal jelly.

2.6.5.5 METHODS AND MATERIAL

Methods of delivery

Presentations, practical, demonstrations, discussions, illustrations, video

Teaching material

Royal jelly, extraction equipment, storage containers, handout, flip chart or chalkboard, marker pen, computer, projector

Duration: 3 hours

Number of participants: maximum of 30 participants

2.6.6 BEE VENOM

2.6.6.1 EXPECTED LEARNING OUTCOME

At the end of the training participants should be able to:

- i. collect and store bee venom;
- ii. know equipment that are required for bee venom collection;
- iii. manage bee colonies for bee venom production;
- iv. understand uses of bee venom;

- v. understand bee venom composition and its properties;
- vi. maintain bee venom quality; and
- vii. use bee venom in value addition.

2.6.6.2 SUMMARY OF THE THEME

Bee venom is chemical substance, odorless and transparent liquid containing a hydrolytic mixture of proteins with acid (pH 4.5 to 5.5) that bees often use as poison against their enemies. When stinging a victim, honeybees release the bee venom. Venom is produced by female worker bees and is known to contain many active components which are important ingredients in the medical and pharmaceutical industries. It is used to treat a range of chronic diseases including rheumatism, multiple sclerosis and various forms of ailments.



Plate 1: Bee venom collection

2.6.6.3 LEARNING CONTENTS

- i. Description of the bee venom, composition and characteristics;
- ii. Management of bee colonies for bee venom production;
- iii. Techniques and equipment used in bee venom collection;
- iv. Bee venom value added product;
- v. Containers used to store bee venom;
- vi. Uses of bee venom;

- vii. Reactions of bee stung victim; and
- viii. Uses of bee venom in apitherapy and other industries.

KEY AREAS

Discuss methods of harvesting bee venom and how to store it for quality maintenance. Exhibit bee venom collection and storage. Explain uses of bee venom, markets and prices. Explain bee venom reaction for stung victims. Explain the importance of bee venom in apitherapy.

2.6.6.4 METHODS AND MATERIAL

Methods of delivery

Presentations, practical, demonstrations, discussions, illustrations, sting reaction test.

Teaching material

Bee venom, bee venom collectors, bee venom containers, refrigerator, venom scrapper, handout, flip chart or chalkboard, video, marker pen, computer, projector

Duration: 5 hours

Number of participants: Maximum of 30 participants.

2.7. PROCESSING, PACKAGING AND LABELING OF HONEYBEE PRODUCTS

2.7.1 EXPECTED LEARNING OUTCOME

At the end of the training participants should be able to:

- i. use appropriate equipment to handle and process honeybee products;
- ii. understand different processing techniques;
- iii. use appropriate packaging materials; and
- iv. use labels with standard information.

2.7.2 SUMMARY OF THE THEME

Honeybee products are processed so that they can be transformed into utilizable forms. There exist different methods of processing each honeybee products, but care must be taken since methods used have a profound influence on the quality of the final product. Low quality of honeybee products may be associated with inadequate processing skills and knowledge, and inappropriate processing equipment. Therefore, processors need to have access to improved knowledge and skills and appropriate technology for handling honeybee products. Likewise, packaging should be handled appropriately because influences quality and marketing of products. Labels should be attractive and full of important information. Specific training for each product should be carefully designed and offered to participants. Careful selection of appropriate packaging containers and packaging materials is vital for maintaining the quality of the products. Proper labeling adds to awareness of the content in that particular container.

2.7.3 LEARNING CONTENTS:

- i. Importance of honeybee products processing;
- ii. Equipment and tools used in processing of honeybee products;
- iii. Methods for processing honeybee products;
- iv. Characteristics of standard labels;
- v. Standard containers or packing materials of bee products; and
- vi. Packaging and labeling of honeybee products.

KEY AREAS

Participants should discuss different methods of processing honeybee products and how they impact quality. They should also process products especially honey and beeswax. It is important to see different types of containers and be guided how to select the appropriate ones. They must be shown different labels and useful information that should be included in the labels. Characteristics of appropriate labels must be demonstrated. This will make participants capable of recognizing appropriate and standard operational materials when handling honeybee products

2.7.4 METHODS AND MATERIAL

Methods of delivery

Presentations, practical, demonstrations, discussions, illustrations, excursions, field visits, exhibitions.

Teaching material

Honeybee products, handout, Beehives, processing equipment, Flip chart or chalkboard, Computer, projectors, processing gears, sample packaging materials and labels.

Duration: 10 hours.

Number of participants: maximum of 30 participants.

2. 8. SAFETY AND QUALITY OF HONEYBEE PRODUCTS

2.8.1 EXPECTED LEARNING OUTCOME

At the end of the training participants should be able to:

- i. understand the importance of producing and maintaining honeybee products quality;
- ii. understand and use standard procedures or agreed methods for producing quality honeybee products;
- iii. identify factors that can affect quality and safety of honeybee products at different stages along the value chain;
- iv. use simple tests to check quality of honey and beeswax; and
- v. recognize signs of honeybee products that has lost its quality.

2.8.2 SUMMARY OF THE THEME

Most honeybee products are used in various industries like cosmetics, food and pharmaceutical industries as well as healthy component of human diet. Contamination of honeybee products either by beekeepers, processors or other dealers along the value chain weakens product's quality and consequently its market value. The production process is tailored according to the market demands. Honeybee products value chain begins with good honeybee husbandry and ends in a market (Figure 3). The illustration indicates the route through

which the product quality is likely to be negatively affected if care is not taken and has negative impact in local and international standards.

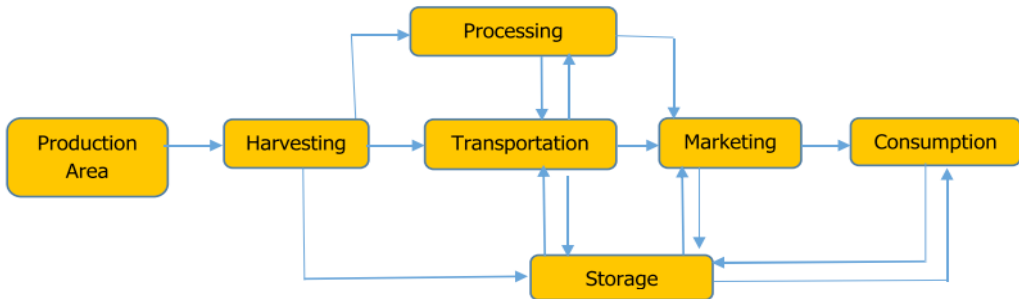


Figure 3: Summary of general Bee products value chain

The general understanding of quality is important, but it is even more important for participants to understand the quality requirement of specific products. This will enable participants to appreciate quality aspects of each product and quality factors that influences its market. Despite having the highest production potential of honeybee products in Africa, beekeeping industry in Tanzania still faces many challenges that are related to product quality and in some aspects, quantity. Other challenges come from contaminants due to beekeepers' activities especially by those who use traditional methods, free residues from agricultural inputs (accidental contamination) and rarely from conventional application of pesticides to control bee pests. Contamination by pollen from genetically modified crops also affects honeybee product quality. Honeybee products are diverse; their methods of production and handling require different considerations in order to maintain its quality.

2.8.3.1 HONEY QUALITY

Quality of honey is intact before being harvested from the hive and its quality starts deteriorating once in the hands of different actors. Quality starts getting bad at harvesting and later, through extraction, processing, transportation and storage if care is not taken. However, safety of honeybee products may be affected in earlier stages when honeybees forage on contaminated nectar, pollen or water. The quality of honey can rarely be improved once it has been harvested. Quality of honey is an important criterion in the food industry as it serves to

eliminate adulteration and honey substitution. The choice of the method to use in determining quality depends on the stage at which the product is along the value chain. Most countries have set honey standards basing on composition. Table 1 summarizes the composition, parameters and reference of analysis.

Table 1: Common parameters and methods of testing honey quality

Indicator/ Composition	Parameter	Measurement/ reference
Freshness	Smell and taste	Olfactory
	HMF	Laboratory tests
	Glucose-oxidase	H ₂ O ₂ test strips
	Diastase	Laboratory test
Moisture content	Density	Measuring jug + scale
	Refraction of light	Refractometer
Fermentation	Alcohol	Foaming
	Acetic acid	Taste
Enzyme	Diastase	Laboratory
	HMF	Laboratory
Electric conduction	Differs per honey	Laboratory
Glucose/ Fructose	Differs per honey	Titration
		Polarization glass
Pollen types	Differs for honey	Microscope and pollen collection or pollen atlas
No residual	Maximum residual Limit	Laboratory tests

2.8.3.1.1 LEARNING CONTENT

- i. Quality parameters for honey;
- ii. Practices of handling honey that impairs its quality along the value chain;
- iii. Honey safety;
- iv. Testing honey quality; and
- v. Common honey contaminants and adulterants.

2.8.3.1.2 METHODS AND MATERIAL

Methods of delivery

Presentations, question and answer sessions, demonstrations, Use video shows, pictures, Practical, illustrations and field visit.

Teaching material

Handouts, Video and Pictures, samples of honey, Computer, projector, flip chart, DVDs, marker pen, stationery, honey refractometer etc..

Duration: 5 hours

Number of participants: 30 Participants

2. 8.3.2 BEESWAX QUALITY

In order to maintain its quality beeswax rendering requires use of appropriate methods. Quality of beeswax can be destroyed through contamination or adulteration which may happen during processing or storage. Often, adulteration is done purposefully by unfaithful players in the value chain by adding different material that spoils its quality. In fact, even types of equipment and materials used during rendering or storage may easily affect the quality of beeswax. Beeswax is used in several industries such as pharmaceutical, cosmetics, textile, confectionary to mention a few, therefore its composition must be intact.

2.8.3.2.1 LEARNING CONTENTS

- i. Beeswax quality parameters and testing methods;
- ii. Handling practices that impairs quality of beeswax; and
- iii. Best practices to manage beeswax quality along the value chain.

2.8.3.2.2 METHODS AND MATERIAL**Delivery Methods**

Presentations, question and answer, demonstration, practical, video, field visits.

Teaching material

Handouts, Video and Pictures, beeswax sample, Computer, projector, wax extractor, wax melting equipment, flip chart, DVDs, marker pen, stationery etc.

Duration: 3 hours

Number of participants: *Maximum of 30 participants*

2.8.3.3 BEE POLLEN QUALITY

Consideration for bee pollen quality requires better understanding of the situations that may result into contamination of the product. Its quality is likely

to deteriorate due to poor planning at production and inappropriate handling of the product during harvesting and storage. The producer must prevent contamination by foreign particles and maintain its safety. An apiary for pollen production requires an environment that is pollution free and practices that avoid possible contaminations. Quality bee pollen is free from any debris such as wax cappings, dust, and debris from bottom of the hive and other foreign particles and pesticide residues. But also, to maintain its quality, precautions need to be taken during drying and storage to maintain its nutritional and calorific value which is important quality parameters for the product. There are different methods for testing quality of pollen. To maintain its quality, pollen must be stored in standard containers. Pollen is used as food supplement and as raw material for pharmaceutical industry. In human body, pollen strengthens immune system, eases symptoms of menopause, reduces stress, boost liver health and works as an antioxidant.

2.8.3.3.1 LEARNING CONTENTS

- i. Bee pollen quality parameters and testing methods;
- ii. Practices of handling bee pollen that impairs quality at different stages along the value chain; and
- iii. Practices that maintain bee pollen quality and safety along the value chain.

2.8.3.3.2 METHODS AND MATERIAL

Methods of delivery

Presentation, question and answer sessions, video shows, pictures, Practical and illustrations.

Teaching material

Handouts, Video and Pictures, bee pollen sample of good and poor quality, computer, projector, pollen trap, pollen drier, Flip chart, DVDs, marker pen, stationery, storage containers etc.

Duration: 3 hours

Number of participants: Maximum of 30 participants

2.8.3.4 BEE PROPOLIS QUALITY

The quality of propolis and its purity thus its safety highly depends on the methods used during collection. Propolis scraped from parts of the hive or wood normally contains various impurities. These deteriorate its quality and have to be removed before it is stored or if to be consumed right away. Propolis collected from propolis traps has fewer impurities. The active ingredient of propolis, its chemical composition and even its quality may vary with plant sources, geographical zone and seasons. Propolis from tropical regions has a low content of active ingredients compared to that in moderate climate (Kajungiev *et al.*, 1999). Its quality parameters can be provided in various quality standards that might be available in each country of origin. Propolis is used in formulation of upper respiratory tract infections, common cold, and flu-like infections, wound healing, treatment of burns, acne, herpes simplex and genitalis as well as neurodermatitis. Propolis production offers considerably better prices as compared to honey; however, its market is still limited by low production and poor quality.

2.8.3.4.1 LEARNING CONTENT

- i. Extraction of Propolis;
- ii. Bee propolis quality parameters and testing methods;
- iii. Practice of handling bee propolis that impairs its quality and safety; and
- iv. Practices to maintain bee propolis quality along the value chain.

2.8.3.4.2 METHODS AND MATERIAL

Method of delivery

Presentations question and answer sessions, video shows, picture, practical and illustrations.

Teaching material

Handouts, video and Pictures, bee propolis sample, alcohol for storage, computer, projector, bee propolis trap, refrigerator, propolis grinder to make powder, Flip chart, DVDs, Marker pen, stationery, appropriate storage containers etc.

Duration: 3 hours

Number of participants: Maximum of 30 participants

2.8.3.5 BEE VENOM QUALITY

The venoms of most stinging insects including honeybees consist of enzymes, protein, peptides and a variety of smaller molecules. Worldwide, bee venom is not considered as an official drug or food, as it lacks official quality standards regarding its composition. It is composed of volatile elements including mellitin which has antiviral properties, dopamine, histamine among others, and these are indirectly used as one of its purity and quality components. However, components of bee venom are strongly affected by storage condition especially light, water, and temperature. Care should thus be taken during production to protect it from deterioration. To maintain its quality bee venom is stored in specific containers.

2.8.3.5.1 LEARNING CONTENTS

- i. Bee venom quality parameters, composition and testing methods;
- ii. Practices of handling and its influence on bee venom quality;
- iii. Factors that affects physical /chemical characteristics of bee venom; and
- iv. Practices to maintain bee venom quality and safety along the value chain.

2.8.3.5.2 METHODS AND MATERIAL

Methods of delivery

Presentations, question and answer sessions, to demonstrations, practical. Use video shows, picture of bee venom production and handling, practical and illustrations.

Teaching material

Handouts, video and pictures, bee venom sample, computer, projector, bee venom trap, refrigerator, venom storage containers, flip chart, DVDs, marker pen, stationery.

Duration: 3 hours

Number of participants: Maximum of 30 participants

2.8.3.6 ROYAL JELLY QUALITY

Royal jelly is a brood and queen food which is rich in proteins, sugars and fatty acids. It is an important component of pharmacological products and is also

used in cosmetics industry. Royal jelly is harvested from queen cells on the comb. Water content is an important quality measure of raw royal jelly. Other quality parameters for royal jelly include 10-HDA, protein, and its sugar contents. However, most of these quality parameters require laboratory test to verify. Royal jelly quality is often affected by adulteration with honey which is done unfaithfully to increase its sugar value. However, products that are mixture of honey with royal jelly are common in the market and is acceptable. Royal jelly quality and safety deteriorates with storage but also due to its higher nutrition values, molds may grow on royal jelly. As many other products specialized containers are required to maintain royal jelly quality. Appendices 1 summarizes test methods for quality of all other bee products than honey.

2.8.3.6.1 LEARNING CONTENT

- i. Royal jelly quality parameters and composition;
- ii. Factors influencing royal jelly quality and safety; and
- iii. Royal jelly quality testing methods.

2.8.3.6.2 METHODS AND MATERIAL

Methods of delivery

Presentations, question and answer session, demonstrations/ practical video shows or picture of royal jelly production and handling, Practical and illustrations.

Teaching material

Handouts, video and Pictures, royal jelly sample, computer, projector, royal jelly collector, refrigerator, royal jelly storage tube, Flip chart, marker pen, stationery.

Duration: 3 hours

Number of participants: Maximum of 30 participants

KEY AREAS

Discuss and demonstrate to participants the difference between good quality products and products with poor quality. Let them appreciate how poor quality affects the price by them placing prices to products with poor and good quality. Demonstrate how Standard Operating Procedures (SOP) of handling different products maintain the quality and safety. Discuss factors that affect quality of honeybee products and what indicates products that have lost its quality. Demonstrate simple procedures of assessing quality of products such as honey and beeswax. Discuss parts of legislations and guidelines that deal with quality especially the Guideline of 2007 for Quality Assurance of Honeybee products in Tanzania. The aim is to make the participants appreciate the importance of producing quality and safe honeybee products.

2.9 MARKETS AND MARKETING

2.9.1 EXPECTED LEARNING OUTCOME

At the end of the training participants will be able to:

- i. apply basic entrepreneurship skills;
- ii. access to markets and knowledgeable of various marketing strategies;
- iii. understand the importance of market and market requirements (prices, quality and quantity);
- iv. access markets and market information;
- v. understand the importance of cooperative societies as marketing strategy to increase quantity of products, bargaining power and maximize price; and
- vi. understand legal framework that govern markets of honeybee products.

2.9.2 SUMMARY OF THE THEME

The ultimate goals of keeping honeybees vary among individuals. Some do beekeeping for livelihood, business, and others keep honeybees as hobby. Beekeepers and traders take beekeeping industry as an important enterprise, which is technically feasible and economically viable activity. However, these groups of stakeholders face among others limited market and market information

for their products. On the other hand, quality and quantity requirements, prices, packaging, market dynamics in relation to supply and demand, level of processing (value addition) differ between and within markets as well as between and within honeybee products and intended uses. Tanzania has often been unable to meet the European market demand of honeybee products due to failure to meet market quality standards and quantity demanded. The importance of cooperative as one of the market strategies and linkage to increase market network, bargaining power and hence better prices, need to be emphasized. The knowledge of entrepreneurial skills needs to be stressed such that different actors may utilize existing opportunities along the beekeeping value chain to their advantage.

Knowledge of profit and loss related to costs and prices must be well articulated for sustainable enterprise. Better understanding of the market system is key to opportunities for beekeepers and other actors to raise their sales, income and eventually improve their standard of living. Snag that affects markets of honeybee products in Tanzania is unawareness of existence of lucrative local and external markets and procedures and legal frameworks that govern market of honeybee products. For example, organic products fetch higher prices than non-organic products but most of beekeeping actors are unaware of the existence of this market and the certification process.

2.9.3 LEARNING CONTENTS

- i. Market and marketing concept;
- ii. Market chain;
- iii. Marketing strategies including use of ICT;
- iv. Market information (including market outlook and export readiness skills);
- v. Supply and demand;
- vi. Challenges associated with honeybee products markets and its solution;
- vii. Business ethics;
- viii. Business record keeping;
- ix. Access to finance;
- x. Legal framework governing market; and
- xi. Entrepreneurship skills and business plan development.

KEY AREAS

Discuss how and where to find and access market and marketing information both locally and internationally. Discuss aspects of prices and market requirements such as quality and quantity, demand and supply and issues of equilibrium price in basic economics and how they can be attained through cooperative unions and associations. Discuss the power of bargaining through cooperative over individual beekeepers as well as ability to mobilize resources both financial and human. Discuss the merits of cooperatives in accessing credits through banks or micro-financing outlets. Discuss parts of the beekeeping act and general regulations that govern marketing of honeybee products. Discuss use of mobile technologies as a marketing tool.

2.9.4 METHODS AND MATERIAL***Methods of delivery***

Presentation, question and answer sessions, demonstration, field visit, exhibitions, excursions, discussions.

Teaching material

Handouts, pictures, computer, projector, flip chart, DVDs, marker pen, business kit, stationery.

Duration: 6 hours

Number of participants: Maximum of 30 participants

2.10. BEE PROTECTION**2.10.1 EXPECTED LEARNING OUTCOME**

At the end of training participants should be able to:

- i. examine and identify bee diseases, pests and other related causes of health problems to bees (stinging and stingless);
- ii. recognize symptoms and/ or signs of major bee pests, predators, infectious and noninfectious diseases and other problems environmental related factors (e.g. pesticides contamination etc.);

- iii. use various control methods on bee diseases, predators, pests and other health problems; and
- iv. manage various bee health problems and maintain healthy bee colonies.

2.10.2 SUMMARY OF THE THEME

Honeybees can be infected by a number of diseases some of which may severely destroy a bee colony, or several. Numerous predators, parasites (mites) and pathogens, (protozoa, bacteria and viruses) that infect and prey upon the bee do exist. Keeping strong and healthy bee colonies through regular maintenance activities remains a potential remedy to many problems on bees. Larvae and adults are more susceptible to disease. Knowledge of common bee diseases, pests and predators in a specific area is crucial. When honeybees lack food, suffer from malnutrition, become weak and unable to perform routine activities, thus becoming susceptible to diseases. On the other hand, bee pests and predators destruct and weaken colonies which result into absconding, low production and sometimes leading to total colony collapse. Generally, benefits from bees highly depend on how beekeepers maintain the health and safety of bee colonies. Thus, recognizing and controlling of bee diseases and pests is an integral part of a beekeeper's activities. This can only be achieved if beekeepers can be able to differentiate a healthier colony from unhealthy one based on clinical signs.

Beekeepers are required by Law to take specific measures in case of emergency of notifiable diseases (Beekeeping Act. 2002). Bee healthy and strength can also be affected by exposure to pesticides and contamination that may cause lethal or sublethal effects. Common health related problems affecting bees fall in the following categories:

- i. bee diseases (e.g. bacterial, viral, protozoans and amoebic diseases)
- ii. fungal diseases (Chalk brood disease, Stone brood disease)
- iii. viral disease -Sac brood disease
- iv. protozoan disease -Nosema disease (Nosemosis)
- v. diseases caused by parasites of bees-Varroa mites (Varroasis), Tropilaelaps mites, Tracheal mites,
- vi. noninfectious diseases (e.g. Malnutrition)
- vii. abnormalities (eg. Laying worker, bald broods)
- viii. Bee pests
- ix Bee predators

2.10.3 LEARNING CONTENTS

- i. Characteristics of various honeybee diseases, pests, predators and other abnormalities on honeybees;
- ii. Bee diseases, pests, predators and other abnormalities on honeybees;
- iii. Diseases causative agent;
- iv. Favorable conditions for diseases occurrences;
- v. Means of spreading and dispersal;
- vi. Effects and symptoms/ clinical signs to a bee colony/ an apiary;
- vii. Control and management of all bee's health related problems; and
- viii. IPM concept on beekeeping.

KEY AREAS

Demonstrate clinical signs of major common diseases in the area and discuss their causes. Exhibit common pests and bee enemies and discuss methods of managing them. Discuss issues related to notifiable disease as required by the Law. Discuss bee problems caused by noninfectious diseases especially contamination from pesticides and measure to protect bees from such exposure. Generally, ensure that Beekeepers capacity to manage various honeybee health problems is enhanced.

2.10.4 METHODS AND MATERIAL

Methods of delivery

Presentations, discussions, study visits and practical to examine and demonstrate control of various related problems.

Teaching material

Handouts, video, pictures, specimens (dead bees, brood combs, pest, nest material), materials to control respective problem or an agent, protective gears, laptop and projector and screen, sample collecting tools, vials, flip chart, marker pen, stationery.

Duration: 3 hours

Number of participants: Maximum of 30 participants

2.11 CONSERVATION OF BEES AND THEIR HABITATS

2.11.1 EXPECTED LEARNING OUTCOMES

At the end of the training participants should be able to:

- i. understand the importance of conserving the bee and its habitats;
- ii. identify threats to bees;
- iii. protect bees and their habitats sustainably;
- iv. understand procedures of establishing bee reserves; and
- v. enrich bee fodder resources.

2.11.2 SUMMARY OF THE THEME

Honeybees are essential component of agro- and natural ecosystems. As main pollinators, they provide essential ecosystem service that result in the reproduction of many flowering plants, hence play a role on food production and ecosystem maintenance. Despite the importance to the peoples' livelihood and biological diversity maintenance, honeybees are still threatened by human activities such as deforestation and the wide use of pesticides. These threats need to be checked if survival of bees is to be ensured.

Communities living adjacent to forests can participate in the conservation efforts of these resources. Conservation of bees and their habitats can be achieved through establishment of bee reserves, establishment of Api-agroforestry practices and systems, enrichment planting and *insitu* conservation in apiaries. It is also important to ensure that projects carried out near bee reserves and apiaries conduct Environmental Impact Assessment (EIA) before they start. On the other hand, availability of safe water for bees cannot be overemphasized. Legislation for conservation of natural resources are in place and they need to be observed.

2.11.3 LEARNING CONTENTS

- i. The relationship between bees and environment;
- ii. Threats caused by pesticides and other contaminants;
- iii. Methods of conserving bees and their habitats;
- iv. Legislation governing conservation of bees and habitats; and
- v. Water quality and safety for bees.

KEY AREAS

Discuss the importance of bees to livelihood. Discuss the concept of conservation and interdependence between bees and plants. Explain procedures of establishing bee reserves. Discuss potential threats to bees and methods to protect them. Explain the necessity of safe water to bees.

2.11.4 METHODS AND MATERIAL***Methods of delivery***

Presentations, discussion, demonstration, question and answer, field visits, excursion.

Teaching materials

Flip chart, chalkboard, video documentaries, projector, computer and handouts.

Duration: 3 hours

Number of participants: Maximum of 30 participants.

2.12 VALUE ADDITION AND DIVERSIFICATION OF BEE PRODUCTS**2.12.1 EXPECTED LEARNING OUTCOMES**

At the end of the training participants should be able to:

- i. make different quality value added bee products;
- ii. understand and act according to the Policies, the Act and Regulations that support value addition and trade; and
- iii. identify beekeeping value added products.

2.12.2 SUMMARY OF THE THEME

Bees produce various products primarily; honey, beeswax, bee pollen, propolis, royal jelly and bee venom. However, the most commonly produced bee products in Tanzania are honey and beeswax. Many beekeepers have not diversified to other products though are more valuable than honey and beeswax. Technology of harvesting all these products exists but beekeepers remain unaware. Harvesting of these products require specialized skills, equipment and technology.

Some of these products, for example honey can be used without any modification that is in the state that bees produce them. However, modifications exist with many other uses where these products are just one of the ingredients of different products. For example, beeswax is just one of ingredients for beeswax soap and honey is one of ingredients of body lotion. It is therefore, the secondary product that is called a “value added product”. In fact, many primary beekeeping products such as propolis, beeswax, venom and royal jelly can only be used effectively when they are converted into value added products. Value addition increases the market value and profitability of the primary products. Value addition enhances the value of primary product. In this case, the extraction, processing and packaging of honey may also be considered as value addition. Value added products are regulated by Tanzania Medical Devices Authority or Tanzania Bureau of Standards.

The National Trade Policy of 2003 encourages value-addition in primary exports products to enhance generation of foreign exchange. The National Trade Policy is geared towards promoting domestic production and technological change that is consistent with the increase in productivity.

2.12.3 LEARNING CONTENT

- i. Product differentiation and diversification, value-addition and quality control of bee products;
- ii. Ingredients and different recipes and methods of producing value added products;
- iii. Carry out practical to show the participants the actual production procedure;
- iv. Making of sample value added honeybee products;
- v. Procedures on new product certification and the role of TMDA and TBS; and
- vi. Industry safety procedures.

2.12.4 EXAMPLE OF RECIPES FOR VALUE ADDED BEE PRODUCTS

Table 2: Honey-beeswax soap

S/NO.	Ingredients	Amount by weight
1	Soap base (chips or bars)	90
2	Beeswax	0.5
3	Glycerol	5
4	Essential oil (or propolis extract)	2.5
5	Honey	2.5
6	Oiled Moulds	

Procedure

Obtain a bar of soap and make chips out of it. Melt and blend the soap with glycerol and beeswax. When the mixture starts to thicken during cooling, add the honey and essential oils. Pour into greased or oiled moulds.

Making of Propolis cream

This cream can be used on cuts abscesses and festering wounds in animals and external ulcers and burns in humans.

Table 3: Propolis cream

S/NO.	Ingredients	Amount in weight
1	Vaseline or animal fat	10
2	Propolis	1

Procedure

Boil the Vaseline or fat to boiling point then cool it to 50-60 °C. At this juncture add propolis and raise the temperature to 70-80°C. Stir the mixture for 10 minutes and cover for 10 minutes. Filter through one layer of thin cloth into clean container and seal and leave it to cool.

Making of Scent Candle

Material

- i. 2 kg beeswax
- ii. Essential oils with preferred scent (can be orange, lemon grass etc.)

- iii. Two Aluminium pot one large another small that can enter into the larger Aluminium
- iv. Thermometer
- v. Candle moulds (where you do not have special moulds you can use glass)
- vi. Spray oil
- vii. Wicks

Procedure

Chop your wax in smaller pieces (they should be real small). Then boil water in a larger Aluminium pot. Insert a small Aluminium pot into the one containing water. Add the pieces of beeswax in the small Aluminium pot and leave it to melt while stirring. Check that the Temperature does not go beyond 90°C. Once the wax has melted, add your desired scent 12 ml for 100 ml of melted wax. Ensure that scent has been distributed evenly. Make the Moulds ready; oil them if you are using temporary Moulds to ensure easy removal. Insert the wick by tying it to a sticky ensure that it is straight from the top to the bottom. Pour in the melted beeswax leaving about 2 cm from the top. Give the molded candle time to harden (it might need over 24 hours) before removing it from the Moulds or lighting it.

KEY AREAS

Discuss on the importance of value addition in the marketing of bee products for increased income and improved livelihood. Emphasize on beekeepers to tap into more and diversified markets, so that they have more control over prices. Discuss on the excess produce and/or waste that can be used more efficiently and provide the opportunity to earn more profits.

Demonstrate how to produce value added products from common products e.g. honey and beeswax. Recipes provided can be used. As value is added to bee products, not only is training required in improved processing methods for value adding, but quality control and quality maintenance training are also required. Great care must be taken in all processing operations for quality and safety reasons.

2.12.5 METHODS AND MATERIAL

Method of delivery

Presentations, discussion, demonstration, question and answer

Teaching material

Video documentaries, materials required to manufacture value added products, different value-added products made from bee products, flip chart, chalkboard, computer, projector, handouts.

Duration: 4 hours

Number of participants: Maximum of 30 participants

More recipes for Bee products value added products can be obtained from Krell R, "entitled Value- added products from Beekeeping" Published by FAO 1996 as FAO agricultural Bulletin No. 124.

2.13: CO-OPERATIVES IN BEEKEEPING DEVELOPMENT

2.13.1 EXPECTED LEARNING OUTCOMES

At the end of the training participants should be able to:

- i. understand the concepts of co-operation and co-operative;
- ii. understand the value and principles of co-operatives;
- iii. understand different types and functions of co-operatives;
- iv. describe the roles of beekeeping groups/ co-operatives;
- v. understand the procedures for establishing beekeeping groups/ co-operative societies;
- vi. manage beekeeping groups/ co-operative societies; and
- vii. understand the role of Integrated co-operatives in beekeeping;

2.13.2 SUMMARY OF THE THEME

A co-operative is a group of people who work together voluntarily to meet their common economic, social, and cultural needs through a jointly owned and democratically controlled enterprise. Co-operatives are based on the values of self-help, self-responsibility, democracy, equality and solidarity. Co-operative

members believe in honesty, openness, social responsibility and caring for others. Co-operatives in Tanzania have a long history, dating back to the late 1920s. In times past, co-operatives played a vital role in rural and urban economic and social development of the country. Since independence, beekeepers have been associated into informal groups and formal associations or cooperatives or community-based organizations. The roles of the associate, among others were to work together for the purpose of combining efforts to manage their initiatives for easy access to various support and gain market advantages for their products.

2.13.3 LEARNING CONTENTS

- i. Concepts of co-operation and co-operative;
- ii. Value and principles of co-operatives;
- iii. Different types of co-operatives;
- iv. Roles of beekeeping groups and co-operatives;
- v. Procedures for establishing beekeeping groups and co-operative societies;
- vi. Management of beekeeping groups and co-operative societies;
- vii. The role of Tanzania Co-operative Development Commission (TCDC) in promotion and regulating;
- viii. Integrated beekeeping groups and co-operatives; and
- ix. Right and responsibilities of members of beekeeping groups and co-operatives.

KEY AREAS

Create awareness of the communities and beekeepers on the importance of working in cooperatives, values, principles, procedures for establishing and management of cooperatives, rights and responsibilities of members, management and accountabilities of each member in the cooperative.

2.13.4 METHODS AND MATERIAL

Methods of delivery

Discussion, demonstration, practical, question and answer, field visit

Teaching Material

Flip chart or chalkboard, Projectors, handouts,

Duration: 6 hours

Number of participants: Maximum of 30 participants

2.14: EMERGING ISSUES**2.14.1 ORGANIC BEEKEEPING****2.14.1.1 EXPECTED LEARNING OUTCOMES**

At the end of the training participants should:

- i. have ability to set organic beekeeping enterprises;
- ii. produce organic products and access to markets; and
- iii. understand organic certification procedure for honeybee products.

2.14.1.2 SUMMARY OF THE THEME

Organic is a term used to describe a product that is produced in a way that cares for the environment. The process guarantees that, 1) all inputs are of natural origin, 2) the product is free from synthetic chemical contaminants and 3) the product has not been chemically altered. It primarily requires that beekeeping practice including equipment, tools and the working environment be free from chemical contaminants. Organic beekeeping is legally regulated, and beekeepers must comply with recognized organic beekeeping standards. The organic standards for beekeeping cover all practices along the beekeeping value chain. Similarly, record keeping arrangements necessary for identification and audit trail need to be emphasized. The certification of honeybee products as organic needs the honeybees to forage only on organically certified agricultural land or from wild natural areas. To access the organic market for honeybee products, beekeepers must manage their honeybees in compliance with recognized organic standards.

2.14.1.3 LEARNING CONTENTS

- i. Requirements for organic bee products production (e.g. honey);
- ii. Standard procedures for setting beekeeping enterprise for organic production;

- iii. Organic Honey Production Process;
- iv. Organic certification procedures and the associated costs;
- v. Advantages and disadvantages of being certified organic beekeepers; and
- vi. Traceability in organic production.

KEY AREAS

Discuss methods of producing organic honeybee products and how such products fetch higher market prices than non-organic products. Discuss the certification procedure and the related costs and means of reducing them e.g. through cooperatives. Discuss availability of markets for such products.

2.14.1.4 METHODS AND MATERIAL

Methods of delivery

Presentation, Discussion, demonstration, question and answer

Teaching materials

Computer, projector, video documentaries, flip chart, chalkboard and handouts

Duration: 5 hours

Number of participants: Maximum of 30 participants

2.14.2 POLLINATION SERVICES

2.14.2.1 EXPECTED LEARNING OUTCOMES

At the end of the training participants should be able to:

- i. Understand the importance of bees as pollinators;
- ii. recognize threats caused by pesticides application to honeybees and their products;
- iii. Understand methods of protecting honeybees from pesticide exposure and;
- iv. use the possibility of increasing income through bee pollination services.

2.14.2.2 SUMMARY OF THE THEME

Pollination is the process of transferring pollens from anther to the stigma of same or another plant of the same species. Bees are the main pollinators

of many crops and wild plant species. Plants that reproduce sexually cannot produce seeds and fruits without pollination. Thus, pollination is important for crop production and food security. Globally, over 85% of human major food crops that is fruit, nut, edible oil, vegetables, proteinaceous crops, spices and condiments depend on animal pollination.

There is interdependence between plants and pollinators, whereas plants provides different rewards for pollinators such as pollen and nectar while bees in return affects pollination. However, bees are not always safe when they visit plants. In agricultural setting, farmers normally use pesticides to control pests and diseases. Most of these chemicals are dangerous to bees. They either kill the bees directly in the field or kills bees and brood if taken to their hive. The problem is not only related to mortality of bees but also sub-lethal effects that affect biology, physiology, demography and/ or behavior of the bees. Globally, pesticide application is one of the factors that have been associated with disappearance of honeybees' colony which also affects quality of honeybee products. Due to the importance of pollination to crop production, in other places income of beekeepers does not only come from sales of honeybee products, but also provisioning of pollination services to farmers. Bees and other pollinators can be protected through application of Integrated Pest Management (IPM) schemes, selection of types of pesticides based on their residue toxicity, time of application and weather conditions.

2.14.2.3 LEARNING CONTENTS

- i. Interdependency relationship between bees and plants;
- ii. Importance of pollination to wild plants and crop production;
- iii. Rewards that bees get from plants;
- iv. Importance of pollination to beekeepers;
- v. Benefit that farmers obtain from pollination services;
- vi. Beekeepers pollination services provisioning contracts;
- vii. Pesticides poisoning on bees due to pollination services;
- viii. Methods of reducing bee risks due to pollination services; and
- ix. Management of bee colonies for pollination services.

KEY AREAS

“Discuss the contribution of pollination to crop production indicating that without pollination of crops it will be impossible to produce most seeds and fruits which will negatively impact economy and food security. Give example of crops that entirely depend on bee pollination. Show that bees are the major pollinators because they can be managed and used to provide such services. Discuss the existing threats to pollinators especially application of pesticides near bee colonies. Discuss possibility of providing pollination service through entering agreements with farmers and ways of protecting bees from pesticide exposure such as use of IPM schemes.

2.14.2.4 METHODS AND MATERIAL***Methods of delivery***

Presentations, practical, demonstrations, discussions, illustrations, field visits

Teaching materials

Bee colonies, sample of pesticides, handout, flip chart or chalkboard, computer, projectors, protective gears, bee smoker, hive tool, pollen trap.

Duration: 10 hours

Number of participants: Maximum of 30 participants

2.14.3 CLIMATE CHANGE**2.14.3.1 EXPECTED LEARNING OUTCOME**

At the end of the training participants should:

- i. be aware of what climate change is and what it means in the context of beekeeping;
- ii. recognize the impacts of climate change in beekeeping; and
- iii. be able to apply adaptive climate change strategies to safeguard beekeeping.

2.14.3.2 SUMMARY OF THE THEME

Climate change refers to a significant variation either in the average state of climate or in its variability, persisting for an extended period (typically decades or longer). It is attributed directly or indirectly to human activity that alters the composition of the global atmosphere.

Climate change is rapidly emerging as one of the most serious global problems affecting many sectors and is one of the most serious threats to sustainable development. It has adverse impact on environment, human health, food security, water resources, natural resources and physical infrastructure. Climate change have negative impacts to the productivity of honeybees. It alters plant flowering time, increase water stress, inhibiting movement, affect bee communications, cause physical damage to hives, colony starvation and retard bee forage activities. In response to climate change beekeepers need to adapt for the purpose of reducing impacts by opting to alternative beekeeping management operations.

2.14.3.3 LEARNING CONTENT

- i. Beekeeping and its vulnerability to climate change;
- ii. Impacts of climate change on honeybees;
- iii. Beekeeping adaptive strategies to climate change impacts; and
- iv. Indigenous practices to mitigate climate change.

KEY AREAS

Explain what defines climate change. Discuss what climate change effects beekeepers are witnessing in their area. Discuss adaptive and mitigation measures they can be used to reduce the observed impacts.

2.14.3.4 METHODS AND MATERIAL

Methods of delivery

Presentations, question and answers, Demonstrations, video, pictures, field visit.

Teaching material

Handouts, video and pictures, flip chart, computer, LCD projector.

Duration: 3 hours

Number of participants: Maximum of 30 participants

2.14.4 API-TOURISM

2.14.4.1 EXPECTED LEARNING OUTCOMES

At the end of the training participants should be able to:

- i. understand the concept of Api-tourism;
- ii. understand Api-tourism products;
- iii. design Api – tourism attraction site; and
- iv. maintain Api-tourism site.

2.14.4.2 SUMMARY OF THE THEME

Api-tourism is one form of tourism that deals with culture and traditions of rural communities. Api-tourism is connected with beekeeping as a traditional profession and with bee products in ecological, food and medicinal aspects. Api-tourism involves, among other things, visiting apiaries, observing the honeybee colonies in their natural environment, visiting apiculture museums (tradition and culture in beekeeping), tasting of different products, making of various bee product goods, walks in bee friendly gardens, apitherapy and traditional nature friendly or nature destructing equipment. These activities provide to visitors, knowledge and familiarization with the importance of bees in nature. Also, a tourist can view various techniques for hive displays and participate in bee colony inspection, processing and tasting of different bee products, learn different indigenous beekeeping activities, prepare and taste local cuisines.

2.14.4.3 LEARNING CONTENTS

- i. Api-tourism concept;
- ii. Api-tourism products;
- iii. Promotion of Api-tourism;
- iv. Features of Api-tourism site;
- v. Things to avoid when in an Api-tourism site; and
- vi. Best Api-tourism practices.

KEY AREAS

Explain what Api-tourism means. Explain Api-tourism products. Discuss the best practices in conducting Api-tourism. Discuss features of Api-tourism site.

2.14.4.4 METHODS AND MATERIAL**Methods of delivery**

Presentations, questions and answers, demonstrations, video, pictures, field visit

Teaching material

Handout, video and pictures, flip chart, computer, LCD projector.

Duration: 4 hours

Number of participants: Maximum of 30 participants.

2.15: LEGAL FRAMEWORK GOVERNING BEEKEEPING SECTOR**2.15.1 EXPECTED LEARNING OUTCOMES**

At the end of the training participants should be able to:

- i. understand legal framework in beekeeping sector; and
- ii. abide to legal requirements governing beekeeping sector.

2.15.2 SUMMARY OF THE THEME

Beekeeping operations are governed by The National Beekeeping Policy of 1998; Beekeeping Act No. 15 of 2002; Beekeeping General Regulations of 2005 and Guidelines. These legislations regulate all beekeeping activities along the value chain and need to be observed by beekeepers and other actors. These legal instruments provide guidance, opportunities, restrictions and spell penalties to offenses.

2.15.3 LEARNING CONTENTS:

- i. National Beekeeping Policy (1998);
- ii. Beekeeping Act. No. 15 (2002);
- iii. Beekeeping General regulations (2005); and
- iv. Beekeeping Guidelines.

KEY AREAS

Create awareness to beekeepers on existing legal framework governing the beekeeping sector and consequences when contravened. The use of all legal documents during the discussions is vital.

METHODS AND MATERIAL***Method of delivery***

Presentations, demonstrations, discussions

Teaching materials

Handout, Flip chart or chalkboard, computer and projectors, Legal Framework documents

Duration: 4 hours

Number of participants: Maximum of 30 participants

2.16 STINGLESS BEEKEEPING**2.16.1 EXPECTED LEARNING OUTCOMES**

At the end of the training participants should be able to:

- i. identify species of stingless bees that can be kept for commercial purposes;
- ii. understand behavior of stingless bees;
- iii. stock beehives using different methods;
- iv. establish Meliponary;
- v. manage Meliponary;
- vi. carry out different management operations;
- vii. sustainably harvest stingless bee products; and
- viii. understand uses of stingless bee products.

2.16.2 SUMMARY OF THE THEME

Stingless bee is a diverse group of eusocial bees comprising the Meliponini subfamily in the family Apidae. Throughout the Tropics, stingless bees are reared by beekeepers for their products (honey, propolis, and bee breads) and for pollination services. The increasing interests for stingless bee are attributed to the fact that they don't sting thus are easy to manage and harvest products. The natural nests of Stingless bees are usually hollow trunks, tree branches, underground burrows or rock crevices. It is from such domiciles beekeepers domesticate them. Establishing and managing stingless bees require specialized skills and knowledge. The source of stingless bee colonies for establishing Meliponary is by hunting feral colonies but also hives can be stocked through colony division.

Honey from stingless bees has higher medicinal value and locally fetch higher prices than honey from stinging bees. Stingless bees are also good pollinators and visit plants some of which cannot be visited by honeybees. Stingless bees exhibit different behaviour from stinging bees.

2.16.3 LEARNING CONTENTS

- i. Species of stingless bees and their local names;
- ii. Distribution and habitats of stingless bees;
- iii. Behaviour of stingless bees;
- iv. Bee plants useful to stingless bees;
- v. Stingless beehives;
- vi. Stocking stingless bee colonies in a beehives;
- vii. Management of stingless bee colonies;
- viii. Management of Meliponary;
- ix. Production of stingless bee products;
- x. Uses of stingless bee products; and
- xi. Pollination services by stingless bees;

KEY POINTS

Describe different species of stingless bees, get local names of the species, their distribution and habitats. Explain methods of stocking hives and demonstrate how to carry out colony division. Discuss stingless bees and Meliponary management operations, harvesting and types of products and services.

2.16.4 METHODS AND MATERIAL***Method of delivery***

Presentations, demonstrations, discussions, illustrations

Teaching materials

Handout, Flip chart or chalkboard, computer and projectors, stingless bee colonies, stingless beehives, stingless bee products.

Duration: 15 hours

Number of participants: Maximum of 30 participants.

3.0 MONITORING AND EVALUATION OF TRAINING AND EXTENSION

Monitoring and evaluation are regarded an important tool for any development intervention in projects and programmes. National Beekeeping Training and Extension Guideline (NBTEG) earmarks the need for maintaining track records of all training and extension programmes to monitor its implementation. Maintaining records helps easy to assess if training expectation of the trainees are met and see its effect and impact from the livelihood point of view.

Monitoring and evaluation are described as the eyes and ears of the project management as it helps in achieving the desired goal as well as the management tools for getting feedback information for effective management decisions. It also helps improve future training and extension performance and increase its efficiency. Therefore, the National Beekeeping Training and Extension guideline strongly encourage establishment and use of monitoring and evaluation tools to record and oversee training and extension performance and to communicate the results to planners, policy makers and stakeholders being served.

Some indicators of an effective and efficient training and extension to be recorded may include; the number of participants (male and female) attended events, the cost, level of understanding of the ideas (technologies) contained in the extension or training event, new innovations included in extension and training and extension and training methods included in programmes. Training and extension staff should be supported and supervised more closely by the responsible Ministry superior Department or Division. Monitoring and evaluation results should provide direction as to which technologies are most or least successful, delivery methods that are most or least successful, and areas which are most or least successful in training and extension programmes. Others such as livelihood assets and/ or capital are important indicators to be monitored to act as a measure of the effectiveness of the extension programme. These will

provide useful information that can be used in decision making and actions to improve programmes to stakeholders.

In case of observed poor performing technologies and adoption, adjustment may be important with research findings support and experience from practitioners. Therefore, trainers and extension staff are obliged to complete a monitoring form (Appendix 2) by recording information at the time the training and/ or extension events are taking place. Detailed guideline for monitoring and evaluation forms is as presented in Appendix 3. Trainers and extension staff need this information to keep track of effectiveness and efficiency of training and extension programmes and to evaluate if goals are met.

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APPENDICES

Appendix 1: Summary of test methods on quality of other honeybee products

Product	Composition	Measuring method
Pollen	Moisture content	Moisture meter
	No molds	Microscope
Bee bread	Moisture content	Moisture meter
	No molds	Microscope
Royal jelly	Moisture content	Moisture meter
	10-HDA (Hydroxy-2-decenoic acid)	Microscope, HPLC
	No residues	Laboratory tests
Beeswax	Purity	Laboratory tests
	No residues	Laboratory tests
Propolis	Flavonoid content	Laboratory tests
	No residues	Laboratory tests
Bee venom	Purity	Laboratory tests
	Mellitin content	Laboratory tests

Appendix 2: Monitoring and evaluation form for Training and Extension programmes templates

2A. Training Programme - Template		
Day	Component	Trainers/ responsible person
	Arrival and Registration	
	Closure	

2B. Training timetable

Time	Topic	Objective
1		
2	Tea break	
3		
4	Lunch	
5		
6		

2C. Training Evaluation Information

In order to rate the effectiveness of the training, trainer shall use this form to collect trainee opinions at the end of the programme. The following scale on a range from 1 (lowest) -5 (highest) may be adopted. Trainee should circle only one response to each question. The explanation of scores is presented on the table below.

Explanation of Score

Scores	Description of score value	Remarks of scores
5	Excellent	= outstanding; superior; exemplary
4	Very good	= above average; very competent; few if any weaknesses
3	Good	= average; may need minor improvements
2	Adequate	= below average; needs improvement
1	Deficient	= definite weakness; inadequate in many respects

Rate the Facilitator(s) ability to train:

Examples of key questions	Score ranks (circle)					N/a
Adapted to my needs	5	4	3	2	1	0
Communicated effectively	5	4	3	2	1	0
Encouraged questions and discussions	5	4	3	2	1	0
Knowledgeable of subject matter	5	4	3	2	1	0
Led by example	5	4	3	2	1	0

Maintained a friendly and helpful/supportive environment	5	4	3	2	1	0
Made the course interesting and alive	5	4	3	2	1	0
Made group presentations	5	4	3	2	1	0
Made training practical and applied	5	4	3	2	1	0
Provided practical examples or scenarios	5	4	3	2	1	0
Responded to questions effectively	5	4	3	2	1	0
Summarized key ideas / practical applications	5	4	3	2	1	0
Unpacked and fulfilled my expectations	5	4	3	2	1	0
Other (unpack please):						

Rate learning experience based on set aspects:

Indicators	Score ranks					N/a
	5	4	3	2	1	
Use of Audio-Visual Media	5	4	3	2	1	0
Use of Case study and application	5	4	3	2	1	0
Course was generally interesting and alive	5	4	3	2	1	0
General discussions were encouraged	5	4	3	2	1	0
Used Relevant Learning materials	5	4	3	2	1	0
Given practical exercises	5	4	3	2	1	0
Simulated exercises / role plays	5	4	3	2	1	0
This course gave me new knowledge	5	4	3	2	1	0
This course gave me new skills	5	4	3	2	1	0
Worked in teams / small groups	5	4	3	2	1	0
Other (unpack please):						

Rate training facilities based on aspects given:

Indicators	Score ranks					N/a
	5	4	3	2	1	
Accommodation	5	4	3	2	1	0
Meals	5	4	3	2	1	0
Medical availability	5	4	3	2	1	0
Resource availability	5	4	3	2	1	0
Field excursions/trips	5	4	3	2	1	0
Other (unpack please):						

2D. Other general questions

Based on information you received before this training course and comments you may have heard from others; you probably had some expectations. To what degree were those expectations met? (Choose one only).

1) The learning experience:

- a) substantially exceeded my expectations
- b) exceeded my expectations
- c) met my expectations
- d) partially met my expectations
- e) did not meet my expectations

2) The pace of the training was:

- a) Too slow
- b) Just right
- c) Too fast

3) The duration of this training programme was:

- a) Too long
- b) Just Right
- c) Too short

4) How much of what you have learnt from this training will be useful to you once you go back

- a) All
- b) About 75%
- c) About 50%
- d) About 25%
- e) None

5) If your answered is c, d or e above please explain why

.....

6) What is your overall rating for this training course/learning experience?

1	2	3	4	5
Poor	Fair	Good	Very good	Excellent

7) Please indicate how you will apply your new knowledge, skills and attitudes

.....

8) To what extent were the learning outcomes useful?

.....

9) Rate the most useful learning outcomes by writing the numbers 1 to 5 in the ‘most useful’ column opposite those outcomes you found most useful.

Trainee opinions for future improvement

Bearing in mind many others will follow in your footsteps and your honest feedback will help deliver a better product and fulfil needs please reply to the following

- a) What should be removed from this training programme?
- b) What should be added to this training programme?
- c) What other improvements can you recommend?

Appendix 3: Livelihood assessment indicators for monitoring effectiveness of training and extension services

There are five types of livelihood assets or capital that we all need in order to make a living and which can be used to measure the effectiveness of the extension programme: Human capital, Social capital, Natural capital, Physical capital and financial capital. The trainer/extension officer may monitor changes of his client’s livelihood after undergoing training using this template.

S/N	Indicators	Descriptions to be used to prepare tools for recording results
1.	Human capital	skills, knowledge, the ability to work and good health
2.	Social capital	the social resources that people draw on to make a living, such as relationships with either more powerful people (vertical connections) or with others like themselves (horizontal connections), or membership of groups or organizations. Generally, relationships of trust, reciprocity and exchange that the poor can draw on in times of need
3.	Natural capital	the natural resource stocks that people can draw on for their livelihoods, including land, forests, water, air, bees and so on
4.	Physical capital	the basic infrastructure that people need to make a living, as well as the tools and equipment that they use. For example, transport and communication systems, shelter, water and sanitation systems, and energy
5.	Financial capital	savings, in whichever form, access to financial services, and regular inflows of money



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