Beekeeping Manual for Training of Trainers (ToT)
Officer Level









Apiculture Development Center
Godawari, Lalitpur

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Government of Nepal
Ministry of Agriculture and Livestock Development
4211639
4211808
4211932
4211665
4211687
4211915
4211940
Fax : 4211935
Singhadurbar, Kathmandu,
Nepal

Ref:

Few Words

Beekeeping is an integral part of the Nepalese agricultural sector. Due to the biological diversity found in Nepal, beekeeping has become an important source of income for rural communities, playing a crucial role in pollination, contributing to the higher production of fruits, vegetables, oilseeds, lentils, and spices. In addition, beekeeping also plays a significant role in environmental balance, food security through biodiversity conservation.

Nepal's geographical diversity and favorable climate have enriched an enormous potential for commercial beekeeping laid on the foundation of the Beekeeping Promotion Policy, 2016 (2073 B.S.) and the Good Beekeeping Practice Implementation Guidelines, 2017 (2074 B.S.). Despite these frameworks, several challenges persist; the lack of uniformity in training programs conducted by the three tiers of government, absence of quality control mechanisms, limited processing infrastructure, and inability to meet international quality standards remain the major.

To contribute in the resolution of aforementioned challenges, this manual has been prepared to enhance scientific knowledge and practical skills for frontline gazetted officers so that they can provide training to farmers and overcome the field-level challenges. Also, it is supposed to guide advanced-level beekeeping training conducted by provincial training centers, municipalities, and INGO/NGOs. This manual covers key topics such as species-specific management of bees, hives, and equipment used in beekeeping, proper management of diseases, pests, and predators, honey harvesting, processing, and marketing.

Special thanks go to the Apiculture Development Center, Godawari, Lalitpur which played an important role in the preparation of this manual. Moreover, I extend my appreciation to Professor Dr. Resham Bahadur Thapa, Dr. Sabitra Baral, Mr. Tirtha Kumar Shrestha, Dr. Shiva Prasad Rijal, Mr. Shiva Sundar Ghimire, Mr. Rajendra Kumar Malla, Dr. Prakash Raj Bista, Mr. Pramod Koirala, Dr. Maniratna Aryal, Ms. Rachana Pandit, and Ms. Surakshya Subedee, who made important contribution to the preparation of this manual.

At last, this beekeeping training manual is expected to deliver systematic knowledge to trainers, farmers, students, and entrepreneurs, and will help to turn existing challenges of beekeeping into opportunities. It is hoped that the effective implementation of this manual will contribute to establishment of a more productive, sustainable, and profitable beekeeping system in Nepal.

Dr. Govinda Prasad Sharma
Secretary
Ministry of Agriculture and Livestock Development
Singhadarbar, Kathmandu.

Few Words



As the modern beekeeping industry is gradually developing and expanding in Nepal, the private sector's attraction towards this business has also been continuously increasing. This business has greater potential to generate good income by producing honey and other bee products: bee pollen, royal jelly, wax, apilarnil, honey dew honey, bee venom, etc. Besides this, Nepal has good enough in biological and climatic diversity which helps for the promotion and extension of beekeeping business. Beekeeping helps to fetch better income for rural communities, playing a vital role in pollination, contributing to raise production and productivity of fruits, vegetables, oilseeds, lentils, and spices.

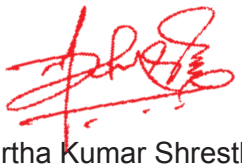
Commercial beekeeping has contributed to the prosperity of the state by protecting the environment, ensuring food and nutrition security, and generating income for the marginalized people. In present time, most of the beekeepers have faced various problems and challenges in their profession: The most common challenges are; Bee Colony Collapse Disorder, Pests and unwise use of pesticides, Lack of well-equipped laboratory facilities and competent human resources, Poor market and marketing system and Open borders and markets.

Prior to start beekeeping business, it is very important to have at least basic knowledge and skills about beekeeping. For this, Government of Nepal has three different bodies for contributing the knowledge and skills to the beekeepers through various training activities as well. They are; Apiculture Development Center, Godawari, Lalitpur, (Federal), Beekeeping Development Center, Bhandara, Chitwan (Bagamati Province) and Center for Industrial Entomology Development, Bandipur, Tanahun (Gandaki Province). However, Beekeeping training is conducted by private sectors in Nepal, is not adequate for successful operating a beekeeping business.

For addressing problem and challenges in apiculture sector, Apiculture Development Center, Godawari, Lalitpur has prepared this manual *(Beekeeping manual for Training of Trainers-Officer Level)*. This manual will help to prepare competent officer trainers in the apiculture sector throughout the nation. In addition to this, the aim of preparing this manual is to maintain uniformity in beekeeping training for officer staffs provided by the three tires of the state; federal, provincial and local levels, as well as other institutions. It is hoped that the effective implementation of this manual will contribute to establishing a more productive, sustainable, and profitable beekeeping system in Nepal. It will further help to reduce the confusion seen in the beekeeping training for

government institutions as well as other training institutions and facilitators involved in the field of beekeeping. It is also expected to deliver systematic knowledge to trainers, farmers, students, and entrepreneurs, and will help to turn existing challenges of beekeeping into opportunities.

Finally, I am very grateful to Prof. Dr. Resham Bahadur Thapa, Dr. Sabitri Baral, Mr. Tirtha Kumar Shrestha, Dr. Shiva Prasad Rijal, Mr. Shiva Sundar Ghimire, Mr. Rajendra Kumar Malla, Dr. Prakash Raj Bista, Mr. Pramod Koirala, Dr. Maniratna Aryal, Ms. Rachana Pandit, and Ms. Surakshya Subedee for their perfect expertise and adorable joint efforts to prepare this integral manual . I am also thankful to my all my staffs who contribute their efforts in this manual preparation work directly or indirectly.



Tirtha Kumar Shrestha
Chief
Apiculture Development Center
Godawari,Lalitpur

List of Writers:

1. Prof. Dr. Resham Bahadur Thapa, IAAS, Kirtipur.
2. Dr. Sabitri Baral, Chief, Center for Industrial Entomology Development, Hariharbhawan, Lalitpur
3. Mr. Tirtha Kumar Shrestha, Chief, Apiculture Development Center, Godawari, Lalitpur.
4. Dr. Shiva Prasad Rijal, Former Chief, Bee Development Center, Bhandara, Chitwan.
5. Mr. Shiva Sundar Ghimire, Insurance Expert.
6. Mr. Rajendra Kumar Malla, Senior Agri. Ext. Officer, AITC, Hariharbhawan, Lalitpur
7. Dr. Prakash Raj Bista, Senior Agri. Ext. Officer, AITC, Hariharbhawan, Lalitpur
8. Mr. Pramod Koirala, Senior Food Research Officer, MOALD, Sigh Darbar, Kathmandu.
9. Dr. Maniratna Aryal, Senior Agri. Economist, MOALD, Sigh Darbar, Kathmandu.
10. Ms. Rachana Pandit, SIYB Association, Nepal.
11. Ms. Surakshya Subedee, Plant Protection Officer, Apiculture Development Center, Godawari, Lalitpur.

List of Editors:

1. Prof. Dr. Resham Bahadur Thapa, IAAS, Kirtipur.
2. Mr. Tirtha Kumar Shrestha, Chief, Apiculture Development Center, Godawari, Lalitpur.
3. Mr. Laxmi Prasad Kharel, Former chief, Apiculture Development Center, Godawari, Lalitpur.
4. Ms. Surakshya Subedee, Plant Protection Officer, Apiculture Development Center, Godawari, Lalitpur.

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Introduction of Training Manual

1. Background:

Honeybees are ecologically important insects that play a key role in pollinating wild plants and agricultural crops. In addition to pollination, beekeeping also provides an opportunity to earn income from the collection and processing of honey, wax, royal jelly, pollen, bee venom, apilarnil propolis etc. Availability of bee forage plants, scope of source specific honey branding (*Chiuri, Rudilo, Phapar,Tori,),* increase in demand of Nepali honey in world market and implementation of bee promotion policy, 2073 have increased interest of people in beekeeping business. It is important to acquire theoretical and practical knowledge before starting beekeeping business.

Beekeeping training is essential to identify different classes of bees, their life cycles, bee diseases, parasitic mites and enemies, swarming, absconding, artificial feeding, bee insurance, honey value chain and market opportunities of bee products. In current scenario, beside Apiculture Development Center, Godawari, Lalitpur, Agriculture Knowledge Center, Agribusiness Promotion Support and Training Center, Municipalities, Farmers group, Cooperative and Private sectors conduct beekeeping training. In this context the objective of this manual preparation is to provide complete guide to trainers who are conducting these trainings in order to ensure uniformity in beekeeping training and facilitation topics.

2. Target beneficiaries:

- Government staff working on federal, provincial and local level.

3. Objectives of manual preparation:

- To provide complete guidance on beekeeping training and facilitation topics.
- To produce trained manpower capable of giving beekeeping training to farmers.

4. Training duration:

- The total duration of the training will be 15 days, out of which 14 days will be theoretical and practical sessions and 1 day will be field excursion.
- Total 4 training sessions will be conducted in 1 day and the duration of each training session will be 1 hour 30 minutes.

- Out of total 60 sessions, 34 session will be theoretical and 26 sessions will be practical.

5. Training evaluation:

- Pre-assessment and final assessment of participants will be conducted during the training.
- After the training is completed, the training coordinator must prepare and submit a training completion report.

6. Number of participants: 20-25 people

7. Use of training manual:

- The trainer/facilitator should be aware of the training method prior to training.
- Each trainer should prepare the necessary training materials before starting the training session.
- Necessary materials for practical exercises and necessary safety measures when inspecting the beehive should be prepared.
- To make training effective and productive, it is necessary to create a good learning environment by establishing rules and discipline that provide belonging to the participants, assign responsibilities, and encourage interaction.

  Asking questions to clarify the topic, such as:

  - What do you know about the subject matter?
  - Have you done this before? /Have you seen this before?
  - What did you learn from this session?
  - Questions related to why, what, where, who, when.
  - Is there anything that is not clear?
- When reviewing among participants, decide how long to review and how to do it.
- When asking questions prepared for review, pay special attention to participants who talk frequently and who talk less.

Session 1

Introduction to beekeeping, current status and challenges

1. Learning objectives

By the end of the session, the participants will be able to:

- Explain the introduction, importance, current status, problems and challenges of beekeeping.
- Describe the future prospects of beekeeping.

2. Sub topics

- Introduction, importance
- Current status
- Problems, challenges and opportunities
- Future prospects

3. Methods and materials

3.1 Training methods

- Lecture
- Brainstorming
- Group discussion/Interaction

3.2 Training materials

- Projector, Power points, Slides, Pictures.
- Marker, Brown paper, Pen, Meta Cards, Masking Tape.

3.3 Time

Theory: 80 minutes

Practical: 00 minutes

Discussion: 10 minutes

3.4 Place: Training hall

4. Activities and exercise

4.1 Inform the participants about the topics covered in the training and inquire about their level of knowledge on the subject matter.

4.2 Presentation

Give a short presentation on the introduction, importance, current status, problems, challenges and opportunities, and future prospects as outlined in the source material.

4.3 Discussion

After the presentation, organize an in-depth discussion to obtain information on whether the participants are clear about the subject matter and further review any unclear topics.

5. Detail schedule

S.N.	Subject Matter	Description	Time	Materials
1.	Introduction	Ask participants to write down what they know about beekeeping.	10 minutes	Marker pen, meta card.
2.	Importance and benefits of beekeeping	Explain the importance and benefits of beekeeping.	20 minutes	Projector, PowerPoint slides, pictures
3.	Current status, problems, challenges and opportunities of beekeeping	Discuss about current status, problem, challenges and opportunities of beekeeping	30 minutes	Projector, power point slides, pictures
4	Scope and future prospects of beekeeping	Provide information about Scope of beekeeping	20 minutes	Projector, power point slides, pictures
5	Discussion		10 minutes.	

6. Resource materials

6.1 Introduction

The commercial beekeeping, which has been practiced in Nepal since ancient times, is gradually expanding. There is a huge potential for generating significant income from beekeeping by producing honey and other bee products. Due to the biological and geographical diversity, wide variety of natural vegetation found and the farming systems adopted in Nepal, beekeeping can be adopted as a major profession for income generation, food and nutritional security and environmental protection. It is very important to have at least basic knowledge and skills before starting a beekeeping business.

Beekeeping can be a profitable business by providing a suitable environment for bees, raising them in a modern way and producing various bee products i.e. honey, royal jelly, pollen, bee wax, bee venom, apilarnil, honeydew honey, beehive air. Bees also play an important role in crop pollination by visiting different flowers of same or different plants to collect nectar and pollen. As a result, bees directly or indirectly contribute greatly to agricultural biodiversity and environmental protection. Therefore, there is a great potential of beekeeping in Nepal for maximum benefits due to existing suitable resources, and scope of national/international market demand.

In line with the national strategy to increase the production and productivity of honey and other bee products in Nepal, import substitution and export promotion are essential for commercialization of beekeeping sector. Farmers and entrepreneurs who have been practicing traditional beekeeping have come to a point where they need to implement the state's strategy by starting modern beekeeping practices in the future.

6.2 Current status of beekeeping

Although traditional beekeeping has been practiced in Nepal since ancient times, the practice of keeping native/local (*Apis cerana*) bees in traditional log (mudhe) and wall (khope) hives to produce honey as a natural and cultural heritage is still found in almost all regions of Nepal. In Nepal, Commercial Beekeeping began in 1994 when the Apiculture Development Center, Godawari, imported 70 colonies of *Apis mellifera* honey bees from India and started rearing them in Chitwan and Sarlahi districts.

In Nepal, there are different Government Offices working in the field of beekeeping under Federal, Provincial and Local government. They are: Apiculture Development Center, Godawari (Federal), Beekeeping Development

Center, Bhandara, Chitwan (Bagmati Province), Center for Industrial Entomology Development, Bandipur, Tanahun (Gandaki Province). They have been conducting various beekeeping promotion activities; viz various different level of trainings on beekeeping, hygienic queen bee production and distribution, conduction of bee clinics, disease (EFB) and mite management campaigns, and two-day mobile training in affected areas. Besides, they are conducting activities like beekeeping, bee breeding, bee species conservation, pollination efficiency studies, and publishing and distribution of books and booklets on apiculture concerned technologies.

Many national and international non-governmental organizations in Nepal have also been conducting different programs related to beekeeping and pollination. In addition to increase employment beekeeping has also contributed to the qualitative and quantitative increase in crop production through pollination of crops, as well as environmental protection. Information about the current status of beekeeping in Nepal is given in Table 1 below.

Table 1: Current status of beekeeping in Nepal

S.N.	Bee type/Race	No. of colony	Yield (MT)	Current Value (Rs)
1	*Apis mellifera*	74010	2590	1.03 billion
2	*Apis cerana*	171000	1718	1.7 billion
	Total	245010	43308	2.73 billon

Source: Ministry of Agriculture and Livestock, Agricultural Statistics, 2022/23

The number of indigenous races (*Apis dorsata* /Khago mauri, *Apis laboriosa* / Bhir mauri, *Apis florea*/Kathauri and Putka) that have not been domesticated is estimated at 10,000 colonies, from which approximately 100 metric tons of honey is being collected.

Table 2: Current status of beekeepers in Nepal

S.N.	Details	Active beekeepers	Commercial farmers
1	Number of farmers who are rearing *A. mellifera* (Imported bee)	3729	1965
2	Number of farmers who are rearing *A. cerana* (Local bees)	10071	6135
	Total	13800	8100

Source: Federation of Nepal Beekeeping Association, B.S. 2081

6.3 The scope/potential of beekeeping in Nepal

- **Suitable climate**: Nepal has a suitable climate for beekeeping. Besides, beekeeping is an ancient profession in Nepal, which can easily be transformed into a commercial business.
- **Diversity:** Nepal's diverse natural pastures and cropping systems can enhance the beekeeping business.
- **Supporting agencies:** Government, Private, /NGOs are involved in the development of beekeeping.
- **Trade mark:** Nepali honey has made its trade mark abroad, and increasing awareness and demand for honey consumption abroad as well as within the country, there is a national policy and program to increase honey production and productivity.
- **Other bee products**: There is a possibility of earning more income from the international market by producing other bee products; Royal jelly, Pollen, Propolis, Wax, Bee venom, Apilarnil (Drone larvae extract), Honeydew honey.
- **Good income source:** Beekeeping can be an effective source of income for women, Dalits, ethnic and indigenous communities, backward and landless people.
- **Api- tourism**: It can be developed by organizing the honey hunting festival of Himalayan cliff bees, *Apis laboriosa*.
- **Emerging commodity for trade:** The Integrated Trade Strategy, 2010, has identified honey as an emerging and promising commodity, which will contribute to foreign exchange earnings through quality production.

The different vegetation in the forests can also be used as bee forage, which has helped in beekeeping. Considering Nepal's existing forests, farming systems, and foraging capacity, it is estimated that up to one million bee colonies can be reared. The number of bee colonies that can be reared in Nepal, along with their production and income, is given in Table 3.

Table 3: Number of bee colonies that can be kept in Nepal, their production, and income

S.N.	Bee type/Race	No. of colony	Yield (MT)	Current Value (NRs)
1	*Apis mellifera*	5,00,000	20000	8 billion
2	*Apis cerana*	5,00,000	5000	4 billion
	Total	10,00,000	25000	12 billon

6.4 Problems and challenges of beekeeping in Nepal

Though, beekeeping business has abundant potential and opportunities, there are many problems and challenges associated with its commercialization, as mentioned below.

6.4.1 Policy-related problems/challenges

- Ineffective implementation of the current Bee Insurance Policy, National Bee Promotion Policy, 2016, and Nepal Good Beekeeping Practices Implementation Guidelines, 2017.
- Lack of access to agricultural loans without collateral and loans at low interest rates.
- The policy on pesticide imports and their use has not been clearly implemented.
- Due to the lack of quarantine and bee area demarcation policies, there is a high risk of various diseases and parasites entering and spreading during the purchase and migration of bees.
- Lack of bee foraging area scale up, and existing forests are being destroyed by forest fires.
- There are problems in the migration of bees for foraging.
- Lack of research on the identification of existing available foraging resources and their carrying capacity.
- Low-priority policies, budget, and program for the conservation and promotion of indigenous bee species.
- Lack of coordination and collaboration among various government, non-government, and private sectors running beekeeping programs.
- Lack of work for the conservation, promotion, and improvement of bee species

6.4.2 Technical problems/challenges

- Lack of expertise in beekeeping among the existing manpower due to lack of opportunities for contemporary training, higher study, and excursions.
- Lack of experts in the field of instrumental insemination technology in virgin queen bees.
- Lack of taxonomists to identify new bee species.
- Inability to identify and conserve bee species which populations are gradually declining.

- The quality beekeeping trainings are not easily available everywhere.
- Lack of availability and reliability of bee resource centers, lack of price uniformity and quality of bee equipment those are sold /distributed.

6.4.3 Other problems/challenges

- Quality honey production and fake honey in markets.
- Open entry of Indian honey and beekeeping equipment due to porous borders. Imported honey dominated the market, its quality and source.
- Pest and other enemies' management.
- Knowledge and application of modern beekeeping technology and development.
- Low access to existing domestic and international markets for beekeepers.
- Lack of public awareness about honey consumption and crop pollination by the honey bee.
- High production cost and low price for the produced honey.
- Unauthorized collection of fees and donations in foraging areas.
- Destruction of forests, forest fires, and forest encroachment, lack of suitable tree plantations for bee foraging.
- Pesticide use, no pesticide residue monitoring programs, no internationally recognized laboratories and equipment, and no quality certification system.
- No Research and technology development for conservation and improvement of bee breeds.
- Lack of Physical infrastructure (collection and processing centers, storage, laboratories, clinics) and Inadequate transportation facilities and other infrastructure in the foraging areas.
- Lack of uniformity in beekeeping statistics. Bee foraging resources data and road facilities in foraging areas are poor.
- Unavailability of study materials related to beekeeping and modern beekeeping equipment.

6.5 Future course of action

How to move forward for the development of the overall beekeeping sector?

6.5.1 Towards commercial beekeeping

- Beekeeping and bee colonies production in mass scale
- Quality Honey production and marketing
- Production of other bee products (royal jelly, wax, propolis, bee venom, honeydew honey, Apilarnil, Pollen, beehive air, bee colonies,)
- Production-based subsidy (received from the state or supporting agencies)

6.5.2 To maintain the quality of the products produced

- Establishment and operation of an internationally accredited laboratory for quality testing
- Branding of Nepali honey
- Certification of Organic Honey
- Capacity building of Bee Resource Centers (Apiaries and Beekeeping Materials)
- Maintaining the quality of honey (Role of beekeepers, farmers, Department of Food Technology and Quality Control (DFTQC), Bee Development Center)

6.5.3 Bee products

- Production and distribution of bee products in reasonable price in the markets
- Production and marketing of quality honey
- Establishment and operation of honey collection and processing center in intensive bee farming area
- Activities required to maintain quality
- Commercial production (quantity, quality, continuity and sustainability, ensuring price)
- Value chain
- Government policy (honey consumption by police, soldiers, schools, hospitals)
- Development of Api-tourism

6.5.4 Conservation and promotion of Local bees

- Conservation of Wild bee species (*Apis florea, Apis dorsata, Apis mellifera, Melipona spp, Trigona spp.,*) through training, technology development, and public awareness.

- Breeding improvement of commercial bees (*Apis cerana* and *Apis mellifera*) through Selection and Instrumental Insemination (II) technology.
- Colony management, expansion and management of foraging areas (bee policy and program).
- Bee clinic operation, disease and parasite management.
- Public awareness in honey consumption and crop pollination
- Bee pollination demonstration, study, research, public awareness, training.
- Research and development: Breed improvement, production increase, conservation, development and introduction of new technologies in *Apis mellifera*, *Apis cerana* and other indigenous species. For this, NARC, NAST, Apiculture Development Center (ADC), Universities, and educational institutions should prioritize research and development in apiculture sector.

6.5.5 Human resource development

- Development of human resource in the field of beekeeping by arranging studies, training and excursions
- Effective policy indorsement.

Sample questions for practice

1. What are the prospects for beekeeping in Nepal?
2. Explain the current challenges for beekeeping in Nepal.
3. Describe the possible future directions for the beekeeping business.

Session 2

Honey bee species characteristics and their conservation

1. Learning Objectives.

By the end of the session, the participants will be able to

- Identify bees and bee-like insects.
- Identify honey-producing bees.
- Know the characteristics of honey-producing bees.
- Identify commercially important domesticated and non-domesticated bees.

2. Sub topics.

- Bumblebees, honeybees, wasps, hornets
- Honey bee species of Nepal, Stingless bee (*Melipona spp*., *Trigona spp*.), Stinged bee; Dwarf honey bee (*Apis florea*), Singus /Giant honey bee (*Apis dorsata*), Giant Himalayan honey bee (*Apis laboriosa*), Cerana honey bee (*Apis cerana*) and Mellifera honey bee (*Apis mellifera)*
- Conservation of bees

3. Methods and materials

3.1 Training methods

- Lecture
- Brainstorming/experimentation
- Group discussion
- Identification of bumblebees, bees, wasps, hornets
- Identification of honey-producing bees
- Experimental exercises

3.2 Training materials

- Projector, power point slides, pictures
- Marker pen, brown paper, pen and masking tape, meta card

- samples/videos of bumblebees, bees, wasps, hornets
- samples/videos of honey-producing bees
- Observation of honey-producing bee colonies and hives
- Microscope/hand lens

3.3 Time

Theory: 50 minutes

Practical: 30 minutes

Discussion: 10 minutes

3.4 Place: Training Hall, apiary (bee farm), laboratory

4. Activities and exercises

4.1 Inform the participants about the lecture/practical exercises included in the training and obtain information about the level of knowledge of the participants on the subject.

4.2 Presentation

Give a short presentation on the identification of bumblebees, bees, wasps, and hornets, the identification of honey-producing bees, and the racial characteristics of bees as outlined in the resource materials.

4.3 Group division/Practical exercises

Divide the participants into 4 groups and complete the following tasks during the practical exercises.

1. Identify bumblebees, bees, wasps, and hornets.
2. Identify honey-producing bees.
3. Identify/observe main features of honey-producing bees known to Nepalese beekeepers.
4. Visit and observe the bee conservation sites.

Take participants to the sample collection lab and bee farm for practice and demonstrate samples of bumblebees, honeybees, wasps, and hornets. Similarly, introduce honey-producing bees to the participants. If available, use a microscope/hand lens to see the racial characteristics of these bees more clearly.

4.4 Discussion

After returning from the lab and bee farm, organize a short group presentation to present the results of their observations. Ask participants about the identification of bumblebees, honeybees, wasps, hornets, and honey-producing bees to find out whether they are clear or not. If not clear, discuss further to clarify the racial characteristics of bees.

5. Detail Schedule

S.N.	Subject Matter	Description	Time	Materials
1	Bee-like insects	Ask participants to write key information on insects, like bees	5 Minutes	Marker, pen, meta card
2	Identifying bees, wasps, and hornets	Discuss with participants to identify insects like bees	10 Minutes	Projector, PPT slides, photo, video
3	Honey-producing bees	Discuss with participants to identify honey-producing bees	15 Minutes	Projector, PPT slides,
4	Honey bee characteristics	Discuss with participants the salient features of honey bees commonly known to Nepalese beekeepers	10 Minutes	Projector, PPT slides, photo, video
5	Bee conservation	Discuss with participants about the conservation of bees	10 Minutes	Projector, PPT slides, photo, video
6	Practical exercise	Organize the participants in four groups and visit to apiary to observe and identify live samples of bumblebees, honeybees, wasps, and hornets. Similarly, familiarize them with honey-producing bees, the racial characteristics of bees, with the help of a hand lens/ microscope in the lab, if available.	30 Minutes	Bumblebees, wasps, hornets, and honey-producing bees
7	Discussion		10 Minutes	

6. Resource materials.

6.1 Species of bees found in Nepal

Bumblebees, honeybees, wasps, and hornets

Due to geographical, botanical, and environmental diversity, different species of bumblebees, honeybees, wasps, and hornets are found in Nepal (Figure 1.)

			
Bumblebee	**Honeybee**	**Wasp**	**Hornet**
Hairy and large body, produces loud noise	Lightly hairy and small body, honey-producing	Hairy and shiny body, non-honey producing	Large and hairy body, non-honey producing

Figure 1: Bumblebees, honeybees, wasps, and hornets

6.2 Bee species

Some bees are solitary and do not collect honey. These bees roam alone. These wild bees are the type that collect and store nutritious food only for their own and their offspring's diet.

Some bees are Asian (domesticated and wild), while some are improved honey-yielding bees introduced from abroad. Among these honey bees, some are domesticated, and some are free-living in nature that cannot be kept at home. Bees of the *Apis mellifera* and *A. cerana* species are of commercial importance, and bees of the **Katheuri, Giant honey bee, and Himalayan cliff bee** species are of free-living nature that cannot be domesticated.

 	 	 	 	 	 
Apis florea	*Apis dorsata*	*Apis laboriosa*	*Apis cerana*	*Apis mellifera*	*Melipona/ Trigona spp.*

Figure 2: Honey bee species that produce honey

6.3 Characteristics of bees

The characteristics of the above species of honey-producing bees are as follows:

6.3.1 Dwarf honey bee (*Apis florea*)

- The **Katheuri** (*Apis florea*) bee is the smallest among the above five species of stinging bees.
- This bee builds a palm-sized single comb in the bushes and stores honey and pollen in it for raising its young.
- The average honey production per year is very low, with a record of 1-3 kg per colony.



Figure 3: Apis florea

6.3.2 Giant honey bee (*Apis dorsata*)

- This bee is found on tree branches and man-made buildings at an altitude of about 50-1000 meter above sea level.
- Like other honey-producing wild bees, it also builds a single comb and stores honey, raises brood and young ones in it.
- Each honeycomb produces 30-50 kg of honey per year.



Figure 4: Apis dorsta

- This bee is slightly smaller (17-20 mm body length) than *Apis laboriosa* and is more aggressive.
- The honey bee migrates far and wide in search of food, and also helps in pollination

6.3.3 Himalayan giant honey bee or Himalayan Cliff honey bee (*Apis laboriosa*)

- This bee is found on cliffs at an altitude of about 1200-3000 meter above sea level.



Figure 5: Apis laboriosa

- This bee builds a single comb and stores honey, raises brood and young ones in it.
- Honey production has been recorded to be up to 40-60 kg.
- This bee is slightly larger (measures up to 3 cm), darker in color, and more aggressive than *Apis dorsata*.
- This bee migrates far and wide in search of food and also helps in pollination

6.3.4 Cerana bee (*Apis cerana*)

- In Nepal, 3 subspecies of the *Apis cerana* bee are present, namely *Apis cerana cerana* in the high western hilly areas, *Apis cerana himalaya* in the mid-eastern hilly areas, and *Apis cerana indica* in the Terai areas.
- This is a local domesticated bee, but also found in the forests of Nepal.



Figure 6: Apis cerena

- This bee is slightly smaller than the *Apis mellifera* and makes multiple honey combs per colony.
- The honey production capacity of the *Apis cerana* bee is 15-20 kg per hive per year.
- This species of honey bee is not very popular because it is more likely to leave its home and migrate.

6.2.5 Mellifera honey bee (*Apis mellifera*)

- This is a domesticated bee imported from Europe.
- It is commercially popular all over the world because it produces a lot of honey, is less likely to leave the hive, and has a gentle nature.
- This bee is larger than the *Apis cerana* bee and builds multiple combs in its colony. Its number in a colony ranges from 20,000 to 75,000.



Figure 7: Apis mellifera

- It has been recorded that its honey production ranges from 40-60 kg.

6.3 Stingless bee (*Mellipona spp., Trigona spp.*)

- This bee is characterized by a lack of a functional sting, like in other worker honey bees.
- The bees have reduced mandibles.
- They prepare nests in cavities with equally sized cells for both workers and queens.
- The nest typically includes a brood area surrounded by a protective and insulating layer of wax and resin called the involucrum.
- There are also storage areas for pollen and honey, and the nest is often sealed off from the rest of the cavity by plates of resin.
- The size of stingless bees varies, with some species being quite small, and their color can range frogblack to golden, and some species have shiny exoskeletons.
- The honey made from the nectar is placed in separate pots from the pollen.
- Honey produced by stingless bees has several sensory particularities, like less sweetness, a more acidic flavor, and a more fluid texture, as well as some different physicochemical properties.
- It can be domesticated, a good pollinator, but the honey yield per hive per year is about 100 gm.



Figure 8: Stingless bee

The salient features of honey bees are summarized in Table 4.

Table 4: Distinctive features of honey bees found in Nepal

SN	Feature	*Florea*	*Dorsata*	*Laboriosa*	*Cerana*	*Mellifera*	*Mellipona*
1	Body weight (mg)	22	118	130	43	77	22
2	Body color	Golden	Black	Bark-black	Golden	Yellowish	Black-blue
3	Wing span (mm)	6-7	12-13	14-15	7-9	8-10	6-7

SN	Feature	*Florea*	*Dorsata*	*Laboriosa*	*Cerana*	*Mellifera*	*Mellipona*
4	Cell size (W:D)	3:5	5:7	5:7	4:7	5:7	3:5
5	Defense behavior	Body shake	Mass attack	Mass attack	Hiss, sting	Sting/ propolis	
6	Thermoregulation (°C)	33-38	30-32		37	34	
7	Productivity (kg/yr)	0.25-0.5	50-60	50-80	15-20	100	Trace
8	Distribution	Terai	Terai	Himalaya	Allover	Terai, hill	Hill
9	Drum coruna (pair)	1	4		1	1	
10	Nest type	Open	Open	Open	Cavity	Cavity	Cavity
11	Comb type	Single	Single	Single	Multi	Multi	
12	Absconding	Common	Common	Common	Common	Less	Common
13	Learning behavior				High	Low	
14	Swarming	Swarm	Swarm	Swarm	Swarm	Less	
15	Communication dance	Perform	Perform	Perform	Perform	Perform	Perform
16	Egg laying (No/day)	250			300-1500	1500-2000	250
17	Worker's laying (Days)				2-5	5-25	
18	Mating time	10-12 am	3-5 pm	3-5 pm	12-2 pm	2-4 pm	10-12 am
19	Mite infestation		Tropilaelap		Varroa	Tropilaelap	
20	Division of labor	Present	Present	Present	Present	Present	Present
21	Sting	Present	Present	Present	Present	Present	Absent
22	Body hair length (mm)	0.1	0.2		0.3	0.4	
23	Tomentum (No)	3-6	3-6		3-6	3-5	

SN	Feature	*Florea*	*Dorsata*	*Laboriosa*	*Cerana*	*Mellifera*	*Mellipona*
24	Hind Wing medial vein	Variable	Present	Present	Present	Missing	Present
25	Tongue length (mm)	3.0	6.5		5.0	6.0	
26	Endophillus (Pair)	1	4	1	1	1	
27	Drone cell capping	Solid	Solid		Perforated	Solid	
28	Hind leg (mm)	5	10		7	8	
29	Foraging temp (°C)	30-32	30-35		15-25	20-25	

6.4 Bee conservation

Over 250,000 of plants and 20,000 bee species have been recorded from the World. Their mutualistic role in crop production through pollination services play vital role in health, nutrition, and food security of the ever-increasing human population. Honey bees have also been recognized as environmental quality indicators. Their declines worldwide have captured the attention of scientists, governments, media, and the general public. Bees are the primary pollinators of most wild plants and many crops, so they are crucial to both ecosystem stability and agricultural productivity. The number of local bees is decreasing day by day. Since these indigenous and imported bee species are invaluable assets of biodiversity, it is absolutely necessary to protect and promote them at all levels, at the national level.

Contributions of wild bees have always been underestimated due to our inadequate knowledge of their nesting behavior and more reliance on domesticated bees. In this context, the conservation of wild as well as domesticated bees is very important to maintain a diverse ecosystem. In fact, wild bees pollinate a diversity of plants in nature, and honey bees are concentrated mainly on some cultivated pollination-dependent crops. Their conservation efforts can provide additional income to the farmers. In the present context of a degrading ecosystem and declining beneficial insects like native bees in the context of climate change, in order to prevent the collapse of ecosystem services, there is an urgent need for the conservation of plants and bees.

6.5 Conservation practices

Some practices for bee and biodiversity conservation include:

i) Use of bee hotels (providing different-sized holes to facilitate nesting sites for different bee species),

ii) Habitat losses are cited as the most frequent factor for declining wild bee populations; their restoration includes the use of floral communities, which are preferred by the bees, for which sound knowledge of the preferred floral communities and their blooming period is imperative.

iii) Planting bee preferred flora on hedgerows around the field margins increases diversity and abundance by providing reliable foraging opportunities,

iv) More than 20,000 bee species nest in the ground tunnels, in dried hollow stems, in dead woods, and some desert bees even burrow into sandstone, and therefore, minimizing disturbances to the habitat to the practical extent during nesting season is necessary.

v) Many pesticides have lethal effects on bees, and pesticide spraying should be avoided during the foraging period, as they get sequestered in pollen and nectar.

vi) Bio-pesticide like Bt. (*Bacillus thuringiensis*) Based sprays are non-toxic to wild bees

vii) Organic farms support significantly more abundant wild bee populations compared to conventional farms due to reduced insecticidal and herbicidal usage,

viii) In the US, the Farm Bill is used to channel federal funding for habitat restoration and is governed by the Natural Resource Conservation Service and the Farm Service Agency.

ix) New approach as integrated management (IPM, ISM, IDM, ISPM) of bees certainly enhances Agri / forest diversity and crop yields. Therefore, all committed institutions, organizations, planners, policy makers, and stakeholders should be aware of the protection of native bees through legal provisions.

In Nepal, bees of the *Apis mellifera* and *Apis cerana* species are being reared commercially, and this has helped in the income level of farmers. However, due to various diseases and pests, the use of toxic pesticides in agriculture, unscientific honey hunting, and the problem of bee foraging, along with the increase in temperature, this business is in trouble.

Sample questions for exercise

1. Write down the common name of hymenopteran insects that look like bees.
2. Prepare a list of honey-producing and non-honey-producing bees.
3. Summarize salient features of honey bees commonly known to beekeepers in Nepal.

Session 3

Honey bee life cycle, work division, and morphology.

1. Learning objectives

By the end of the session, the participants will be able to:

- Identify the different classes of honeybees present in a colony
- know about the life cycle of the honeybee
- know about the three kinds of adult bees in a colony and their specific tasks
- know the morphology of worker, queen, and drone bees
- know about the work division in a colony according to the type of bees and the colony's needs

2. Sub topics

- Life cycle of the honeybee
- Identification of the honey bee class
- Identification of body organs/parts in the different kinds of adult bees
- Work division of different bees according to the kind, age, and needs of the colony

3. Methods and materials

3.1 Training methods

- Lecture
- Brainstorming
- Group discussion
- Observation
- Practical exercise

3.2 Training materials

- Projector, power points, slides, pictures.
- Marker, brown paper, pen, masking tape, meta card

- Movable frame hive with a bee colony including brood (eggs, larvae, pupae) and all three kinds of adult bees
- Hive inspection materials and tools
- Microscope/hand lens

3.3 Time

Theory: 50 minutes

Practical: 30 minutes

Discussion: 10 minutes

3.4 Place: Training hall, apiary, lab

4. Activities and exercise

4.1 Inform participants about the topics covered in the session and inquire about their level of knowledge on the subject matter.

4.2 Presentation

Give a short presentation on the life cycle of the honey bee, the three kinds of adult bees in a colony, the morphology of queen, worker, and drone bees, and the work division in a colony as outlined in the resource materials.

4.3 Group division/practical exercise

Divide the participants into 4 groups and complete the following tasks during practical exercises.

1: Identify different classes of bees in the hive

2: Observe the activities of different classes of bees

3: Observe the physical structure of different classes of bees

4: Observe the stages of the life cycle of different classes of bees

Take participants to an apiary for practical exercise and open a bee hive for the identification of egg, larva, pupa, and adult stage. If needed, use a microscope/ hand lens to observe the external morphological structure.

4.4 Discussion

After returning from the apiary, organize a group presentation to discuss the results of their observations. Use in-depth discussion and question-answer to

discover whether the participants can recognize and differentiate the different stages in the life cycle, can identify the three types of adult bees and whether the participants are clear about the morphology of different classes of honey bees.

5. Detail Schedule

S.N.	Subject Matter	Description	Time	Materials
	Honey bee classes	Ask participants to write down what they know about the honey bee classes.	5 minutes	Marker pen, meta card.
2	Identification of queen, drone, and worker.	Discuss methods for identifying queen, drone, and worker bees	10 minutes	Projector, PowerPoint slides, pictures, videos.
3	Life cycle of the queen, drone, and worker	Provide information on how to identify the different stages of the life cycle: egg, larva, pupa, and adult.	15 minutes	Projector, PowerPoint slides, pictures, videos.
4	Honey bee morphology	Discuss the external and internal body parts of honey bees.	10 minutes	Projector, PowerPoint slides, pictures, videos.
5	Work division according to class, age of the bee, and colony needs	Explain the work of the queen, drone, and worker according to their age.	10 minutes	Projector, PowerPoint slides, pictures, videos.
6	Practical exercise	Divide the participants into groups and take them to the apiary, open the hive, and explain the egg, larva, pupa, and adult stages of queen, drone, and	30 minutes	➢ Movable frame hive with a bee colony with brood (eggs, larvae,

S.N.	Subject Matter	Description	Time	Materials
		worker. Similarly, identify the external morphological structures of bees. To see the external morphological structures more clearly, use a microscope/hand lens if available.		➢ pupae) and all three kinds of adult bees ➢ Hive inspection materials and tools ➢ Microscope/ hand lens
7	Discussion		10 minutes.	

6. Resource materials

6.1 Life cycle

A honeybee colony has three kinds of adult bees: queen, worker, and drone. Each goes through the same four developmental stages, but the time needed to complete each stage differs. The honeybee life cycle has four stages: egg, larva, pupa, and adult. (Table 5)

Table 5: Life cycle of different classes of the honeybee

Bee class	Stages				Life span
	Egg	Larva	Pupa	Total time to adult emergence	
Queen	3	5	7-8	15-16	2-5 years
Worker	3	6	11-12	20-21	7-8 weeks to 6 months
Drone	3	7	14	24	About 2 months

6.1.1 Egg stage

The queen inserts her head into a cell to see if it is clean or not and then lays a single egg. The egg looks like a small white cylinder. The queen lays eggs for workers, drones, and queen production in specific worker, drone, and queen cells in a brood comb. The worker bees make the cells in



Figure 9: Egg

different sizes for each type of bee. The queen and worker producing eggs are fertilized, but the drone producing eggs are unfertilized. The egg stage of all classes of bees lasts for 3 days. At the start, the egg stands vertically on the base of the cell, then slants, and finally lies horizontally on the base before hatching.

6.1.2 Larva stage



Figure 10: Larva

Small larvae hatch from the egg after 3 days. They are shiny white and curved with no eyes. Queen and drone larvae grow to be larger than worker larvae. The larval period is 5 days for a queen, 6 days for a worker, and 7 days for a drone. The food given to the larvae differs according to their class. Queen larvae are fed royal jelly throughout the larval period, while drone and worker larvae are fed royal jelly for 3 days and bee bread (a mixture of honey and pollen) for the remaining 3 - 4 days. The internal organs start to develop as the larvae grow. They molt several times, and after the last molt, they enter the pupal stage. The larval stage lasts 5 to 7 days, depending upon the kind of adult they will be born.

6.1.3 Pupa stage

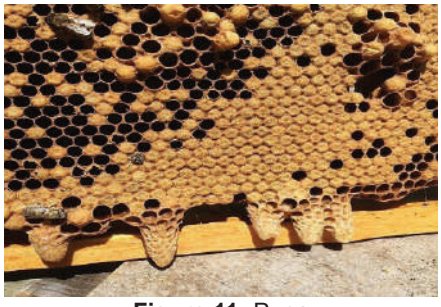


Figure 11: Pupa

The pupal stage is also called the dormant stage. Worker bees seal the cells with a porous beeswax cap, and the larva spins a cocoon around itself. The developing bee remains inside the cocoon without eating or moving. The pupal stage lasts for 7–8 days for a queen, 11–12 days for a worker, and 14 days for a drone. During this stage, the internal organs and external body appendages develop. Finally, the adult bees emerge.

6.1.4 Adult stage

The adults emerge from the pupal cells by making a hole in the top of the sealed cell to come out. Immediately after emergence, the adult workers are a light color, and then they become darker. The total time taken to develop

from egg to adult is 15–16 days for a queen, 20–21 days for a worker, and 24 days for a drone. The life span of the different types of adult bees is different. A queen lives for 2–5 years, a worker for 6 weeks to 6 months, and a drone for an average of 2 months.



Figure 12: Adult bee

6.2 Honey bee class and work division

6.2.1 Queen bee

Each bee colony has a single queen bee, irrespective of the colony size. The queen is the only egg-laying bee and thus the mother of all the bees in the colony. The queen bee is larger than the worker and drone bees. It has a black and shiny cylindrical and longer body, and a round and comparatively small head. The queen has a small sting at the end of the abdomen, which is used for fighting with other queens if any are produced in the colony. At emergence, the virgin queen is comparatively smaller and moves fast on the comb, whereas the mated and egg-laying queen has a bulging abdomen and moves slowly.


Figure 13: Queen bee

The primary task of a queen bee is to lay eggs. The virgin queen goes to mating flight on a warm and sunny day, around 3–8 days after emergence, to a 'drone congregation area', where she mates in flight with a number of drones from her own or other colonies (10 to 20 or so). She may return to the area for several days until she is fully mated.

She stores the drone sperms in a structure called the spermatheca, from where they is selectively released over her lifetime. The queen starts laying eggs 3–7 days after mating. The queen can lay fertilized and unfertilized eggs as needed. Eggs are fertilized just before laying by using the stored sperm. Workers or queens emerge from fertilized eggs; while male/ drones are emerged from unfertilized eggs. A healthy *Apis cerana* queen can lay around 800 eggs per day; where as an *Apis mellifera* queen can lay up to 2000 eggs per day. The queen bee is also responsible for colony mobilization. She releases different types of pheromones which determine all the functions of the colony including identification, foraging, suppression of worker's ovary, swarming, and absconding.

6.2.2 Drone

Drones are male bees produced from unfertilized eggs. A drone bee is larger than the worker bee, blackish in color and hairy. The drone population in a colony increases at the time of swarming and during the nectar flow period; during spring and autumn in the plains and mid hill areas, and during summer in the high hills and mountains. Drones are fed by the workers. A colony will usually have a few hundred drones. The only task of drones is to mate with a virgin queen. After mating, the workers stop feeding the drones and they die



Figure 14: Drone bee

6.2.3 Worker

Workers are sterile females and develop from fertilized eggs. Workers are smaller than the drones and have yellowish and dark brown abdominal stripes. The workers are the main group in a colony, with 60,000–70,000 in an *Apis mellifera* colony and 25,000–30,000 in an *Apis cerana* colony. All the works in a honeybee colony are performed by the worker bees, including honey and pollen collection, brood rearing, building combs, feeding the drones and queen, cleaning the hive, and defending the colony.



Figure 15: Worker bee

The specific activities are defined by the age of the worker bee with tasks inside the hive for the first 3 weeks after emergence (comb building, brood care, hive cleaning, thermoregulation, queen care, honey ripening) and then outside (foragers and scouts). Under special circumstances, workers can perform any kind of task irrespective of age as per the need of the colony. Normally workers do not lay eggs. However, in the absence of a queen, queen cells, or eggs for 2 weeks (*Apis cerana*) or 3 weeks (*Apis mellifera*), they start laying eggs. These workers are called laying workers. They lay unfertilized eggs which develop into drones, and the colony may slowly collapse.

Table 6: Work division of worker bee

Age of worker	Work division
Before 6 days	Cell cleaning and capping (cleaner bees)
6-12 days	Feeding brood and queen (Nurse bees)
12-18 days	1. Receiving nectar (Nectar ripening bees) 2. Cleaning debris 3. Packing Pollen 4. Comb building (wax producer) 5. Orientation flight (15-18 days)
Above 18 days	1. Ventilating 2. Guarding 3. Foraging (Nectar, Pollen, Resin and Water)

6.3 Honey bee morphology

The honeybee is an insect and has a body divided into three parts: head, thorax, and abdomen.

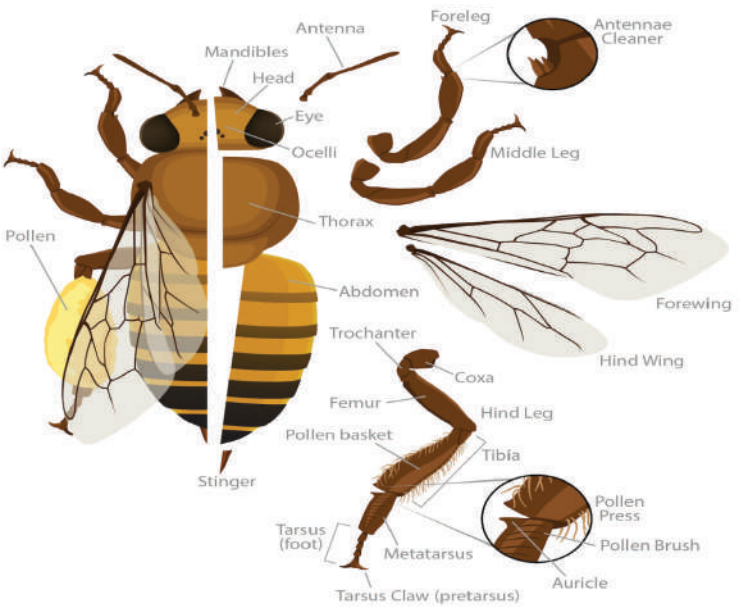


Figure 16: Honey bee morphology

6.3.1 Head

The head contains the eyes, mouth parts, antennae, hypopharyngeal gland, and salivary gland.

i) Eye

The honeybee has two flat oval compound eyes at the side of head and three simple eyes located in a triangular pattern between the compound eyes.

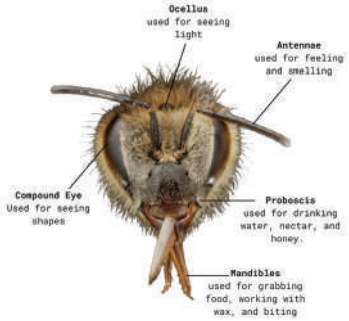


Figure 17: Honey bee eye

ii) Antenna

The head contains a pair of antennae which are used to detect smells, for touching, and help to balance the body during walking and flight.

iii) Mouth

The mouth is composed of the proboscis, mandibles, labrum, and labium. The proboscis is a flexible tube used to suck up liquids (nectar, water, honey) into the mouth. It is a temporary structure formed from the glossa, Para glossa, and galea and is folded behind the head when not in use. The glossa is composed of an array of hairs that form a tube at the center and a sponge-like structure at the end. The spongy hairs absorb the liquid which is sucked upward through the tube. The glossa functions as a tongue and can 'taste'. The sucking capacity of a honeybee depends upon the length of its proboscis. *Apis cerana* has a shorter proboscis (3.5–4 mm) and smaller nectar collection capacity; *Apis mellifera* has a longer proboscis (6.5 mm) and greater collection capacity.

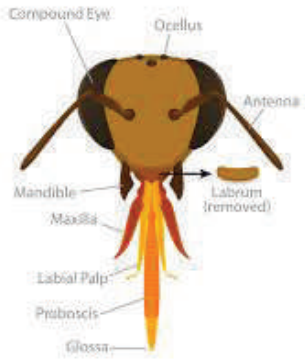


Figure 18: Bee mouth parts

The sickle-shaped mandibles are like paired 'teeth', one on each side of the mouth. They are used to collect pollen and propolis, to soften and manipulate wax by chewing, to clean other bees, and to bite workers from other colonies or pests. The labium is formed from two fused secondary maxillae and is equivalent to the floor of the mouth; it assists in chewing. The labrum is equivalent to the upper lip and supports the sucking process

iv) Hypopharyngeal glands

Worker bees have a pair of hypopharyngeal glands on the head which secrete the food called royal jelly. Hypopharyngeal glands are large and active during the period in the worker bee's life when they are feeding royal jelly, and then dry and inactive.

v) Salivary gland

Worker bees have salivary glands in their mouth connected with the glossa ('tongue'). They produce saliva containing enzymes, which is mixed with the food called 'bee bread' that worker bees prepare by grinding honey and pollen in the mouth. The enzymes help in food digestion.

6.3.2 Thorax

The thorax is divided into three segments i.e. prothorax, mesothorax and meta thorax. It has three pairs of segmented legs and two pairs of wings. The three pairs of legs have different functions. The forelegs hold an antenna cleaner or pollen comb, the middle legs are used to clean the thorax, and the hind legs have a pollen basket for the collection and carrying of pollen. The two pairs of wings are mounted on the dorsal (rear) segments of the thorax. The front (fore) wings are larger than the back (hind) wings. The pairs are connected by hamuli (hooked structures), which enable flight.

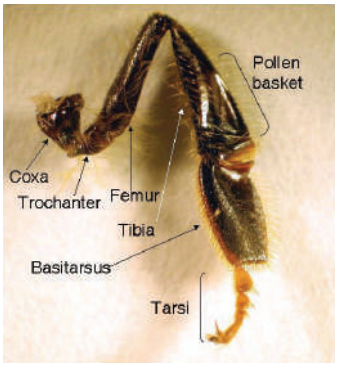


Figure 19: Honey bee leg

6.3.3 Abdomen

The abdomen is divided into nine segments, which contain three major glands: the wax glands, scent gland, and poison gland.

i) Wax gland

The fourth to seventh segments of the abdomen have white shiny wax mirrors located on their lower parts connected to four pairs of wax glands, which secrete liquid wax onto the mirrors to form wax plates. The pollen combs on the forelegs are used to scrape the wax off and move it to the mandibles where it is ground and mixed with the secretion from the salivary gland (saliva) before being used to build combs.



Figure 20: Wax gland

ii) Scent gland

The seventh abdominal segment contains a wide pale-yellow stripe connected to a scent-producing gland inside. The scent is used for the identification of friends and enemies.



Figure 21: Scent gland

iii) Poison gland and sting

The seventh abdominal segment contains a pair of poison glands (made from merging the eighth and ninth segments) connected to a sting. The sting has curved barbs which stick in the bodies of mammals. When the bee flies off after stinging, the sting usually separates from the brackets, pulling out part of the bee's abdomen, and the bee dies. Bee venom (apitoxin) is a complex mixture of proteins (enzymes), peptides, amines, and other compounds. Bee venom is commonly used in traditional medicine, but high doses can be lethal. The lethal dose for a human is equivalent to about 600 stings for an adult, or 90 stings for a small child. However, most human deaths result from just one or a few bee stings as a result of allergic reactions, heart failure, or suffocation from swelling around the neck or the mouth.

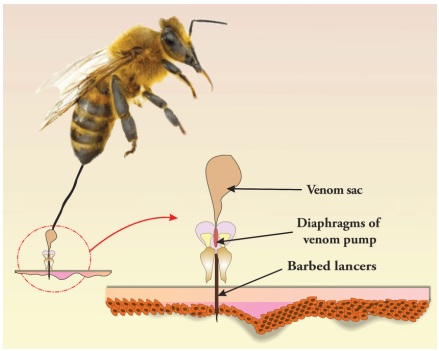


Figure 22: Poison gland

6.4 Internal anatomy of honeybee

i) Honey stomach

The honeybee alimentary canal passes from the mouth through the thorax to the fourth segment of the abdomen where it connects to an enlarged sac called the honey stomach or crop. Nectar is stored in the crop temporarily after collection and regurgitated after the bee returns to the hive, where it is passed to a house bee who stores it in a honey cell. A thick membrane inside the crop prevents the nectar from passing into the intestine.

ii) Respiration

The honeybee has ten pairs of small breathing pores called spiracles: three on the thorax and seven on the abdomen (to the right and left of the body). They are connected to the tracheal trunk via air sacs for respiration

iii) Circulatory system

The heart is a long slender tube extending from the thorax and connected to the aorta which runs forward to the head.

The ventral (lower) part of the abdomen does not have any blood vessels.

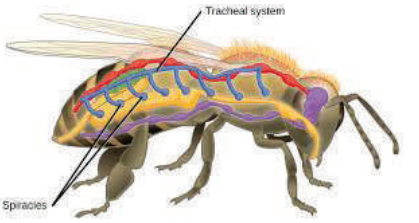


Figure 23: Respiratory System

iv) Nervous system

The brain is a very small organ located in the upper portion of the head and joined by sensory nerves to the eyes, antennae, and frontal mouth parts. The brain coordinates and regulates the functions of all the bodily systems.

v) Reproductive organs

The reproductive organs of the drone comprise a pair of small flattened testes at the side of the abdomen. The testes produce spermatozoa which are ejaculated via an ejaculatory duct. The reproductive system of the queen consists of a cylindrical ovary composed of narrow tubes. The ovary produces eggs, which pass out through an oviduct. The semen received during mating with drones is stored in an organ called the spermatheca, which is connected with the oviduct. Workers are sterile females and have poorly developed reproductive organs. Egg laying workers can develop reproductive organs in the absence of a queen, but can only lay unfertilized eggs

Sample Questions for Practice.

1. What are stages of honey bee life cycle?
2. What are the works done by worker bee?
3. What are the organs present in honey bee head?

Session 4

Hives and equipment for beekeeping

1. Learning objectives

By the end of the session, the participants will be able to:

- Identify the different types of beehives and beekeeping equipment.
- Use the beekeeping equipment.

2. Sub topics

- Identification, types, standards and use of modern hives.
- Identification and quality of equipment used in beekeeping.
- Usefulness and method of use.

3. Methods and materials

3.1 Training methods

- Lecture
- Brainstorming
- Group discussion
- Observation
- Practical exercise

3.2 Training materials

- Projector, power points, slides, pictures.
- Marker, brown paper, pen, masking tape, meta card
- Different types of movable hives and Beekeeping equipment.

3.3 Time

Theory: 30 minutes

Practical: 50 minutes

Discussion: 10 minutes

3.4 Place: Training hall, Apiary, Place with beekeeping equipment.

4. Activities and exercise

4.1 Inform participants about the topics covered in the session and inquire about their level of knowledge on the subject matter.

4.2 Presentation

Give a short presentation on identification, hive designs and types of modern beehives and beekeeping equipment as outlined in the resource materials.

4.3 Practical exercise.

After theoretical presentation take participants to a place where equipment is kept or bring the equipment to training hall for demonstration and identification. Explain their usefulness and method of use.

4.4 Discussion

Use in depth discussion and question/ answer to discover whether the participants can identify the equipment, explain their usefulness and method of use.

5. Detail schedule

S.N.	Subject matter	Description	Time	Materials
1.	Introduction	Make participants to write down what they know about the bee hives and beekeeping equipment.	5 minutes	Marker pen, meta card.
2	Presentation on beehives and beekeeping equipment.	Discuss about the identification, types, usefulness and method of use.	10 minutes	Projector, power point slides, pictures, videos.

S.N.	Subject matter	Description	Time	Materials
3	Demonstration	Demonstrate hive, different parts of hive, and beekeeping equipment to participants. Let them handle and try to use the hive and different equipment while discussing among themselves.	50 minutes	Bee hives and beekeeping equipment.
4	Discussion		10 minutes.	

6. Resource materials.

6.1 Introduction

Beekeeping operations can be easily managed if modern equipment and materials are used in order to perform various tasks such as hive/bee colony inspection, honey production and bee colony management quickly and efficiently. The modern beekeeping materials, their structure and use are described as bellow.

6.2 Modern bee hive

A smaller bee hive called a Newton hive is used for *Apis cerana* and Langstroth hive is used to rear *Apis mellifera*. The modern bee hive is constructed with ten frames in each chamber, the super chamber for honey production and the brood chamber for egg laying and brood rearing. The super/honey chamber is only added during the honey flow season. The frames are set at a fixed distance from each other, which is calculated to prevent bees form attaching honeycombs where they would connect adjacent frames or connect the frames to walls of the hive.

The queen can be excluded from the super chamber, which allows combs to be built that contain only honey without brood. Both the brood and the super chamber are designed to adjust ten frames. The brood chamber is taller than the super chamber and the brood frames are also higher than the super frames. When colonies are small or weak and cannot build combs on all frames, individual frames can be replaced with a dummy board, which is solid and can't be used to build a comb. The dummy board fills the empty space and helps the colony to keep warm.

6.2.1 Parts of a modern hive

6.2.1.1 Bottom board

This is the lowest part of the bee hive where the brood chamber is kept.

6.2.1.2 Hive entrance

This is the front part of bottom board and its size can be adjusted according to the availability of forage and the attack of natural enemies. It is used for entry and exit by the bees.

6.2.1.3 Brood chamber

Brood chamber has 10 movable brood frames and one dummy board. In brood chamber queen lays eggs and worker stores pollen and honey to raise the brood.

6.2.1.4 Brood frame

These frames are movable and are placed vertically inside the brood chamber. The bees collect honey, pollen, and raise brood in the upper, middle, and lower parts of these frames, respectively.

6.2.1.5 Honey chamber/super

Honeybees collect and store honey in this chamber. It is placed above the brood chamber and also contains 10 movable honey frames.

6.2.1.6 Honey frame

The honey frame is placed vertically inside the honey chamber. The bees use the frames to store the collected nectar after converting into honey.

6.2.1.7 Inner cover

It is placed at the top of the honey chamber. It regulates the temperature and humidity inside the hive and protects the bees from external elements and enemies. It also acts as a protective shield between the honey chamber and the outer cover.

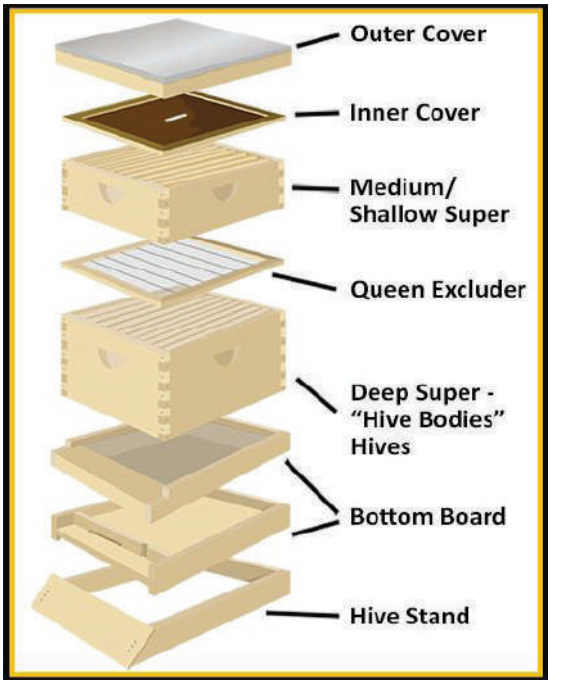


Figure 24: Hive Parts

6.2.1.8 Outer cover

This is the topmost roof of the bee hive. It protects the other parts of the beehive from adverse weather conditions such as sun, rain, wind, and bee enemies.

6.3 Equipment used in beekeeping

6.3.1 Nucleus hive

Function: Keeping bees during disease management, during queen production, and when the bee colony is small with less numbers of bees.

Method of use: Arrange the bee frames in the hive. If the number of bees in the hive is low use dummy boards in cold weather.



Figure 25: Nucleus hive

6.3.2 Smoker

Function: It is used for smoking the bee colony to make bees calm during hive inspection and other operations.

Method of Use: Burn any slow burning material such as dry sacking, rotten wood, rags or dried leaves. A few puffs of smoke at the entrance and the central hole of the inner cover at the top of the opened hive are usually enough to calm the bees.



Figure 26: Smoker



Figure 27: Bee veil

6.3.3 Bee-veil

Function: Helps to protect the face against bee stings.

Method of Use: The black mesh part of the bee veil is placed in front and worn on the head. The string at the bottom of the bee-veil is tightened so that the bees cannot enter inside and sting during inspection and other operations.

6.3.4 Gloves

Function: Gloves are used to protect the hands from bee stings at the time of bee colony inspection and other operations.

Method of use: The glove is made of cloth or rubber. It is worn on the hand and then tied to the wrist.



Figure 28: Gloves



Figure 29: Hive tool

6.3.5 Hive-tool

Function: It helps to easily remove frames during hive inspection.

Method of use: Sharp or hooked hive tools can be used to separate frames and remove the inner cover that are stuck together due to propolis or wax without disturbing the bees.

6.3.6 Honey-extractor

Function: Helps extract honey from honeycombs.

Method of use: First, honey frames are removed from the honey chamber and wax layer of the honey is removed with the help of sharp knife. Then the uncapped frames are put in the honey extractor. In some extractor, honey is extracted from one side of the frame, and the frame is then taken out and replaced to extract the honey from the other side. Nowadays, reversible extractors are available in which honey from both sides can be extracted without removing the frames by reversing the movement.



Figure 30: Honey extractor

6.3.7 Soft-brush

Function: It is used to remove bees from frame during hive /frame inspection.

Method of use: While inspecting the frames, the bees are gently removed from the frames using the bristles of a soft brush and lowered into the hive.



Figure 31: Soft and hard brush

6.3.8 Hard brush

Function: To clean the debris from inner side of the hives that cannot be removed by honeybees.

Method of use: This brush is used to remove dirt and other debris which the bees are not able to clean themselves or that remains inside the bottom board and inner cover.

6.3.9 Queen excluder

Function: It prevents queen from entering the honey chamber.

Method of use: It is kept between brood chamber and honey chamber that prevents queen to lay eggs in honey chamber but worker bees can freely move between chambers.

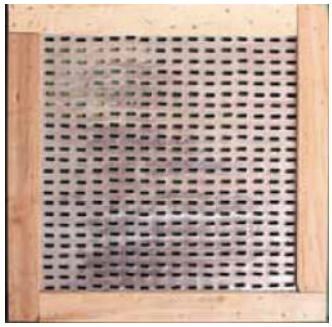


Figure 32: Queen excluder

6.3.10 Queen-gate

Function: To prevent the queen bee to go outside the hive.

Method of use: It is kept in front of hive entrance. It is attached by clove nails or by mixing mud around the edges.



Figure 33: Queen gate

6.3.11. Queen-cage

Function: A small mesh container used to transport the queen bees or to introduce new queen bees into a queen less colony.

Method of use:

- A queen bee can be transported for short distances by placing a queen, 4-5 worker bees, and some honey in a cotton bag in a queen cage.
- When introducing a new queen bee into a beehive/colony without queen bee and queen cells, the cage with queen bee is placed between two frames in the middle of the brood chamber.



Figure 34: Queen cage

- After the worker bees accept the new queen, the queen is taken out of the queen cage and released into the beehive.

6.3.12. Frame-feeder

Function: For artificial feeding to bees. It is made up of wood or plastic. **Method of use:** The frame feeder is filled with artificial food/ sugar syrup and placed on one side of the brood frames inside the brood chambers.



Figure 35: Frame feeder

6.3.13 Carrying-cage

Function: It is used to transport small bee colony from one place to another.

Method of use: 4-5 brood frames with worker bees and a queen bee is kept in the carrying cage and transported from one place another place.

6.3.14 Pollen- collector

Function: It is used to collect natural pollen from honeybee's legs during pollen flow season.

Method of use: It is kept in front of the hive entrance on the bottom board and natural pollen brought by worker bees is collected on the mesh attached to the trap.



Figure 36: Pollen trap

6.3.15 Mating-hive

Function: It is used to rear queen cell or virgin queen until it gets mated by the drone bees.

Method of use:

- Some young worker bees and brood are placed in the mating hive.
- Artificially produced queens are placed in the mating hive 1-2 days before they emerge from the queen cell.
- After the queen is emerged, the worker bees in the hive take care of the new



Figure 37: Mating hive

queen. After few days' emergence the new queen mates with the drones and start to lay eggs. Once she starts laying eggs, the queen can be sold or transferred to another hive.

6.3.16 Hive stand

Function: It is used to place the bee hive and protects the bee colony from ants or other small enemies.

Method of use:

- A bee hive with bees is placed on the four-legged iron stand.
- Four steel bowls filled with water are placed under the four legs.

6.3.17 Queen-cell protector

Function: To protect the queen inside the queen cell from the attack of old queen or newly emerged queen.

Method of use:

- Matured queen cell is covered by queen cell protector.



Figure 38: Queen cell protector

6.3.18 Press type comb foundation machine

Function: To build artificial comb foundation.

Method of use:

- Its inner side has a honeycomb-shaped imprint on both sides.
- Molten wax is poured over the surface of lower part and gently pressed with the upper part or lid.
- After letting it sit for a while, the comb foundation is ready.

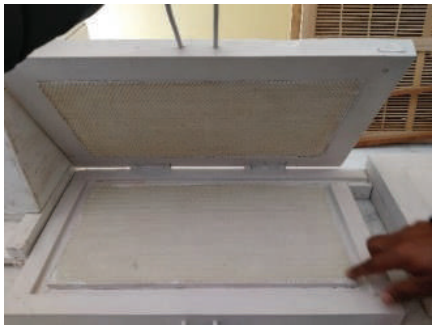


Figure 39: Comb foundation machine

6.3.19 Roller type comb foundation machine

Function: To build artificial comb foundation.

Method of use:

- Plain wax sheets are prepared.
- The plain wax sheet is placed in between two rollers and the machine is rotated
- Comb foundation with a cell imprint is produced.

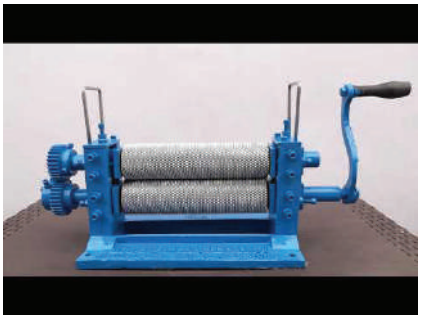


Figure 40: Roller machine

6.3.20 Knife

Function: It is used to cut the comb foundation or remove the wax seal of the honeycomb during honey harvesting.

6.3.21 Bee-venom collector

Function: It is used to collect bee-venom.

Method of use:

- Place this machine in front of the entrance of the hive with the help of a bottom board.
- When the worker bee comes into contact with it, it feels a slight electric shock and releases venom on the glass at the bottom of the machine.
- Remove and collect the venom stuck on the glass with the help of a blade.



Figure 41: Bee venom collector

Sample Questions for Practice

1. Which hives are used for *Apis cerana* and *Apis mellifera* bees in Nepal?
2. What are the essential materials for beekeeping?
3. How to use a feeder?

Session 5

Bee colony inspection

1. Learning objectives

By the end of the session, the participants will be able to:

- Inspect the external and internal of the bee colony
- Explain the condition of the bee colony after the inspection
- Identify the activities and problems of the bees inside the hive after the internal inspection
- Describe the health and food needs of the bees in the bee colony

2. Sub topics

- Introduction and objectives
- Preparation for inspection
- Suitable weather and time for inspection
- Colony inspection (external and internal)
- Inspection steps
- Methods of inspection record keeping
- Things to be considered during inspection

3. Methods and materials

3.1 Training methods

- Lectures/presentations
- Brainstorming
- Group review/interaction
- Colony inspection
- Practical exercises

3.2 Training materials

- Projector, power point slides, pictures
- Marker pens, brown paper, pens and masking tape, meta cards
- Videos/role plays showing how to inspect beehives
- Modern beehive with Adult bees and brood (eggs, larvae, pupae)
- Tools for bee colony inspection
- Record file

1.3 Time

Theory: 30 minutes

Practical: 50 minutes

Discussion: 10 minutes

1.4 Place: Training Hall, Apiary

4. Activities and exercise

4.1 Provide participants with information on the topics covered in the training and obtain information about the participant's level of knowledge on the subject matter.

4.2 Presentation

Give short presentation on the inspection of the hive (external and internal), inspection steps, how to record the inspection, preparation for the inspection, and precautions as outlined in the resource material.

1.3 Group division/practical exercise.

Divide the participants into 4 groups and complete the following tasks during practical exercises.

- Inspect the colony externally
- Inspect the colony internally
- Observe the situation of food storage in the colony, the working capacity of different classes of bees
- Observe the condition of mites and disease infestation in the colony

Take participants to apiary for colony inspection. Inspect 4 different colonies by 4 groups separately. Demonstrate them how to open the hive, how to handle

brood frames, from where to start inspection and show them eggs, larvae, pupae, adults, pollen, honey. Observe the disease and pests and their symptoms if present. Use the hand lens if needed.

1.4 Discussion

After returning from the apiary, one person from each group will present the findings of the observations in a documented format. Review any unclear topics such as the food situation in the colony, the status of diseases and parasite infestations, and the work done by different classes of bees.

4. Detail schedule

S.N.	Subject matter	Description	Time	Materials
1	Introduction to bee colony inspection and its purpose	Make participants to write down what they know about the colony inspection.	5 minutes	Marker pen, meta card.
2	Preparation for inspection, suitable weather and time for inspection	Prepare for the colony inspection and discuss the appropriate weather and time for the colony inspection and the steps of the inspection	5 minutes	Projector, power point slides, pictures, videos.
3	Colony inspection (external and internal)	Explain the method of colony inspection (external and internal)	10 minutes	Projector, power point slides, pictures, videos.
4	Record keeping	Explain the record keeping method of colony inspection.	5 minutes	Projector, power point slides, pictures, videos.
5	Things to be considered during inspection	Mention the things to pay attention during inspection	5 minutes	Projector, power point slides, pictures, videos.

S.N.	Subject matter	Description	Time	Materials
6	Practical exercise	Take participants to the apiary for colony inspection. During inspection of the exterior and interior of the beehive show the different classes of bees: queens, workers, drones and brood (eggs, larvae, pupae) as well as the condition of food storage (honey and pollen). Similarly, show them the symptoms of bee parasites and diseases if present. Provide information about record keeping of inspection.	50 minutes	Bee hive with bee colony (adults, eggs, larvae, pupae) Equipment for colony inspection Hand lens Record keeping format
7	Discussion		10 minutes	

6. Resource materials

6.1 Introduction

Bee colony inspection refers to the observation of various conditions of bee colonies in an apiary. During a bee colony inspection, information is collected about the presence and activeness of queen bees, the status of diseases and mite infestations in the colony, the presence of bee food (pollen, honey) in the hive, the condition of the brood (eggs, larvae, and pupae), and the activities of worker and drone bees. A colony inspection provides information regarding the management practices that should be applied in the bee colony according to the weather condition to make the colony healthy and strong to maximize production and productivity. There are two methods of colony inspection: external and internal.

6.2 External inspection

This is an inspection carried out from outside the hive to obtain information about the condition of the bees in the colony. During external inspections,

information is collected about the movement of worker bees at the entrance, the condition of dead bees/brood, the condition of robbing in the colony, the condition of enemy attack and damage of beehive by external pests.

Table 7: Simptoms and signal seen in he hive inspection

Symptoms seen on inspection	Signal (information) received through symptoms
A large number of bees having entry and exit at the hive entrance and the large no. of bees carrying the pollen.	The colony is strong.
Dead brood seen dumped at the hive entrance or at the bottom of the hive	The brood have infected by disease.
Bee droppings and black spots are visible everywhere at the hive entrance.	Abnormal condition of the hive
Large numbers of dead bees with their tongues sticking out at the hive entrance or bottom.	Signs of pesticide exposure
Bees crawling, seemingly unable to fly	Symptoms of disease and mites in bees
Large numbers of bees flying in, seemingly dying by colliding with each other at the hive entrance.	Signs of robbing
Sitting on the porch at the hive entrance, less no. of bees foraging	Signs of abandonment or homelessness
Large no. of drones are visible, the worker bees are more aggressive.	Sign of queen less colony or presence of egg laying workers

6.3 Internal inspection

This is an inspection/observation done by opening the hive. This helps to identify the condition of the colony and make any necessary further management practices. Before conducting an internal inspection, the materials required for inspection of colony (smoker, hive tool, comb, gloves, bee veil, etc.) should be gathered. During the internal inspection, the colony should be managed by considering the following conditions:

- The condition of diseases or mites in the colony
- The condition of swarming or abandonment/ absconding
- The need of adding comb foundation to the hive

- The condition of food storage (honey and pollen) in the combs
- The condition of sanitation in the hive
- Manage if bees have built their comb in inappropriate places.
- The condition of the colony in the hive (the number of brood and adult bees)
- Commercial beekeepers should inspect the representative colonies internally to collect information about the condition of the bees in their apiary. Only after inspection, they can get accurate information about the condition of their bees in the colonies and follow the appropriate management practices.



Figure 42: Hive inspection

6.4 Time and season of bee colony inspection

- Beekeepers should conduct inspections activities based on the favorable weather conditions. Extreme hot/cold, rainfall, windy and fogging should be avoided.
- Generally, sunny and clear days are preferred for colonies inspection when the majority of the worker bees are busy in foraging
- However, due to the climate and geographical diversity found in Nepal, the time for inspecting bee colonies differs in the Terai and the hills.
- Bee colonies inspection should be done at least twice a month or once a week.

Table 8: Schedule for bechive inspection

Region	Season	Favorable time	Inspection interval
Hill	Winter	11:00 AM-2:00 PM	Once in 3 to 4 weeks
	Summer	10:00 AM-3:00 PM	Once in 10 to 15 days
Terai	Winter	10:00 AM-2:00 PM	Once in 3 weeks
	Summer	7:00AM-10:00 AM 4:00PM - 6:00 PM	Once in 7-10 days

Despite the above schedule, during swarming season, at the time of disease infestation, at the time of enemy attack and at the time of introduction of new queen/queen cell, bee colonies should be inspected every 3-7 days interval.

6.5 Materials required for hive inspection

- Bee veil
- Gloves
- Hive tool
- Knife
- Smoker
- Comb foundation
- Inspection form
- Pen

6.6 Internal Inspection Steps

There are certain steps for inspecting bee colonies in the apiary. They are given as below.

- Stand to the right or left of the hive and start to inspect the colony.
- Give smoke lightly from the entrance of the hive (2-4 times from the smoker).
- Remove the hive roof/outer cover and place it in upright position in front of the hive, and also lightly give smoke into the hole of the inner cover.
- Remove the inner cover and keep on the side of the hive (if you see a queen when removing the cover, place it securely in the hive).
- Keep the super/honey chamber safely on the outer cover placed in front of the entrance.
- If there is a dummy board or frame feeder in the brood chamber, remove it.
- Inspect the brood frames carefully ensuring that nectar, pollen, brood and adult bees do not fall outside the hive.
- Remove the brood frames and inspect one by one carefully, and keep them in their original place.
- After completing the inspection, replace the honey chamber, inner and outer cover carefully.
- Maintain inspection records and implement the colony management activities according to the records.

6.7 Points to be considered by the colony inspector

During the bee colony inspection, the colony inspector should follow as;

- Wear clean, odorless, plain clothes.
- The inspection should be completed in a short time (5 to 10 minutes) with a light hand.

- Lightly smoke bees with smoker to calm them down.
- If the bees become more aggressive, immediately close the hive cover.
- Inspection should be done first on healthy and strong colonies and then on weak, sick and angry colonies.
- Inspect the sick colony at last and clean the materials used with soap water.



Figure 43: Hive inspection

- If the queen bee is seen in a brood frame, inspect the frame carefully and place it immediately back inside the brood chamber.

6.8 Sample of bee colony inspection records

Number of bee colony: 1

Location of apiary: Apiculture Development Center, Godawari, Lalitpur

Queen age: 1 year

Table 9: Bee colony inspection record (sample)

Inspection Date	No. of comb		Condition of bees				Food availability		Disease situation	Remarks
	Brood	Honey	Adult	Egg	Larva	Pupa	honey	pollen		
2082/07/02	+++	+	+++	++	++	++	++	++	-	
2082/07/17	+++	++	+++	++	++	++	+++	++	-	

Note: Very good = +++, If moderate=++, If less = +, if not = -

Sample questions for practice

1. What are the equipment/materials needed for a colony inspection?
2. What is the appropriate weather and time for a colony inspection?
3. What are the steps in an internal colony inspection?

Session 6

Bee seasonal management

1. Learning objectives

By the end of the session, the participants will be able to:

- Understand the need of seasonal management of honeybee colonies.
- Practice colony management operations during different seasons.
- Save bee colonies from food, heat, and cold stresses.
- Manage hives with healthy bee colonies.

2. Sub topics

- Introduction and importance
- Monitoring/inspection of bee colony
- Seasonal management
    - Spring season management
    - Summer season management
    - Autumn season management
    - Winter season management
    - Monthly Management Activities

3. Materials and methods

3.1 Training methods

- Lecture
- Brainstorming/experimentation
- Group discussion
- Practical Exercise
- Visits and observation of management practices of bee colony

3.2 Training materials

- Projector, power point slides, pictures
- Marker pen, brown paper, pen and masking tape, meta card
- Healthy bee colony sample/videos of bee colony management
- Protective wears, bee smoker, hive tool, feeders, feeds, pests and disease samples.
- Microscope/hand lens

3.3 Time

Theory: 50 minutes

Practical: 30 minutes

Discussion: 10 minutes

3.4 Place: Training Hall, bee farm, lab

4. Activities and exercises

4.1 Inform the participants about the lecture/practical exercises included in the training and obtain information about the level of knowledge of the participants on the subject.

4.2 Presentation

Give a short presentation on the bee colony inspection, seasonal management, healthy colony observation and record keeping, activities in different seasons and year-round management activities as outlined in the resource materials.

4.3 Group division/practical exercises

Divide participants into 4 groups and complete the following tasks during the practical exercises.

1. Inspection of a bee colony and recording performance (queen egg laying, workers jobs, larval pupal, drone, pollen and honey shells), health and hygiene of bee colony.
2. Each group performing at least one seasonal activity (spring, summer, autumn, winter).

3. Main activities listing by groups for year-round management of bee colony.

4. Visit apiary and observe the bee performing various activities.

Take participants to the bee farm/apiary for practice and demonstrate bee colony inspection, record keeping and decision to be made for the better management of the colony. Similarly, introduce the seasonal management activities. If available, use binocular/ hand lens to observe the process more clearly.

4.4 Discussion

After returning from the bee farm, organize group presentation to present the results of their observations. Ask participants about bee colony inspection, record keeping, seasonal and annual management activities, and colony performance, to find out whether they are clear and to discuss topics to clarify if they are not clear.

5. Detail schedule

S.N.	Subject matter	Description	Time	Materials
1	Bee colony inspection and recording performance	Ask participants to write importance of bee colony inspection and recording colony performance.	5 minutes	Marker, pen, meta card
2	Spring season management	Discuss with participants to prepare activities of spring season management	10 minutes	Projector, PPT slides, photo, video
3	Summer season management	Discuss with participants to prepare activities of summer season management	15 minutes	Projector, PPT slides,
4	Autumn season management	Discuss with participants to prepare activities of autumn season management	10 minutes	Projector, PPT slides, photo, video
5	Winter season management	Discuss with participants to prepare activities of winter season management	10 minutes	Projector, PPT slides, photo, video

S.N.	Subject matter	Description	Time	Materials
6	Practical exercise	Organize participants in four groups and visit to apiary to inspect and observe bee colony performance, record all observations and decide activities to perform for maintaining healthy and strong colony	30 Minutes	Bees, bee flora, honey potential plants, conservation areas
7	Discussion		10 Minutes	

6. Resource materials.

6.1 Introduction

The climate and vegetation in Nepal are extremely variable from upper Himalaya to lower Terai belts. The domesticated honey bee species, *A. mellifera* and *A. cerana* can survive through the country including Himalayan region below 11000 feet altitude. The aim of honeybee colony management is to aid the colony to build up to its maximum during the main nectar flow and to survive the dearth. Well-managed colonies assure the greatest possible return to the beekeepers. It depends upon the climate of different area, major forage plants and their flowering periods, seasonal incidence of disease and insect pests. It also differs to some extent on honeybee species.

6.2 Monitoring/inspection of bee colony

Monitoring of bee colony is important to understand the value of their performance in terms of healthy bee population growth, colony development and hive storage. 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 their performance to prevent bees leaving/escaping the new hive. During inspection different observations are made ranging from activities of worker bees to the performance of the queen.

6.3 Seasonal management

Beekeeping management practices may vary depending on the seasons and local climate such as nectar and pollen are not available to bees throughout the

year, however, during some part of the year, surplus food is available. Varying weather conditions during different seasons influence to honeybee population and their activities. Beekeepers need to consider factors such as spring build-up, swarming, honey flow, summer, rainy and winter preparation handling bee colonies accordingly in such a manner that the colonies are well maintained to perform activities in all aspects throughout the year.

6.3.1 Spring management: Spring management is very crucial, because it is time of building up bee colonies and foraging of plants for collection and storage of bee products. Examine the colonies on a bright, warm and calm day to assess the condition of the colony.

Spring season management activities (March-May)

- Examine working of the queen, amount of the brood present, and honey and pollen stores
- Clean the bottom board debris accumulated during winter
- Give stimulant feeding
- Follow up for robbing control
- Follow golden rule of colony management
- Replace the old queen
- Add withdrawn combs during rainy and winter seasons
- Follow up for swarm management
- Avoid congestion in the hive and draw surplus honeybees to supers
- Place a queen excluder between super and brood chambers three weeks before honey extraction
- Extract honey from all sealed or two third capped combs leaving 5-7 kg for dearth period
- Improve verification by showing the super bees ward

6.3.2 Summer/Rainy management: This period is essentially a lean or dearth period (except in temperate, i.e. Europe) and hard for the bees. There is no pollen, the weather is unfavorable and brood bearing is reduced. In rainy season, humidity in the hive coupled with high temperature creates an unfavorable environment for bees and they become lethargic and often suffer from dysentery. Rain and cloudy weather hamper bees foraging activity. Pollen becomes moldy and unripe honey ferment. Examine and follow good practices to manage the colony.

Summer/Rainy season management activities (June-August)

- Prepare and make the colony strong
- Keep the colonies with new prolific queen
- Place the hive under shade to protect from sun and rain
- Sprinkle cold water twice over hive on sunny and hot days
- Provide proper ventilation by removing entrance rods
- Make provisions of clean water near apiary
- Provide wind breaks against hot wind
- Feed bees supplying artificial diets
- Supply broods from strong colonies to weaker colonies
- Examine colony, maintain hygiene and protection from pests and diseases and robbing
- Unite weak colonies with strong one following dummy method or smoke method

6.3.3. Autumn season management: After harsh monsoon period, the autumn is the second-best season for bees and the bee management depends on floral and weather conditions. The colonies need proper management to keep them in good condition. This is also a period when failing queens or old queens need to be replaced. Proper management at this time assures successful overwintering of the colonies and later rapid buildup during spring season.

Autumn season management activities (September-Novmber)

- Inspect working of the queen, amount of the brood present, and food stores
- Clean the bottom board debris accumulated during rainy season
- Give stimulant feeding
- Harvest the honey if sufficient
- In the areas of honey flow sources, the division of colony can be done in the beginning of the season
- Replace the failing queens or old queens by new queen
- Prepare the colonies for overwintering in cold areas
- Monitor and control pests and diseases.
- Perform mite treatments and ensure food stores are adequate
- Migrate the colonies in the warm areas of foot hills and plains

6.3.3. Winter season management: The foraging period is shorted and prevented due to fogging. The bees spend their energy in protecting the colony form low temperature. Bee colonies can be managed properly following good practices for the winter.

Winter Season management activities (December-February)

- Close all the openings, cracks, and crevices in the beehive
- Keep the hive entrance gate opposite to the wind direction
- Place the hive in an open area for sun rays, but protect it from frost
- Provide artificial food if necessary
- Cover beehives with gunny bags and use packing materials inside for insulation
- Inspect the colony and keep them strong
- Unite the weak colony with the strong one, following the golden rule of bee management

6.4 Monthly management activities:

The year-round activities of the colony management are summarized in Table 10.

Table 10: Summary of seasonal management practices

Month	Beekeeping activities
January	Check hive weight and provide supplemental feed if necessary. Insulate hives for winter protection Monitor hive entrance for signs of activity and ventilation
February	Continue monitoring hive weight and food stores. Monitor and control varroa mite infestation. Prepare for early spring hive inspections
March	Inspect and assess hive strength Remove winter insulation and reduce supplemental feeding Begin brood expansion management and brood box additions
April	Conduct thorough hive inspections and assess colony health Provide adequate space for brood and honey storage Monitor and control pests and diseases.
May	Manage swarm control and perform split or colony division if necessary. Super hives with honey supers for nectar flow. Maintain hive ventilation and check for signs of swarming activity.

Month	Beekeeping activities
June	Continue colony inspections and monitoring for pest and disease issues. Harvest honey from honey supers if appropriate. Monitor and control honey bee nutrition and health.
July	Continue monitoring colony health and population. Provide water sources for bees. Assess honey production and extract honey as needed.
August	Monitor hive weight and food stores for winter preparation Begin varroa mite treatments if necessary. Evaluate honey production and prepare for late-season nectar flow.
September	Conduct final inspections and assessments before winter. Consolidate hive resources and reduce entrances. Provide winter feed and medications if required.
October	Prepare hives for winter by insulating, reducing entrances, and providing windbreaks. Monitor and control pests and diseases. Perform mite treatments and ensure food stores are adequate.
November	Perform occasional checks on hive weight and food stores. Monitor hive entrance for signs of activity and condensation. Keep hive entrances clear from debris and dead bees.
December	Perform periodic checks on hive weight and food stores. Maintain winter insulation and ventilation. Protect hives from extreme weather conditions.

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.

Sample questions for practice.

1. Write down the overall general practices of bee colony management in your areas.
2. What are the things to consider while inspecting and managing a bee colony?
3. Prepare list of activities to manage a bee colony during honey flow and dearth season.

Session 7

Swarming and absconding in bee colony and its management

1. Learning objectives

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

- Explain the concepts of swarming and absconding in bee colony.
- Identify the causes, timing, and symptoms of swarming and absconding.
- Distinguish the differences between swarming and absconding.
- Implement preventive and management strategies and practices for both.

2. Sub topics

- Introduction to swarming and absconding
- Symptoms and causes of swarming and absconding
- When and why swarming and absconding occur
- Preventions/management key for swarming and absconding
- Key differences between swarming and absconding

3. Methods and materials

1.1 Training methods

- Lecture/presentation
- Brain storming
- Group discussion/observation

1.2 Training materials

- Projector, power points, slides, pictures, video.
- Marker pen, brown paper, pen, masking tape, meta card
- Empty modern hive/ nucleus hive
- Swarming bag/ cartoon/bamboo basket
- Queen cage/queen gate

1.3 Time

Theory: 50 minutes

Practical: 30 minutes

Discussion: 10 minutes

1.4 Place: Training hall, Apiary

3. Activities and exercise

3.1 Inform the participants about the lecture/practical exercises included in the training and obtain information about the level of knowledge of the participants on the subject.

1.2 Presentation

Give a short presentation on swarming and absconding in bee colony outlined in the resource material,

4.3 Group division, discussion, presentation and group review

Divide the participants into four groups and conduct a group discussion and review on one of the specified topics.

1: Causes of swarming and absconding.

2: Symptoms of swarming and absconding.

3: Management of swarming and absconding.

4: Difference between swarming and absconding.

After completing the group discussion, organize group presentation. Select a group leader from each group and make them to present what they have listed in the brown paper. After presentation discuss with other participants and any additional insights.

1.4 Discussion

Use in depth discussion and question and answer to discover whether the participants can recognize and differentiate the different between swarming and absconding, and understand the way in which tasks and activities are assigned among them. During the review, it will be assessed whether participants are capable of:

- Identifying **swarming and absconding** in bee colonies,
- Recognizing **different behaviors and conditions** inside and outside the hive,

- Explaining **swarming and absconding** clearly,
- Mentioning **causes, timing, and conditions** of **swarming and absconding**,
- Explaining the **preventive and management** methods for **swarming and absconding**,
- Describing the **differences** between **swarming** and **absconding**.
- Any unclear or misunderstood topics will be further clarified during the review.

5. Detail Schedule

S.N.	Subject matter	Description	Time	Materials
1	Introduction	Ask participants to write down their existing knowledge about swarming and absconding events in beekeeping.	10 minutes	Marker pen, meta cards
2	Identification, Causes, Timing, and Season	Provide an explanation on how to identify swarming and absconding, their causes, timing, and seasonal conditions.	20 minutes	Projector, power point slides, pictures, videos
3	Differences, Control, and Management	Explain the differences between swarming and absconding along with their control and management techniques.	20 minutes	Projector, power point slides, pictures, videos
4	Practical Exercise	Divide participants into four groups. Assign one topic to each group and organize the group discussion, presentation and review.	30 minutes	If available, actual swarming/ absconding bee colonies, necessary hive inspection tools, bee brush, feeding containers, queen gate, etc.
5	Discussion		10 minutes	

6. Resource materials

6.1 Swarming

6.1.1 Introduction.

Swarming is a natural phenomenon of increasing honey bee colony. It typically occurs when a colony becomes overcrowded. In swarming process, a portion of the worker bees leave the hive with the old queen to form a new colony. This usually happens in the spring and early summer when there is plenty of nectar and pollen available in nature. Swarming is an indicator of a healthy and growing colony, but for beekeepers, it can result a reduction in honey production.

6.1.2 Symptoms of swarming:

- A sudden increase of bee population inside the hive.
- Presence of queen cells (especially along the bottom edges of frames).
- Worker bees become more active and aggressive.
- A large number of bee cluster near the hive entrance or outside on tree branches are seen.
- Increased number of drones are seen.
- Swarming typically occurs during peak flowering seasons (spring/ summer).

6.1.3 Causes of Swarming:

- Overcrowding bees in the hive.
- Abundant supply of foods (nectar and pollen) leading to fast colony growth.
- Lack of abundant space to lay eggs or store food (honey/pollen).
- Strong and healthy queen laying a large number of eggs.
- Genetic tendency of the bee species to swarm.
- Seasonal behavior (common during favorable weather and blooming seasons) of the .

6.1.4 Swarming - when and why it happens

When?

- Mostly occurs in **spring to early summer**
- Coincides with **peak flowering season** when nectar and pollen are abundant.

- Typically observed when the colony population reaches in its peak.

Why?

- It's a **natural process of multiplication** of honeybee colonies.
- Triggered by **overcrowding**, excessive food supply, or a **healthy, high-performing queen**.
- The colony splits as part of its natural life cycle: the old queen leaves with a large number of worker bees (approx. ½ of the colony) to form a new colony.

Key message: Swarming is not a disease but it's a biological process aimed at expanding bee populations.

6.1.5. Prevention of swarming

1. Regular hive inspections
   - Monitor colony strength and detect queen cells early.
2. Manage sufficient space in bee hive
   - Add extra frames or super boxes if the colony is growing quickly.
   - Avoid overcrowding inside the beehive.
3. Timely division of strong colonies
   - If a colony is getting too large, split it into two colony to prevent natural swarming.
4. Clip the queen's wings (if practicable)
   - In some regions, this is done to prevent the queen from flying off during a swarm.
5. Destroy unnecessary queen cells
   - If unnecessary queen cells are found during inspections, remove them carefully.
6. Rotate or shift hive locations
   - Helps manage bee flight paths and reduce congestion.

6.1.6 Management of swarming

1. Catch the swarm

- If swarming has occurred, locate the new cluster (often on a nearby tree branch or wall or building) and gently collect the bees using a **swarm-catching box/bag** and **bee brush**.

2. Transfer into new hive

- Place the caught swarm into a prepared new hive/box with clean frames and comb.
- Ensure proper ventilation and feeding for the
- newly settled colony.



Figure 44: Swarming

3. Provide a queen or let them rear one

- If the swarm has no queen, introduce a mated queen or queen cell or allow them to rear one from existing brood by supplying a brood comb from other colony.

4. Modify conditions in original hive

- Reduce congestion.
- Remove the excessive queen cells.
- Add additional space (new frames or super) to prevent further swarming.
- Provide sufficient ventilation inside the hive.



Figure 45: Management of Swarming

5. Feed both colonies as needed

- Ensure both the parent hive and new hive have enough food to recover the strength.

6.2 Absconding

6.2.1 Introduction:

Absconding occurs when the entire colony of bees abandons the hive. Unlike swarming, absconding is usually caused by unfavorable conditions such as pest infestation, attack of natural enemies, food shortage, poor ventilation, or frequent disturbances. It is a sign of stress or poor hive management and results in the complete loss of the bee colony.

6.2.2 Symptoms of absconding

- Sudden absence of most or all bees in the hive.
- Hive appears deserted, with no foraging activity.
- Remaining combs may have little or no honey or brood.

- No sign of pests in early stages, but secondary infestations (like ants) may follow.

6.2.3 Causes of absconding

- Disturbances: Frequent or excess inspection of the bee colony, smoke, or movement of the hive.
- Pest infestation: wax moths, ants, mites, etc.
- Poor hive location: too hot, damp, or exposed to wind/rain.
- Insufficient food supply: shortage of food (nectar or pollen).
- Poor ventilation or over temperature inside the hive.
- Diseased or weak queen.
- Repetitive environmental stress.
- Frequent attack of natural enemies.

6.2.4 Absconding - When and why it happens

When?

- It can happen at **any time of the year**, especially:
    - During **extreme temperatures** (hot or cold)
    - At the time of **drought or food scarcity**
    - When the hive is under **stress or threat**

Why?

- Bees abandon the hive due to **unfavorable internal or external conditions**.
- Common triggers include:
    - Persistent pest attacks (like ants or mites)
    - Poor hive management
    - Shortage of food and water
    - Excessive human/animal disturbances
    - Frequent exposure to chemicals or smoke
    - Unhygienic hive conditions

Key message: Absconding results in **complete colony loss**, unlike swarming, which only reduces colony strength.

6.2.5 Types of absconding

6.2.5.1 Planned absconding

This type of absconding is a natural, cyclical behavior, particularly common in tropical and subtropical regions. It's triggered by seasonal changes in resource availability, such as the blooming of certain flowers or the onset of a dry season. Bees migrate to areas with more abundant food sources or better climatic conditions. It's a survival strategy, allowing colonies to persist even when conditions become harsh in one location. The bees scout for a new location and communicate its location to the rest of the colony using waggle dances, similar to swarming. However, unlike swarming, the entire colony migrates, not just a portion of it.

6.2.5.2 Unplanned/emergency absconding

This type of absconding happens due to factors that negatively impact the hive's environment or the bees' well-being. It can be triggered by:

- **Pests and diseases:** Varroa mites, small hive beetles, wax moths, and other pests can weaken or infest the hive, causing the bees to leave the hive.
- **Lack of resources:** Shortage of food (nectar and pollen) or water can lead to absconding.
- **Excessive disturbances:** Frequent disturbances from humans, animals, or even loud noises can stress the bees and cause them to abandon the hive.
- **Unfavorable environmental conditions:** Extreme temperatures (too hot or too cold), lack of ventilation, or exposure to smoke or bad odors can also trigger absconding.
- **Predators:** Yellow jackets or other predators can make the hive unsafe for the bees.

Unlike planned absconding, this type is often a response to a crisis and may happen suddenly. The entire colony, including the queen, will leave the hive in search of a new, safer location.

6.2.6 Prevention of absconding

1. Avoid frequent disturbance
    - Don’t open or move the hive too often or aggressively.

2. Ensure food supply
    - Provide supplemental feeding (sugar syrup, pollen substitutes) during lean seasons.
3. Keep hive clean and well-ventilated
    - Maintain hygiene, proper drainage, and ventilation.
4. Control pests and predators
    - Regularly check for ants, mites, wax moths, etc.
5. Place hive in a suitable location
    - Choose spots that are dry, shaded, not exposed to strong wind or rain.
6. Replace weak or diseased queens
    - Colonies with strong queens are less likely to abscond.

Proactive and preventative management is key - once absconding happens, it's often too late to recover the colony.

6.2.7 Management of absconding

1. Investigate the cause
    - Check for pests, disease, heat stress, poor food supply, or repeated disturbance.
2. Clean and disinfect the hive
    - Remove dead bees, pests, mold, or contaminated comb.
    - If possible, flame or sun-dry the hive components.
3. Improve the hive environment
    - Relocate the hive to a more suitable location.
    - Ensure ventilation, shade, and protection from predators.
4. Introduce a new colony
    - Once the hive is ready, reintroduce a new bee colony from a split or caught swarm.
5. Monitor closely
    - After restocking, observe closely for signs of stress or repetition of the issue.

Remember:

- Swarming is recoverable if caught early.
- Absconding results in total loss, so **prevention is far more effective than management**.

Table 11: Differences between swarming and absconding

Aspect	Swarming	Absconding
Nature	Natural, reproductive behavior	Abnormal, stress-induced behavior
What Happens	Part of the colony (workers + queen) leaves	Entire colony abandons the hive
Timing	During favorable seasons (spring/summer)	Any time, often during harsh or stressful conditions
Cause	Overcrowding, strong queen, good food supply	Pest attack, food shortage, environmental stress
Queen Status	Old queen leaves with worker bees	Entire colony leaves with or without the queen
Colony Health	Indicates a healthy, growing colony	Indicates stress, disease, or poor management
Management Goal	Control and catch swarm to retain productivity	Prevent total colony loss through better conditions

In summary:

- **Swarming** is a natural sign of colony strength and multiplication but needs to be managed to avoid colony loss.
- **Absconding** is a negative outcome of stress and poor conditions, and must be prevented through good beekeeping practices.

Sample question for practice.

1. What are symptoms of swarming and absconding?
2. What are the preventive measures of absconding?
3. Write the difference between swarming and absconding?

Session 8

Colony division in beekeeping

1. Learning objectives

By the end of the session, the participants will be able to:

- Describe the reasons and timing of colony division.
- Explain the methods of colony division.
- Divide the colony.
- Manage the colonies after division.

2. Subtopics

- Introduction
- Reasons, timing, and season for colony division
- Methods of colony division
- Precautions during colony division
- Mandatory tasks to be performed after colony division

3. Methods and materials

3.1 Training methods

- Lecture/presentation
- Brainstorming
- Group discussion/interaction
- Practical exercises

3.2 Training materials

- Projector, PowerPoint, slides, pictures
- Marker pen, brown paper, tape and masking tape, meta cards
- Strong colony
- Empty modern hive

- Necessary tools for colony inspection
- Supportive materials for colony division (brood frames, sugar syrup, feeder, sugar/honey, etc.)
- Queen excluder, queen gate, and queen cage

1.3 Time

Theory: 35 minutes

Practical: 90 minutes

Discussion: 10 minutes

3.4 Place: Training Hall, Apiary

4. Activities and exercises

4.1 Inform the participants about the lecture/practical exercises included in the training session and obtain information about the level of knowledge of the participants on the subject.

4.2 Presentation

Give a short presentation on colony division, reasons for division, precautions during and after division, and management after division as outlined in the resource materials.

4.3 Group division/practical exercise

Divide participants into 2 groups and take them to the apiary for practical exercise of colony division. Introduce them the qualities of strong hive before dividing the colony. Follow each step and procedure of colony division and make participants divide the colony themselves. Demonstrate the management activities that should be done after colony division. Allow participants to prepare presentations after practical exercises about cony division and precautions related to colony division.

4.4 Discussion

After returning from the apiary, organize a group presentation to discuss the results of their observations and practical experiences. Perform an in-depth discussion and question/answer to discover whether the participants can recognize the colony that should be divided and whether the participants are

clear about the methods of colony division and precautions that should be considered while performing the given tasks.

5. Detail schedule

S.N.	Subject matter	Description	Time	Materials
1	Introduction	Ask participants to write their knowledge about colony division	10 minutes	Marker pen, meta cards
2	Reasons, time, and season	Brief explanation about the reasons, time, and suitable seasons for colony division, including internal and external colony conditions	10 minutes	Projector, Power point slides, images, videos
3	Methods of colony division	A concise theoretical explanation of the methods of colony division and precautions in colony division.	15 minutes	Projector, Power point slides, images, videos
4	Practical exercise	Divide participants into two groups; each group practices colony division. Each group then presents its findings, first to smaller groups for review, then to the larger group for additional discussion and feedback.	90 minutes	Colonies for division, empty modern hives, inspection materials, bee brush, feeding boxes, queen cage
5	Discussion		10 minutes	

6. Resource materials

6.1. Introduction

Colony division is the process of producing two or more colonies from one strong parent colony. Beekeepers can split one colony into multiple colonies keeping the quality parameters of colony intact. This activity helps beekeepers to sell colonies for additional income or keep them to produce more honey

and increase their income. But the decision for colony division should consider reduced honey production during the nectar flow season.

6.2 Precautions during colony division:

6.2.1 Time/Season:

Generally, colony division occurs during the nectar flow season. Depending on geographical location, colony division can be done twice in a year. For example, in Terai and Mid-hills: late January to mid-April and August-end to mid-September. Likewise, in Higher hills of Nepal: April to mid-July is suitable. Commercial beekeepers can adjust colony numbers as per the plan of honey production.

6.2.2 Ideal conditions:

- Avoid colony division during rain or cold weather.
- Perform colony division on warm, sunny afternoons.

6.2.3 Colony conditions:

- Strong and healthy colony with 10 frames of bees and more than 6 frames of brood, sufficient food reserves, and the presence of a young, healthy and mated queen or matured queen cell.

1.3 Selecting high-quality colonies for division:

The quality colony parameters are as follows:

- High egg-laying capacity of queen bee
- Good honey and pollen storing ability
- High disease and pest resistance ability
- Less swarming and aggression
- Capacity to maintain colony strength even in off-season

6.4 Preparation for colony division:

Prepare all required materials in hand, including empty hives, selected strong colony, foundation frames, sugar, inspection materials, etc.

6.5 Required materials for division:

- Empty hives/Dummy boards
- Selected strong colony

- Frames with comb foundation
- Sugar feed
- Inspection tools

1.6 Division methods:

6.6.1 Natural division: Using queen cells produced naturally during the swarming season to prevent swarming.

6.6.2 Artificial division by quality queen production: Selectively produce queen cells from high-quality queens, and create nucleus colonies with at least 2 brood frames and 3-4 frames of food.

Parallel method of colony division (Practical exercise):

- Select a strong and healthy mother colony.
- Shift mother colony 1 foot left from current position.
- Place the new hive 1 foot to the right from original place of mother colony.
- Transfer the queen and 5 frames having sufficient amount of brood and food into new hive.



Figure 46: Colony division

- Keep one matured queen cell and remaining frames to old hive.
- Ensure balanced adult bee population in both hives.

For this;

- Pay attention to whether the bees returning from foraging are entering both hive equally. If not slightly shift the hive away from the original place in which bees are entering more.
- If the number of adult bees in both divided hives are not equal, the number of bees can be adjusted by swapping the hives on the evening of the day of division.
- Gradually separate the hives as needed after the bee colony has settled.



Figure 47: Colony division

- Once the bees start doing their work, we can move the hive 1-1.5 feet every evening and place it in the desired location.
- The divided colonies should be fed light sugar syrup in the evening for 3 days.

Sample questions for practice:

1. What is colony division, and how should suitable colonies be selected for this purpose?
2. What are the qualities of strong colony for division?
3. What are the methods of colony division?

Session 9

Colony unification in beekeeping

1. Learning objectives

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

- Explain the method of colony unification.
- Describe the reasons and timing of colony unification.
- Perform colony unification.
- Manage the colony after unification.

2. Subtopics

- Introduction
- Reasons, time, and season for colony unification
- Methods of colony unification
- Precautions during colony unification
- Tasks to be performed after colony unification

3. Methods and materials

3.1 Training methods

- Lecture/presentation
- Brainstorming
- Group discussion/interaction
- Practical exercises

3.2 Training materials

- Projector, Power point slides, pictures
- Marker pen, brown paper, tape and masking tape, meta cards
- Bee colonies for unification
- Required materials for colony inspection

- Auxiliary materials for unification (frames, old newspaper, sugar syrup feeder, sugar/honey, etc.)

3.3 Time

Theory: 35 minutes

Practical Exercises: 90 minutes

Discussion: 10 minutes

3.4 Place: Training Hall, Apiary

4. Activities and exercises

4.1 Inform the participants about the lecture/practical exercises included in the training and obtain collect information about the level of knowledge of the participants on the subject.

4.2 Presentation

Give a short presentation on colony unification, reasons for unification, procedure of unification as outlined in the resource materials.

4.3 Group division/Practical exercise

Divide participants into 2 groups and take them to the apiary for practical exercise and demonstrate bee colony unification. Introduce them the two weak colonies before uniting the colonies. Follow each step and procedure of colony unification and make them unite the colonies themselves. Demonstrate the management activities that should be done after colony unification. Allow participants to prepare presentations after reviewing practical exercises and precautions related to colony unification.

4.4 Discussion:

After returning from the apiary organize a group presentation to discuss on the result of their observations and practical experiences. Perform in depth discussion and question/answer to discover whether the participants can recognize the colony that should be united, difference between division and unification, understand the way in which tasks and activities were divided among them, and whether the participants are clear understanding about the methods of colony unification and precautions that should be considered while performing the given tasks.

5. Detail schedule

S.N.	Subject Matter	Description	Time	Materials
1	Introduction	Ask participants to write their knowledge about colony unification	10 minutes	Marker pen, meta cards
2	Reasons, time, and season	Brief explanation about the reasons, time, and suitable seasons for colony unification, including internal and external colony conditions	10 minutes	Projector, Power point slides, images, videos
3	Methods of colony unification	A concise theoretical explanation of the methods of colony unification	15 minutes	Projector, Power point slides, images, videos
4	Practical exercise, review, and presentation	Divide participants into two groups; each group practices colony unification. Each group then present its findings, first to smaller groups for review, then to the larger group for additional discussion and feedback.	90 minutes	Colonies for unification, inspection materials, bee brush, feeding boxes, queen cage
5	Discussion		10 minutes	

6. Resource materials.

6.1 Colony unification

Colony unification is a process of uniting two or more weak colonies or one weak colony with a strong colony to form a healthy and strong colony. After proper unification procedures, bees of two different colonies accept each other and become a strong colony.

6.2 Precautions during colony unification:

6.2.1 Time/Season:

There is no specific time or season for colony unification. It can be done whenever needed. In general, during adverse weather condition, most bee

colonies become weak and can be destroyed or become laying worker colony. Such colonies can be united at any time. Similarly, two healthy colonies can be combined during the honey flow season to make a strong colony and produce honey.

6.2.2 Ideal conditions:

Typically done in the evening when all bees return to the hive

6.2.3 Colony conditions

One weak colony and another strong colony having healthy queen or more than two weak colonies having one healthy queen.

6.3 Reasons for colony unification:

- **Weak colonies:** Uniting two or more weak colonies results in a single strong colony.
- **Queen less colony or weak queen:** If the colony doesn't have a queen, and there is no possibility of producing a new queen (absence of fertilized eggs, 2-3 days larvae and queen cells in the colony) or has a very weak queen, the colony should be united with a colony having a good queen (a 'queen-right colony').
- **Laying worker colony:** Sometimes worker bees may start laying eggs in the absence of active queen, new queen cells, fertilized eggs and newly hatched larvae (more than 7 days for *Apis cerana* and 10 days for *Apis Mellifera*) in the colony. In this situation, the laying worker bees should be removed as soon as they start laying eggs and the remaining worker bees should be united with a colony having active queen.
- **Inability of the queen to lay fertilized eggs:** Sometimes a queen may not lay eggs or may lay only unfertilized eggs which only produce drone bees. This occurs under unfavorable weather conditions or when the colony has an emergency queen. Under such conditions, the non-performing queen can be removed and the colony should be united with the colony having active queen**.**
- **Increasing honey production:** Two or more colonies can be united at the onset of the honey flow season to increase colony strength and maximize honey production.

6.4 Points to be considered:

- Conduct unification only in the evening time after returning all the foraging bees to the hive.

- Always integrate weaker colony into stronger & healthy colony having healthy and quality queen.
- Remove diseased or failing queens before unification.
- Do not unite the diseased colony with healthy colony.
- Treat the egg laying worker colony before unification.
- As far as possible follow the newspaper method for peaceful and successful unification.

6.5 Preparedness for colony unification:

- Identify the colonies for unification.
- Bring the colonies closer gradually if they are far apart. Shift the weaker colony towards the strong colony by 2 feet daily.
- If there is a shortage of food, provide sugar syrup for at least three days before unification.
- Remove the queen from the weaker colony 24-48 hours before unification.
- Remove extra empty frames/combs from the brood chamber and remove the super chambers of both hives.
- Treat the laying workers colony before unification and remove the combs with laying worker's eggs.
- Always unite the weak colony (top) with the strong colony (bottom).

6.6 Method (newspaper method):

Paper method is the mostly used and safe method of colony unification. In this method, a paper is placed in between two hives making small pin holes for the fusion of the scent of united colonies. The basic steps are as follows;

- Lightly smoke both colonies which are prepared ready for unification.
- Remove outer and inner covers of hive of strong colony and cover the brood chamber with newspaper having small pin holes.
- Drizzle honey or 2:1 sugar syrup lightly on the newspaper.



Figure 48: Colony unification

- Remove the bottom board of weak colony and place the brood chamber on the paper above the strong colony.
- Collect all the remaining bees from the bottom board of weak colony and put them in the brood chamber of weak colony.
- Allow bees to unite naturally.
- After 48 hours, remove newspaper and rearrange brood frames as needed and remove the upper brood chamber.

6.7 Management of united colony

A piece of paper with pin holes placed between two colony helps to mix up the scents of the two colony, making the bees in both colonies feel they are of same colony. Meanwhile, within about 48 hours, the bees on both sides cut the newspaper and pass up and down through it. Then, the hive should be opened and the frames having brood and food from upper chamber should be shifted to lower chamber and the upper chamber is removed. After removing the paper and upper chamber, artificial food (sugar syrup) should be fed in the evenings for 3 days.

Sample questions for practice.

1. Under what conditions should bee colonies be unified?
2. What are the reasons of bee colony unification?
3. What management practices should be followed after bee colony unification?

Session 10

Robbing behavior in bee colony and its management

1. Learning objectives

By the end of the session, the participants will be able to:

- Identify the robbing behavior of honey bees and its causes.
- Prevent and manage the robbing in bee colony.

2. Sub topics

- Concept
- Causes
- Problem identification
- Management

3. Methods and materials

3.1 Training methods

- Lecture
- Brainstorming
- Group discussion
- Observation
- Practical Exercise

3.2 Training materials

- Projector, Power points, slides, pictures.
- Marker, brown paper, pen, masking tape, meta card
- Bee hive inspection tools.
- Flour or yellow saffron powder
- Sprayer with water mixed with 2-3 drops of kerosene/petrol
- Artemisia or parthenium leaves.

3.3 Time

Theory: 50 minutes

Practical: 30 minutes

Discussion: 10 minutes

3.4 Place: Training hall, Apiary

4. Activities and exercise

4.1 Inform participants about the topics covered in the session and inquire about their level of knowledge on the subject matter.

4.2 Presentation

Give presentation on robbing behavior of honey bees its causes, prevention and management as outlined in the resource materials.

4.3 Practical exercise.

Take participants to the apiary where robbing behavior can be seen in bee colonies. If robbing activity is found, dust flour or saffron powder over the fighting bees and inspect the other bee hives where these dusted bees are seen. Puff smoke or spray water on the robbing bees at the entrance of the hive being robbed. Place artemisia or parthenium weeds at the entrance of the hive.

4.4 Discussion

Use in depth discussion and question/ answer to find whether the participants can identify and manage robbing behavior of bee colonies.

5. Detail schedule

S.N.	Subject matter	Description	Time	Materials
1	Introduction	Make participants to write down what they know about the robbing behavior of honey bees.	5 minutes	Marker pen, meta card.

S.N.	Subject matter	Description	Time	Materials
2	-Introduction, causes and impacts of robbing, -Prevention and management of robbing.	Discuss about the concept, causes, impacts, prevention and management of robbing behavior in bee colonies.	45 minutes	Projector, power point slides, pictures, videos.
3	Demonstration and practical exercise	Observe the robbing behavior of bees in apiary if present and perform the control or management activities.	30 minutes	Flour or yellow saffron powder, sprayer with water mixed with 2-3 drops of kerosene/ petrol, Artemisia or parthenium leaves.
4	Discussion		10 minutes.	

6. Resource materials.

6.1 Introduction:

Honey is one of the major foods of bees. In the absence of honey in the colony, a strong colony will fight with a weaker colony to steal honey. This is called the robbing in bee colony.

6.2 Causes:

- lack of food inside the beehive and a lack of nectar sources outside.
- If there is leakage of honey, while it is extracted in an open space.
- If sugar syrup is given to bees in day time and it is spilled over on hive or ground.
- If honey is rubbed on the equipment used during the beehive inspection and that equipment is left outside the hive.
- After feeding, if the left-over sugar syrup is not taken out next day morning.
- If there are strong and weak bee colonies in the apiary and only the weak colonies are fed sugar syrup.

- If the colony inspection time is too long in low nectar flow season.
- If the beehive is old and cracked and the smell of honey is spread outside through these cracks.
- If the hive entrance is enlarged at the time of low nectar flow season and the smell of honey from inside the hive spreads outside.



Figure 49: Robbing

- If two species of honeybees are kept in the same apiary.

6.3 Symptoms:

- Increased colony activity, including bees fighting at the hive entrance.
- Dead bees at the entrance, and remnants of hive debris like shredded wax capping.
- Robber bees often have empty abdomen while entering the robbed hive and have swollen (filled) abdomen while exit.

6.4 Impacts:

6.4.1 Impact on robbed colony

- Honey robbing has a direct effect on the productivity of the robbed colony by draining of the colony's food supplies.
- The intense fighting between the foraging bees on both sides triggered by honey robbing often results in significant casualties, causing a sharp decline in the colony strength of both colonies.
- In extreme cases, a colony that has been robbed can find its honey reserves completely depleted, with larvae and pupae being dragged out and harmed.
- In some instances, the queen bee may even be injured or killed, ultimately compelling the entire colony to abandon their hive.

6.4.2 Impact on robbing colony

- The predatory behavior significantly depletes the energy reserves of robber bees and may even shorten their natural lifespan.
- The robbing operations often disrupt the internal division of labor within the robbing colony undermining its overall organizational efficiency and social structure and weakens the colony's ability to collect nectar and

protect itself, sometimes even making it a target of predation by other colonies.

- Furthermore, Robber bees are more susceptible to infection by pathogens such as Varroa mites and Nosema spores.
- The frequent interactions between the robbing colonies and the robbed colonies not only endanger the health of the bees in the robbed colonies but also increase the risk of disease and parasite infection in the robbing colonies.
- Thus, while honey robbing may offer immediate survival benefits to the robbing colonies, profound negative consequences for their population's health and overall survival prospects can ultimately occur.

6.4.3 Impact on beekeeping industry

Honey robbing may initially be confined to individual colonies, but if prompt measures are not taken to control it, its impact can quickly spread, affecting the entire apiary, similar to a "behavioral contagion". When honey robbing becomes frequent or widespread, the bees' alertness and aggressiveness increase significantly, rendering them unusually fierce. This change undoubtedly complicates colony inspections and feeding, severely disrupts normal breeding and production routines, and presents a significant challenge to beekeepers' management efforts.

6.5 Prevention:

- Maintain strong colonies and reduce hive entrance.
- Give sugar syrup only at evening and to all the colonies of apiary.
- Avoid dripping syrup or honey around the colony, if any is spilled, clean it up immediately with a wet cloth.
- Harvest honey by covering the honey combs with net or clean cloth.
- Extract honey in the closed space or in net house.
- *Apis mellifera* and *Apis cerana* colonies should be kept in different apiaries to minimize robbing between them.
- Ensure hive is in good condition, with no cracks or crevices that robber bees can enter.
- Avoid leaving exposed honey combs or honey in the apiary, as this will attract robber bees.

6.6 Management:

- Clean water or kerosene mixed water should be sprayed over the bees, which will encourage the robber bees to return to their colony as if it were raining.
- As an alternative, Artemisia or Parthenium leaves can be kept in front of the entrance of the colony being robbed to prevent robbing.
- The robber bees cannot enter into a colony if longer weeds or tree branches are kept in front of the entrance of robbed hive.
- While robbing is continued, smoke the hive being robbed every 5–10 minutes to calm the bees and narrow the entrance of the hive so that at a time, only one bee can pass through .
- If robbing continues, dust flour or saffron powder over the flying bees and observe where incoming bees are coated with flour or color to identify the robber colony.
- If robber bees are attempting robbing over a longer period, take the robber colony 1–2 km away from the apiary for at least one week.
- If only one colony is susceptible to robbing, then move the colony to another site or inside the house, and place an empty hive with combs having some honey at its original position. The robber bees will finish the honey and then feel that the hive has nothing more to offer and there is no one to fight with and will not return back.

Sample question for practice

1. What are the impacts of robbing behavior of bees to beekeeping industry?
2. What are the major causes of robbing behavior?
3. How can we prevent robbing behavior of honey bees?

Session 11

Management of laying worker

1. Learning objectives

By the end of the session, the participants will be able to:

- Identify the colony with laying workers.
- Manage the laying worker colony.

2. Sub topics

- Concept
- Identification and causes of the colony being a laying worker.
- Causes
- Management of laying worker colony.

3. Methods and materials

3.1 Training methods

- Lecture
- Brainstorming
- Group discussion
- Observation
- Practical Exercise

3.2 Training materials

- Projector, Power points, Slides, Pictures.
- Marker, Brown paper, Pen, Masking Tape, Meta Card
- Hive inspection materials and tools
- Laying worker colony
- White cloth
- Newspaper.

3.3 Time

Theory: 20 minutes

Practical: 60 minutes

Discussion: 10 minutes

3.4 Place: Training hall, Apiary

4. Activities and exercise

4.1 Inform participants about the topics covered in the training and inquire about their level of knowledge on the subject matter.

4.2 Presentation

Give a short presentation on how to identify, control, treat, and manage a colony with laying workers as outlined in the resource materials.

4.3 Practical exercise.

Take the participant to the apiary for practical exercises of identification, control and management of the laying worker colony. Following steps are done to treat laying worker colony.

- Identify the colony with a laying worker.
- Take such a colony 100 m down in sloppy land and 100-200 m away, and put another empty hive in the original place.
- All the bees from such a colony will be knocked onto a cloth spread on the ground.
- A laying worker with a heavy stomach cannot fly back to its original place and is left behind. While a normal worker who does not have eggs in their stomach will return to their original place.
- Remove the eggs laid by worker bees on the frame. If the egg number is high, dump the frame.
- Put a brood frame from a healthy colony having eggs, larvae, pollen, and honey.
- If available, place a new queen in a queen cage and give it to the treated colony.

4.4 Discussion

Use in-depth discussion and question/answer sessions to discover whether the participants can recognize laying worker colony, their symptoms, and management techniques.

5. Detail schedule

S.N.	Subject matter	Description	Time	Materials
1	Introduction	Make participants write down what they know about the laying worker colony	10 minutes	Marker Pen, Meta card.
2	Identification and Management of laying worker colony.	Discuss the identification and management techniques of a laying worker colony.	15 minutes	Projector, PowerPoint slides, Pictures, Videos.
3	Practical exercise	Take the participant to the apiary, select the colony with a laying worker. Show participants the eggs laid by the worker and teach them the techniques to identify them. Then treat the laying worker colony by following the steps described in the resource material.	60 minutes	Colony with laying workers. White cloth Newspaper
4	Discussion		10 minutes.	

6. Resource materials.

In the absence of a queen, the queen cell, 3-day-old larva, and eggs colony fails to produce a new queen; then worker bees eat the queen bee's royal food and lay unfertilized eggs, which is called laying worker. A laying worker only lays drone eggs.

6.1 Identification and symptoms of laying worker.

The following are the symptoms of a laying worker.

- Laying workers are aggressive, black, and have larger abdomen than normal workers.
- These are seen inserting abdomen inside cell.
- In such colony more than one egg can be seen, and eggs are not centrally located.
- A smaller drone than a normal drone can be seen.

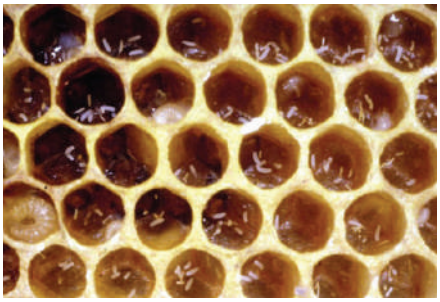


Figure 50: Laying Worker Colony

- Smaller queen cells are built on the faces of the comb, and bees cluster at the entrance to the hive.

6.2 Causes

- If a queen bee dies in some kind of accident.
- If an Unmated queen is killed by an enemy during mating flight.
- If a queen gate is used for a long time in a hive with an unmated queen bee.
- If the wings of an unmated queen bee are cut,
- If the colony is divided during unfavorable weather.

6.3 Control:

- Regular hive inspection, ensuring the presence of the queen bee.
- Immediately manage the queen-less colony.

6.4 Management:

A laying worker colony can be managed by following the steps.

- Once the colony becomes a laying worker, it is difficult to fully manage as it refuses a new queen or queen cell.
- Thus, first such colony should be treated.
- Take the beehive 100-200 meters away and keep a new hive on the original place.

- Spread white cloth or newspaper and shake off all the bees from the frame. Laying workers with large abdomen cannot return and are left behind, while normal workers return to their original place.
- Brood frames with absence of multiple eggs can be placed, but the frame with a high number of multiple eggs should be discarded.
- Brood frame with egg, larva, pollen, and honey from a healthy colony should be added.
- If available new queen or queen cell must be given along with queen cell protector.

Sample question for practice.

1. What are the symptoms of laying worker colony?
2. What are the causes of colony being laying worker?
3. How laying worker colony can be managed?

Session 12

Colony migration

1. Learning objectives

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

- Understand the concept and benefits of migratory beekeeping.
- Recognize the right time for migration and identify key factors to consider when planning bee migrations in different parts of Nepal.
- Learn practical steps involved in preparing, moving, and managing bee colonies during migration in Nepal.
- Recognize potential challenges and mitigation strategies in migratory beekeeping.
- Appreciate the role of migratory beekeeping in increasing honey production and pollination services in Nepal.

2. Sub topics

- Introduction of colony migration.
- Considerations before migration.
- Planning and preparation for migration.
- Managing bees at the new locations.
- Challenges and migration strategies.

3. Methods and materials

3.1 Training methods.

- Lecture.
- Brainstorming/experimentation.
- Group discussion.
- Practical Exercise.

3.2 Training materials.

- Projector, power point slides, pictures
- Marker pen, brown paper, pen and masking tape, meta card
- Hive inspection tools.
- Empty hive
- Rope, wooden piece, pins

3.3 Time

Theory: 50 minutes

Practical: 30 minutes

Discussion: 10 minutes

3.4 Place: Training hall, Apiary

4. Activities and exercises

4.1 Inform the participants about the lecture/practical exercises included in the training and obtain information about the level of knowledge of the participants on the subject.

4.2 Presentation

Give short presentation on the on the introduction of colony migration, considerations before migration, planning and preparation for migration, managing bees at the new location and challenges in colony migration as outlines in the resource materials

4.3 Practical exercise

After theoretical session take participants to apiary and demonstrate the steps of colony migration.

- Explain the methods used to migrate colonies.
- Select the colonies to prepare for migration.
- Add additional empty frames or dummy boards if needed and nail the frames to fix them so that they do not move.
- Ask the participants to practice the method of packing a hive, first positioning the bottom board, then the brood chamber, and fixing these parts with the help of wooden strips and nails.

- Ask them to close the entrance. First demonstrate, and then ask the participants to load the packed hive onto a vehicle.
- Explain to participants how to place a hive in an apiary according to season and pasture.
- Demonstrate how to open a hive entrance after placing the colonies in an apiary, and ask participants to open the entrances on the remaining hives.

4.4 Discussion:

After returning from the apiary, organize discussion session to find out whether participants are clear about preparation of colony migration, steps to pack colony before migration and steps to open hive in new location. Select one participant and make him/her demonstrate the steps of colony packing and opening. Discuss the topics in which participants are not clear.

5. Detail Schedule

S.N.	Subject Matter	Description	Time	Materials
1	Introduction of colony migration	Ask participants to write what they know about colony migration.	5 minutes	Marker, pen, meta card
2	Considerations before Migrating	Briefly mention the importance of understanding local regulations, obtaining necessary permission for land access and movement of bee colonies within Nepal (if any specific regulations are known for the area).	5 minutes	Projector, PPT slides, photo, video
3	Planning and Preparation for Migration	Make understanding on identifying suitable locations, scouting potential locations, developing migration plan and site criteria	10 minutes	Projector, PPT slides, photo, video

S.N.	Subject Matter	Description	Time	Materials
4	Preparing Bee Colonies for Transportation	Discuss techniques behind ensuring and healthy colonies, securing bee hives components, closing entrances. providing adequate ventilation. feeding, timing to move and transportation methods	10 minutes	Projector, PPT slides, photo, video
5	Managing Bees at the New Location	Discuss about the topography and bee flora that should considered for new location. Explain how to open the hive and new place.	10 minutes	Projector, PPT slides, photo, video
6	Challenges and Mitigation Strategies	Discuss the risk of pesticide exposure, impact of sudden weather change, risk of spreading pest and disease, address the potential for theft etc.	10 minutes	Projector, PPT slides, photo, video
7	Practical Exercise	After theoretical session take participants to apiary and demonstrate the colony packing and opening steps. Make one participant to demonstrate colony migration in empty hive.	30 minutes	➢ Hive inspection tools. ➢ Empty hive ➢ Rope, wooden piece, pins

6. Resource materials:

6.1 Introduction:

Migratory beekeeping, the practice of moving honeybee colonies seasonally to follow nectar flows from blooming plants or to provide pollination services to agricultural crops, is a sophisticated and increasingly vital aspect of modern

apiculture. This technique allows beekeepers to significantly enhance honey production, improve colony health, and generate income through pollination contracts. However, successful migratory beekeeping requires meticulous planning, careful execution, and a deep understanding of bee biology, plant phenology, and logistical considerations. Migratory beekeeping in Nepal involves moving bee colonies from one location to another in search of optimal forage and to ensure bee productivity through enhanced pollination services. Whether for honey production or crop pollination, migrating bee colonies require meticulous planning and management to ensure their health and productivity. Below are key considerations and best practices to follow before, during, and after bee migration in Nepal.

6.2 Benefits in detail:

1. **Maximized honey production*:*** The primary driver for migratory beekeeping is access to concentrated and sequential nectar flows. By strategically placing colonies near fields of blooming crops like mustard, sunflower, buckwheat, or fruit orchards at their peak nectar secretion, beekeepers can significantly increase honey yields compared to stationary apiaries relying on less abundant and diverse local flora (Delaplane & Mayer, 2000). This allows for multiple honey harvests throughout the year, maximizing productivity.

2. **Improved colony health and strength:** Migratory beekeeping provides bees with access to a wider variety of pollen sources. Diverse pollen is crucial for the nutritional well-being of the colony, providing essential proteins, lipids, vitamins, and minerals necessary for brood rearing, adult bee health, and disease resistance (Roulston & Cane, 2000). Extended foraging seasons in favorable environments also contribute to stronger and more populous colonies, better equipped to withstand pests, diseases, and harsh winter conditions.

3. **Pollination income and agricultural support:** Migratory beekeepers play a crucial role in agricultural pollination, contributing significantly to the yields of numerous fruit, vegetable, and seed crops. Farmers often rent bee colonies during bloom periods to ensure adequate pollination, resulting in higher fruit set, larger and more uniform produce, and improved seed production (McGregor, 1976). This provides a valuable income stream for beekeepers and underscores the interconnectedness of apiculture and agriculture.

4. **Extended foraging season:** In regions with distinct flowering periods, stationary hives may experience periods of nectar dearth. Migratory

beekeeping allows colonies to remain active and productive for a longer duration by moving them to areas with ongoing blooms, preventing stress and the need for extensive supplemental feeding.

6.3. Places of migration (district-wise)

Nepal's diverse topography and climate make it highly suitable for migratory beekeeping across various ecological zones—from the lowland Terai to the Mid-hills and High mountains. Beekeepers often migrate seasonally to follow the flowering patterns of key nectar and pollen plants such as Chiuri, mustard, litchi, and wildflowers. The figure and table below provide district-wide information on suitable bee migration sites, key forage species, altitudinal ranges, and optimal seasons for migration and mode of transportation.

The following table shows the potential places for bee colony migration.

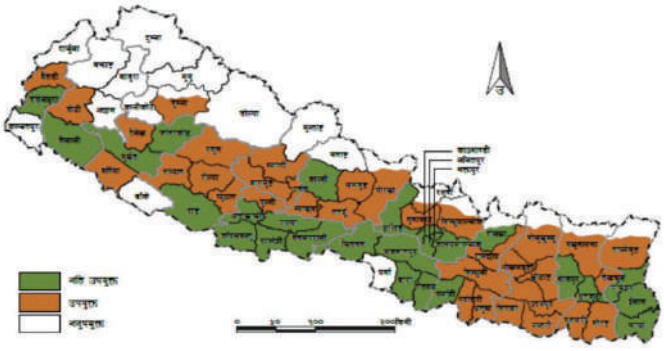


Figure 51: Places of beekeeping districts of Nepal

Table 1 provides district-wise details of suitable bee migration sites across Nepal, highlighting major forage plants, altitudinal ranges, and ideal migration seasons. It covers diverse provinces—from Terai districts rich in mustard and litchi, sissoo, and Rudilo to mid-hill areas known for Chiuri, katus and wildflowers. This helps beekeepers plan for seasonal migration to optimize honey production and colony health.

Tables 12: Suitable bee migration sites in nepal (District-wise)

Province	District	Suitable migration sites	Key bee forage plants	Altitude range (m)	Migration season
Koshi	Jhapa	Bhadrapur, Damak, Birtamod	Mustard, litchi, mango, wildflowers	60–300	Nov–Feb, Apr–Jun

Province	District	Suitable migration sites	Key bee forage plants	Altitude range (m)	Migration season
Koshi	Ilam	Fikkal, Kanyam, Mai Valley	Chiuri, rudilo, wild berries	800–1800	Mar–May, Aug–Oct
Madhesh	Sarlahi	Lalbandi, Hariwan, Haripur	Mustard, sunflower, mango, guava, Eucalyptus	100–300	Dec–Feb, Apr–Jun
Madhesh	Mahottari	Jaleshwor, Bardibas, Gaushala	Mustard, litchi, mango, wildflowers, Eucalyptus	80–300	Nov–Feb, Apr–Jun
Madhesh	Rautahat	Gaur, Chandrapur, Garuda	Mustard, guava, mango, wild plants, Chamre	70–300	Dec–Feb, Apr–May
Bagmati	Chitwan	Madi, Bhandara, Padampur, Bharatpur	Litchi, rapeseed, Chiuri, Rudilo, mango, wildflowers, buckwheat	100–800	Nov–Mar, Apr–Jun
Bagmati	Makwanpur	Hetauda, Manahari, Bhimphedi	Chiuri, rudilo, sisoo, tuni rapeseed, buckwheat	400–1800	Feb–May, Aug–Oct
Bagmati	Ramechhap	Manthali, Doramba	Chiuri, rudilo, buckwheat, wildflowers	800–2000	Mar–May, Sep–Nov
Gandaki	Tanahun	Damauli, Bandipur, Shuklagandaki	Chiuri, rudilo, mustard	500–1500	Mar–May, Sep–Dec

Province	District	Suitable migration sites	Key bee forage plants	Altitude range (m)	Migration season
Gandaki	Kaski	Pokhara, Lumle, Begnas	Uttis, Chiuri, rudilo, buckwheat	800–2000	Mar–May, Oct–Nov
Lumbini	Dang	Ghorahi, Tulsipur	Mustard, Chiuri, litchi, mango	200–900	Nov–Feb, Apr–Jun
Lumbini	Nawalparasi (West)	Sunwal, Bardaghat, Parasi	Mustard, litchi, Chiuri, mango, Sissoo	100–400	Dec–Feb, Apr–Jun
Lumbini	Rupandehi	Butwal, Bhairahawa, Tilottama	Mustard, mango, litchi, guava	100–300	Dec–Feb, Apr–Jun
Lumbini	Kapilvastu	Taulihawa, Banganga, Shivaraj	Mustard, litchi, wildflowers, sunflower	100–300	Nov–Feb, Apr–May
Lumbini	Palpa	Tansen, Rampur	Chiuri, Rudilo, mustard	800–1800	Feb–May, Sep–Dec
Lumbini	Pyuthan	Khalanga, Bijuwar, Sari	Chiuri, Rudilo, buckwheat, niger, wildflowers	800–2000	Mar–May, Aug–Oct
Karnali	Surkhet	Birendranagar, Barahatal	Chiuri, wild legumes, buckwheat	600–1500	Feb–May, Sep–Nov
Karnali	Jumla	Khalanga, Sinja Valley	Buckwheat, apple, Chiuri, rudilo	2300–3000	May–Jul, Aug–Sep
Sudurpaschim	Kailali	Dhangadhi, Ghodaghodi	Mustard, litchi, mango	150–500	Nov–Feb, Apr–Jun
Sudurpaschim	Doti	Dipayal, Silgadhi	Chiuri, Rudilo, wild plants	1000–2000	Feb–May, Sep–Nov

6.4. Key considerations for successful migration:

Site Selection and Timing: Identifying suitable locations with abundant nectar and pollen resources at the appropriate time is paramount. This requires knowledge of local agricultural practices, bloom calendars of various plant species, and communication with farmers or landowners. Scouting potential sites for accessibility, water availability, sunlight exposure, and protection from wind and pesticides is crucial. Timing the move to coincide precisely with the peak bloom is essential to maximize foraging opportunities.

Colony preparation

Colonies intended for migration must be strong, healthy, and free from significant pest or disease infestations. Hives need to be securely prepared for transportation by strapping hive bodies together, ensuring frames are stable, and screening entrances to prevent bee escape while providing adequate ventilation to avoid overheating. Feeding colonies with sugar syrup before and after transport may be necessary to provide energy and reduce stress.

Transportation logistics:

Safe and efficient transportation is critical. This involves using appropriate vehicles (trucks, trailers) equipped to secure the hives and minimize movement during transit. Moving bees during cooler parts of the day or night reduces stress and the risk of overheating. Careful loading and unloading procedures are essential to prevent damage to hives and injury to beekeepers.

Apiary management at the new location:

Once at the new location, hives should be strategically placed with adequate spacing and access to water sources. Regular monitoring for colony health, honey stores, and swarming tendencies is crucial. Communication with landowners or farmers regarding pesticide application schedules and other relevant activities is essential to protect the bees.

6.5 Challenges and mitigation strategies:

1. **Pesticide exposure:** This is a significant threat to migratory beekeeping. Beekeepers must actively communicate with farmers regarding pesticide use and advocate for bee-friendly practices. Covering hives during spraying, moving bees temporarily away from treated areas, and selecting locations with minimal pesticide risk are crucial mitigation strategies (Johansen & Mayer, 1990).
2. **Theft and vandalism:** Remote apiary locations can be vulnerable to theft or vandalism. Implementing security measures such as fencing, locks, and

establishing relationships with local communities can help mitigate these risks.

3. **Transportation stress:** The physical act of moving can stress bee colonies. Proper preparation, careful handling, and minimizing travel time can reduce this stress. Providing adequate ventilation during transport is vital to prevent overheating.

4. **Unfavorable weather conditions:** Unexpected weather events at the new location can impact foraging and colony health. Selecting well-drained sites and providing windbreaks can offer some protection.

5. **Disease and pest transmission:** Moving colonies can potentially spread pests and diseases. Thorough inspection of colonies before migration and practicing good biosecurity measures at each location are essential to prevent the transmission of pathogens.

6.6 Considerations and best practices for bee migration in the context of Nepal

Migratory beekeeping in Nepal involves moving bee colonies from one location to another in search of optimal forage and to ensure bee productivity through enhanced pollination services. Whether for honey production or crop pollination, migrating bee colonies require meticulous planning and management to ensure their health and productivity. Below are key considerations and best practices to follow before, during, and after bee migration in Nepal.

6.6.1 Considerations before bee migration

a*) Colony health and preparation

- Check colony strength: Ensure that the colonies are strong, with enough worker bees, brood (young bees), and adequate food stores (honey and pollen) for the journey. Healthy colonies are essential for successful migration.
- Disease and pest management: Before migration, check for pests like Varroa mites, American Foulbrood, European Foulbrood, and other diseases. Treat any issues before moving hives, as stressed colonies are more vulnerable to diseases during migration (Tasić et al., 2016).
- Feeding: If the colonies are short of food reserves, provide supplemental feeding (sugar syrup or fondant) to ensure they have enough resources for migration, particularly if the move will take them to areas where forage is scarce initially.

- Hive inspection: Inspect hives for structural integrity, and ensure there are no cracks, leaks, or any issues that could affect the stability of the hive during transport.

b) Planning the migration route

- Geographical considerations: Plan migration routes based on geography. Nepal has diverse topography, and altitude plays a significant role in forage availability. The Terai region is suitable for winter migration, while the mid-hills offer abundant forage during summer (Sharma & Adhikari, 2021).
- Forage availability: Research the blooming seasons of various crops and wild plants in potential migration areas. Ensure that forage (nectar and pollen) is abundant at the time of migration, and map out areas where forage is most accessible.
- Climate and weather: Monitor weather conditions, as extreme weather (e.g., unseasonal rains or frost) can affect bee health. Avoid moving colonies during periods of adverse weather conditions, particularly during the monsoon season (June to September).
- Legal and permission aspects: In some areas of Nepal, local regulations and permits may be required for moving colonies across districts or national parks. Ensure that all necessary permissions are obtained before migration.

c) **Transportation considerations**

- Safe Transport: Bees can be stressed during transport, especially if moved over long distances. Use well-ventilated trucks or bullock carts (in rural areas) for transport. Secure the hives properly to prevent damage or shifting during transit.
- Timing: Transport the colonies during cooler parts of the day (early morning or late evening) to minimize heat stress on the bees. Avoid transporting bees during the hottest parts of the day, particularly in the Terai, where temperatures can be extreme in summer.

6.6.2 Considerations during bee migration

a) Hive management during the journey

- Minimize stress: During migration, minimize external stress by covering hives with breathable cloth to shield them from the sun while still allowing airflow. Avoid exposure to strong winds, direct sunlight, or excessive heat.

- Provide food: If the journey is long or if forage is unavailable upon arrival, ensure colonies have enough stored food (e.g., honey or sugar syrup) during the trip. Beekeepers can use portable feeders during the journey if necessary.
- Maintain temperature control: If traveling to higher altitudes where the temperature can drop significantly, ensure that the hives are insulated to avoid cold stress. In contrast, during hotter conditions in the Terai, ensure proper ventilation to prevent overheating.

b) Settling the colonies in the new location

- Proper placement of hives: Once the colonies arrive at the destination, place the hives in areas with abundant forage and protection from strong winds or extreme temperatures. Ensure that hives are stable and positioned to avoid flooding during rains.
- Acclimatization: Allow the colonies to acclimatize to their new environment. Do not disturb the bees for a few days and observe their behavior. If necessary, provide temporary supplemental feeding until natural forage becomes available.
- Monitoring for stress: Look for signs of stress, such as decreased activity at the entrance, abnormal flight patterns, or aggressive behavior. Stress indicators may require the beekeeper to take corrective action, like providing additional food or shelter.

c) Pollination agreements and collaboration

- Work with local farmers: In the case of migratory pollination services, ensure that agreements with local farmers are in place before migration. Discuss the timing and expectations for pollination, and coordinate the movement of bees to match the flowering periods of crops.
- Communication with stakeholders: Beekeepers should stay in touch with local farmers, agricultural agencies, or cooperative groups to ensure smooth coordination and to address any challenges that may arise during the migration.

6.6.3 Considerations after bee migration

a) Post-migration hive checks

- Inspect hive health: After settling in the new location, thoroughly inspect each hive for signs of pests, diseases, or queen failure. It is essential to ensure that the colony has not been weakened by the migration process (e.g., starvation or exposure to diseases).

- Ensure adequate forage: Once the colony has settled, assess whether there is enough forage available. If necessary, provide supplemental feeding until the bees can fully take advantage of the local flowers.
- Monitor bee activity: Observe the bees' behavior closely in the new environment. Successful migration should result in visible signs of foraging activity. Lack of activity may indicate environmental issues such as poor forage availability or hive stress.

b) Long-term management

- Regulate queen production and health: If the migration involves moving hives for pollination services (e.g., to orchards or crop fields), ensure that the queen remains healthy and productive. Monitor the brood pattern and replace queens if necessary to maintain colony strength.
- Disease control: Beekeepers should continue to monitor for diseases and pests, especially as colonies adjust to the new environment. Varroa mites can be a significant issue during migration, and ongoing monitoring and treatment may be required.
- Post-migration maintenance: After migration, the beekeeper should perform regular hive inspections, checking for colony strength, brood development, and food stores. During the monsoon season, ensure that colonies are protected from excessive rain and flooding.

c) Record keeping and data collection

- Keep detailed records: Maintain detailed records of migration timings, routes, weather conditions, forage availability, hive health, and other relevant information. These records help beekeepers plan future migrations more effectively and improve practices over time.
- Evaluation and feedback: After the migration season, assess the overall success of the migration by reviewing colony health, honey yields, and pollination effectiveness. Share insights and feedback with other beekeepers in your community to foster knowledge exchange.

6.7 Best practices for beekeeping during migration in Nepal

1. Proper hive setup: Ensure that hives are properly constructed and are insulated to protect the bees during migration.
2. Transport at optimal times: Move colonies during cooler parts of the day, such as early morning or evening, to avoid excessive heat.
3. Forage planning: Always ensure that there is an adequate supply of nectar and pollen at the destination before moving colonies.

4. Colony health checks: Perform regular health checks before, during, and after migration to manage diseases and pests proactively.
5. Bee-friendly crop cultivation: Collaborate with local farmers to promote pollinator-friendly farming practices and plant bee-friendly crops to increase forage availability.
6. Climate and elevation awareness: Understand the regional climatic and altitudinal variations in Nepal to plan migration routes that align with local forage availability.

6.8 Conclusion

Migratory beekeeping in Nepal requires careful planning, understanding of the local environment, and proactive management practices. By considering colony health, planning migration routes based on geography and forage, ensuring safe transport, and maintaining hive health after migration, beekeepers can optimize honey production, pollination services, and overall colony performance. These practices not only ensure the success of migratory beekeeping but also contribute to the sustainability of agriculture and biodiversity in Nepal.

Sample questions for practice

1. What are the steps of colony packing?
2. How to manage the migrated colony in the new place?
3. What are the challenges of colony migration?

Session 13

Artificial diet/feed management

1. Learning objectives

By the end of the session, the participants will be able to:

- Identify the conditions under which artificial food should be given to bees.
- Prepare different types of artificial food.
- Feed the prepared artificial food to bee colonies.

2. Sub topics

- Need for artificial feeding
- Appropriate time for giving artificial feeding
- Method of preparing artificial feeding
- Method of giving artificial feeding

3. Methods and materials

3.1 Training methods

- Discourse/Presentation
- Brainstorming
- Group review
- Practical exercises
- Review and Q&A

3.2 Training materials

- Projector, Power Point slides, pictures
- Marker pens, brown paper, pens and masking tape, meta cards
- Beehives with colonies in the apiary
- Colonies inspection materials

- Sugar, boiled lukewarm water, jar or bowl for making sugar syrup, frame feeder
- Honey, powdered sugar, plate
- Soybean/chickpea flour, natural bee pollen
- Vitamins B complex and vit C

1.3 Time

Theory: 20 minutes

Practical: 60 minutes

Discussion: 10 minutes

1.4 Place: Training hall, Lab, Apiary

3. Activities and exercise

4.1 Provide participants with information on the topics covered in the training and obtain information about the participant's level of knowledge on the subject matter.

4.2 Presentation

Give short presentation on the importance and need for artificial food for bees, methods for making artificial food, and methods for feeding artificial food to bees as outlined in the resource materials.

4.3 Group division/ Practical exercise.

Divide Participants into three groups and complete the following task of making and serving sugar syrup, making and giving candy and making and giving artificial pollen.

4.3.1 Preparing and feeding sugar syrup

- Gather the ingredients needed to make sugar syrup.
- Boil 1 liter of water and let it simmer until it is lukewarm.
- Take a jug or bowl and add 1 kg of sugar to 1 liter of lukewarm water and stir it slowly until the sugar is completely dissolved.
- Pour the prepared sugar syrup into the frame feeder and open the beehive and place it in the beehives.

4.3.2 Preparing and feeding candy

- Gather the ingredients needed to make the candy.
- Mix half to 1 kg of sugar powder and 200-300 grams of honey in a bowl carefully.
- As it mixed well, the sugar melted and started to form lumps/candy.
- Place the candy on the top bar of the beehive by using a plastic sheet or wax paper.

4.3.3 Preparing and feeding artificial pollen

- Gather the ingredients needed to make artificial pollen.
- Place 250 grams of soybean or chickpea flour, 350 grams of sugar powder, some natural pollen if available, and vitamins B and C at the rate of 100 milligrams per 100 grams in a bowl or jar, and mix it well.
- Add honey to the mixture as needed and mix it well. Place the prepared dough in plastic or wax paper and place it on the top bar of the beehive.

4.4 Discussion

After preparing artificial food and feeding the bees, assign each group the following tasks:

Task 1: The need, importance, and proper timing of artificial feed

Task 2: Steps in preparing artificial feed

Task 3: Preparation and method of giving artificial feed to bees

Give the participants 5 minutes of review time and ask each group to make a 1-minute presentation. Review if there are any points that have not been covered in the participant's presentation. Review and ask questions to clarify any additional questions the participants may have.

5. Detail schedule

S.N.	Subject matter	Description	Time	Materials
1.	The need for artificial feeding	Have the participants write down what they know about artificial feeding.	10 minutes	Marker Pen, Meta card.

S.N.	Subject matter	Description	Time	Materials
2	The right time to give artificial feeding	In what situations do bees need artificial food, and to provide information about the differences in artificial food given during dry, rainy, and winter seasons.	10 minutes	Projector, PowerPoint slides, Pictures, Videos.
3	Artificial diet preparation method	Making sugar syrup, candy, and artificial pollen	45 minutes	Sugar, lukewarm water, a jug or bowl for making sugar syrup, honey, powdered sugar, a plate, soybean/chickpea flour, natural bee pollen
4	Method of feeding artificial food to bees	Feeding prepared sugar syrup, candy, and artificial honey to bees	15 minutes	Beehive Inspection Materials Frame Feeder
5	Discussion		10 minutes.	

6. Resource materials

6.1 Introduction

The beehives may not always have enough food as they require. The main natural food of bees is nectar and pollen, which they collect from different flowers in nature. In the shortage of flowers nectar and pollen for bees, the beekeepers should provide them supplementary food, is called artificial food. Generally, bees do not visit all types of flowers, but only those that have more nectar and pollen. When harvesting honey in late autumn and spring, minimum 30 % of honey comb should be left without harvesting. Bees need artificial food to protect them from starvation, keep their colonies strong, and increase honey production. Bees should be given sugar syrup in the absence of honey at adverse climatic condition.

6.2 Time to feed

- Artificial feed should be given mainly during the rainy and winter months.
- Artificial feed is also necessary in special conditions of the hive (Division and union).
- If artificial feed will be given 2 or 3 weeks before the start of the season, the beehive will be strong at the beginning of the season and honey production will be increased.

6.3 Need to feed

- To increase honey production by allowing the queen bee to lay more eggs and raise all the brood during the season
- To prevent the queen from stopping laying eggs
- To encourage worker bees to build combs
- To encourage new queens who have not yet been fledged to become fledged
- When the beekeeper has extracted all the honey
- When the queen has been replaced
- When dividing and uniting the brood
- When drug treatment is required

6.4 Sugar syrup

6.4.1 Method for preparing sugar syrup

- For preparing sugar syrup, first boil the water and let it cool up to lukewarm, add sugar as required and stir until it is dissolved in water well.
- Sugar syrup is ready for providing the bee colonies.
- Sugar syrup should never be boiled, otherwise it will be crystallized.

S. N.	Weather/ season	Type of syrup	Purpose of giving sugar syrup	Remarks
1	In the Rainy season	1part sugar 1part water	After extracting honey, bees are fed	Generally, 1part sugar to 1part water sugar syrup can be given in all seasons.

S. N.	Weather/ season	Type of syrup	Purpose of giving sugar syrup	Remarks
2	At the beginning and end of spring	1part sugar 2part water	For increasing egg production and for comb building	
3	In the winter season	2part sugar 1part water	To make up for the lack of flower nectar	

6.4.2 How to feed sugar syrup

- It is easier and safer to give sugar syrup in a feeder (plastic container, frame feeder). This way, the bees will not drown and die and the syrup will not be wasted.
- When giving sugar syrup in a plastic container, make a small hole in the lid of the plastic container with a needle before putting the sugar syrup in it.



Figure 52: Sugar Syrup Feeding

- Place the syrup in the jar and close the lid tightly.
- Open the outer covers of the beehive and place the jar in the hole in the inner cover.
- Place the unframed honeycomb on top and close with roof.
- The bees suck the syrup and store it in the comb.
- If using a frame feeder, place the sugar syrup in the feeder and place it on one side of the brood chamber or honey chamber.

6.4.3 Things to be considered while feeding syrup

- Only give sugar syrup when there is a shortage of food (flowers) in nature; otherwise, the bees become lazy, and the quality of honey deteriorates.
- Use pure water in sugar syrup.
- Give sugar syrup only in the evening.
- Give sugar syrup only inside the hive.
- Make sugar syrup thick or thin as required.
- Give sugar syrup to all hives at once.

6.5 Candy

6.5.1 Method of preparing and feeding candy

Candy is a sweet made by mixing finely grind sugar with honey or water. Candy is a type of artificial food given to bees when there is a shortage of honey in the hive. Candy made from honey is very nutritious and good for bees. It is prepared as follows;



Figure 53: Candy Feeding,

- Take half kg to 1 kg of sugar.
- Grind the sugar until it is fine and make it into powder.
- Mix honey or water as required in the sugar powder and make a paste/ candy
- Place the candy in a clean plastic bag or aluminum foil and put it on top bar of the brood box.
- we can use a frame feeder to feed candy.

6.6 Artificial pollen

6.6.1 Method of preparing artificial pollen

The materials required

1) Sugar: 350 grams
2) Chickpea or soybean flour: 250 grams
3) Honey: 25 ml.
4) Vitamin C: 100 mg. per 100 gr
5) Vitamin V complex: 100 mg. per 100 gr
    - Take a clean bowl or saucepan and mix the above-mentioned ingredients in it.
    - After mixing the ingredients, knead them slowly with your hands.
    - By doing this, the sugar will melt and the dough will be ready when it becomes soft like bread.

6.6.2 Artificial pollen feeding method

Place the artificial pollen pallet in a clean plastic bag/ aluminum foil and place it on the top bar of frame in the brood chamber. Leave all the artificial pollen pallet until the bees have eaten it.

Sample questions for practice

1. What are the things to keep in mind while making and serving sugar syrup?
2. Mention the ingredients required for making artificial pollen.
3. Mention the ratio of sugar syrup to be prepared according to the season.

Session 14

Observation tour

1. Learning objectives

By the end of the session, participants will be able to,

- Learn about the importance of beekeeping, options, challenges, opportunities, and ways of becoming a successful beekeeping entrepreneur.
- Learn about the prevailing market for hive products.
- Receive primary information about successful and unsuccessful beekeeping activities from different organizations and individual beekeepers.

2. Subtopics

- Successful beekeepers, apiaries, and beekeeping resource centers.
- Government and private farms.

3. Methods and materials

3.1 Training methods

- **Lecture**
- Direct observation and discussion in the field.
- Discussion and question/answer

3.2 Training materials

- Projector, power point slides, pictures
- Marker pen, brown paper, pen, masking tape, meta card

3.3 Time

Tour: 350 minutes (5 hours 50 minutes)

Discussion: 10 minutes

3.4 Place: Apiaries, Government, and private farms.

4. Activities and exercises

4.1 Inform participants about the objectives of the observation tour, the places that will be visited, and particular points to which they should pay attention.

4.2 Observation tour

- Contact successful beekeepers, entrepreneurs, and other relevant organizations or officials in the vicinity of the training event to make arrangements for an observation tour.
- Orient the participants on the where, why, and how of the visit(s) and the code of behavior. Remind participants that they should take care not to disturb the bees as directed by the entrepreneurs they visit. Remind them to keep a record of their observations by filling out the observation sheets.

1.3 Discussion

After the tour, use discussion and question/ answer approaches to discover what participants have learned during the tour and to answer their queries and discuss the observations. Look at the observation sheets to identify points of agreement and disagreement, and points that participants have missed. Provide feedback on the sheets to the participants.

Observation sheets

Table 13: Sample format for recording observations related to the tour

Strengths	Weakness	Remarks
1	1	
2	2	
3	3	
4	4	
5	5	
6	6	
7	7	
8	8	
9	9	
10	10	

Suggestions if any

Session 15

Major bee diseases, malnutrition and their management

1. Learning objectives

By the end of the session, the participants will be able to:

- Identify the symptoms of various diseases in bees.
- Manage the disease according to the symptoms.
- Identify and manage the causes of malnutrition in bees.

2. Sub topics

- Identification, symptoms and management of diseases and malnutrition in bees
- Diseases in brood (European foulbrood, Thai sac brood, American foulbrood, chalk brood)
- Diseases in adults (Nosema, Amoeba, Paralysis)
- Malnutrition

3. Methods and materials

3.1 Training methods

- Lecture/Presentation
- Brainstorming
- Group Review/Interaction

3.2 Training materials

- Projector, Power point slides, pictures
- Marker pen, brown paper, pen and masking tape, and meta card
- Necessary materials for bee inspection
- Sick bee colonies (if any)
- Bee disease samples

- Sugar, feeder
- Medicines
- Pins or bamboo skewers

3.3 Time

Theory: 60 minutes

Practical: 20 minutes

Discussion: 10 minutes

3.4 Place: Training hall, Apiary, Lab

3. Activities and exercise

4.1 Provide participants with information on the topics covered in the training and obtain information about the participants' level of knowledge on the subject matter.

4.2 Presentation

Give a short presentation on the identification, symptoms, and management of diseases and malnutrition in bees (Larvae and adults) as outlined in the resource materials.

4.3 Group division/Practical exercise.

If possible, take participants to the apiary and teach participants step-by-step about identifying and managing major bee diseases.

- As explained in the resource material, show the participants the diseased bees, brood, and their identification step by step, and show samples and pictures if there are no diseased bees, brood.
- Show the participants the methods of identifying the disease.
- Explain and demonstrate the methods of controlling the disease.

1.4 Discussion

At the end of the session, discuss what is clearly understood/not clearly understood about the causes of bee diseases, symptoms of disease identification, and all aspects of disease management, and further review any unclear topics.

5. Detail schedule

S.N.	Subject matter	Description	Time	Materials
	Identification, symptoms, and management of diseases and malnutrition in bees	Have the participants write down what they know about bee diseases and malnutrition.	10 minutes	Marker Pen, Meta card.
2	Diseases in larvae (European fowl brood, Thai sack brood, American fowl brood, Chalk brood)	Explain/discuss diseases in honey bees (European Fowl Brood, Thai Sack Brood, American Foul Brood, Chalk Brood)	25 minutes	Projector, PowerPoint slides, Pictures, Videos.
3	Adult diseases (Nosema, amoeba, paralysis)	Identifying diseases in adults (Nosema, amoeba, paralysis). Explaining symptoms and management	15 minutes	Projector, PowerPoint slides, Pictures, Videos.
4	Malnutrition	Explain the causes of malnutrition in bees and their management.	10 minutes	Projector, PowerPoint slides, Pictures, Videos.
5	Practical exercise	Whenever possible, take participants to apiaries or laboratories and have them identify various diseases and malnutrition, as well as teach them how to use medicines for management.	20 minutes	Projector, PowerPoint slides, Pictures, Videos. Microscope/ hand lens
6	Discussion		10 minutes	

6. Resource materials

6.1 Introduction

Major bee diseases are a challenge in the promotion of the beekeeping business. Beekeepers have to bear huge losses every year due to the spread

of various diseases in the apiary. These diseases mainly affect the adult or brood stages. The diseases that affect the brood and adult stages of bees are quite different, and diseases that affect one stage do not affect the other stage of bees. Therefore, a brief description of major honeybee diseases at the brood stage and adult stages is given below.

6.2 Brood diseases

6.2.1 European foul brood (EFB)

It is caused by a microorganism called *Mellissococcus pluton*. This bacterium infects the stomachs of new larvae and multiplies rapidly. The bacteria spread throughout the larvae's stomachs, causing the larvae to rot. The bacteria are excreted in the feces of infected larvae. The disease is then spread by adult bees as they feed the larvae and clean the cells. As this disease spreads, the hive weakens, and bee dies. This disease causes severe damage to both *A. mellifera* and *A. cerana* bees.

Symptoms and identification:

- Weakening of the hive and a decrease in the number of bees during the honey flow season
- Dead larvae are seen in front of the entrance to the hive.
- The color of the brood is different from that of healthy larvae
- Abnormal position of the larva is seen
- Larvae die in open cells
- A strong, unpleasant odor from the decaying larvae
- Inconsistency in the brood pattern in the brood comb

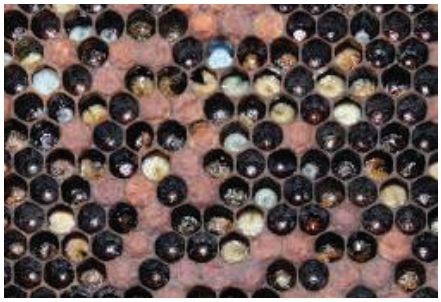


Figure 54: European Foul Brood

Disease management

- Avoid the food shortage in the hive and replace the hygienic queen annually.
- Follow the regular colonies inspection and provide good management practices.
- Break the cycle of brood in the hive. Make the colony brood free for 11-14 days. For this, the queen should be kept in the brood frame cage and let her lay eggs in a confined frame.

- Give special attention to inhibit disease transmission.
- Burn and remove the infected hives and combs from the apiary.
- Feed the medicine to the infected colonies. Prepare 500 mg of oxytetracycline or terramycin per liter of sugar syrup and use it 3 times at intervals of 3 to 4 days.

6.2.2 American foul brood (AFB)

This disease was first studied and discovered in 1907 by Dr. G. F. White of America.

That is why this disease is named American foulbrood. It is a deadly infectious disease that affects bees. This disease is caused by a microbe called *Bacillus larvae*. Once this disease has spread to bees, it is very difficult to control. This disease is found to be more prevalent in March/April. It is common in *Apis mellifera* bees in the USA. However, it is understood that there is no record of this disease in Nepal so far.

Symptoms and identification

- The color of diseased larvae changes,
- Death of larvae after cells close,
- Difficulty in removing diseased or dead larvae or pupae,
- If the larva is gently pulled out with tweezers, a brownish substance resembling a slippery threadlike organ will come out.



Figure 55: American Foul Brood

- Finally, it dries and becomes a crust, sticking to the cell.

Disease management

Americans destroy all bees and bee-related hives and combs to avoid the attack of this disease. Since this disease is very dangerous management work must be done from the beginning to control it.

6.2.3 Sac brood disease

This disease was first identified in *A.cerana* bees in Thailand, hence the name Thai sac brood disease. This disease is found to be transmitted through a virus. The parasite multiplies by infecting the larvae's stomach. It is excreted in the feces and spreads to other adult bees as they clean and feed.

Symptoms and Identification

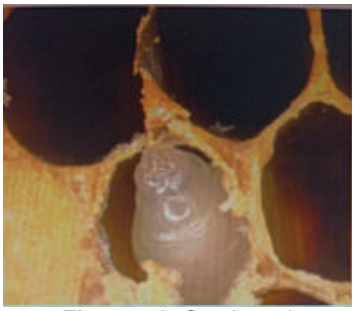


Figure 56: Sac brood

- Larvae appear of a different color than healthy larvae, which later turn black,
- The outer skin of infected larvae softens, swells, and forms a sac-like shape, inside which a light yellow-brown fluid is formed.
- If the diseased larva is gently removed from the cell with tweezers, the larvae are visible inside the bag,
- The larvae die after being covered,
- The head, skin, and abdomen of the dead larvae inside the cover first turn black,
- The brood pattern of the diseased chick is disturbed.

Disease management

- No cure for this disease.
- Make the colony strong and hygienic by replacing the hygienic queen bee.
- keep the queen bees in a cage for a few days to break the brood cycle.
- Place the sealed broods from the strong and hygienic colonies.

6.2.4 Chalk brood diseases

This disease is caused by a fungus (*Ascosphaera apis*). This disease attacks especially in the winter season.



Figure 57: Chalk brood

A white fungus appears in the honeycomb cells. Later, it takes the form of stones, and black spots appear on the white surface. Since this disease is larval, the larvae die before reaching the pupal stage.

Symptom and identification

- The larvae are initially soft and slightly swollen,
- The color of the dead larvae is initially white, brown, and finally black with the growth of fungus inside the larvae's body,

- Later, it shrinks and becomes hard and white like chalk. In this case, the bee has removed the lid,
- Some dead larvae are chalky white, while others are dark blue, brown, and black.
- Newly infected larvae do not show any signs of disease and do not die. However, the larvae die within 2 days of the cell being covered.

Disease management

- Make strong colonies by replacing hygienic and quality queen bees every year.
- Keep hives warm during cold weather.
- Keep good sanitation in the bee hives to prevent the spread of fungal spores everywhere.
- Remove the uncovered frames and use a dummy board.
- Provide good ventilation to remove moisture from the hive.
- Feed the colonies artificial food to prevent food shortages in the colony.

6.3 Adult bee diseases

Diseases affecting adult bees in Nepal are very rare. Some diseases have been appearing in Jumla, Kalikot, Darchula, Baitadi, Doti, Dadeldhura, Dolakha, and other districts of Nepal. Some diseases affecting adult bees are as follows.

1) Nosema disease

2) Amoeba disease

3) Paralysis disease

6.3.1 Nosema disease

This disease is caused by a parasite called *Nosema apis* in adult bees. It attacks the digestive system of adult bees. Due to which the bees suffer from the disease and have thin stools. This disease is seen in late winter and early spring. This disease attacks all classes of bees.



Figure 58: Nosema

Symptoms and identification

- Abdominal distension of the diseased bees,
- Thin stools inside and outside the hive,

- Low honey and pollen accumulation in the hive,
- Foul-smelling feces of the infected bees
- Shorter lifespan of the bees and weaker hives,
- The intestines of healthy bees are seen brown in color, while the intestines of bees suffering from Nosema disease are seen white and swollen.

Disease management

- Make bee colonies strong, it usually comes under control when the temperature increases.
- Give good sanitation in the beehives.
- Destroy the affected colonies.
- Keep the beehives warm during cold weather.
- There is no chemical treatment for it.

6.3.2 Amoeba bee disease

This disease is also spread to bees by a type of microbe. This disease is more common in summer or hot places than in winter.

This is a type of infectious disease that can cause great damage to bees. The bacteria of this disease reach the stomach of the bees through the digestive tract. There they reproduce and increase in number. The symptoms and prevention measures of this disease are as follows.

Symptom and identification

- Infected bees do not show any symptoms.
- Examine the bee in the Laboratory to identify this disease.

Disease management

- Open the hive in the sunshine.
- Remove the diseased combs and replace them with new artificial combs
- Transfer the sealed brood frame from the strong and healthy colonies to a new hive
- Pay special attention to maintaining good sanitation in the beehives.

6.3.3 Bee paralysis disease

This is a disease spread by a virus. This disease is more common in summer than in winter due to a lack of management. Symptoms of paralysis can also be seen due to nutritional deficiency, Acarine mites, and the effects of pesticides.

Symptom and identification

- Bees are unable to enter the hive and fly
- The body of the infected bees turns black, and the abdomen swells
- Healthy bees do not allow the sick bees to enter the hive
- The bees' bodies tremble
- They slowly walk outside the hive and then die



Figure 59: Bee Paralysis

Disease management

- Make colonies strong and hygienic by requeening.
- Feed vitamins B1 + B6 + B12 to the colonies.
- Provide the capped healthy brood from the strong colonies.
- Remove the dead bees from the hives immediately.
- Keep good sanitation in the hive.

1.1.4 Malnutrition

Bees need nutrients for the growth and development of their body parts as well as to keep their colonies in good condition. If there is a shortage of nutrients, the bees show signs of malnutrition. If the queen bees are malnourished, the brood will not be uniform.

Symptom and identification

- Bees are disabled and sick without full physical development,
- Unable to perform their daily activities,
- Dying before reaching old age,

Malnutrition management

- Make colonies strong and hygienic in the apiary
- Requeen annually.

- Provide sufficient artificial food in the shortage period of nectar and pollen in nature.

Sample questions for practice:

1. What diseases do bees get when they are young?
2. What diseases do bees get when they are adults?
3. What symptoms do bees show when they are malnourished?

Session 16

Identification and management of mite infestation

1. Learning objectives.

By the end of the session, the participants will be able to

- Understand the concept of bee parasites and their impact on honeybee colonies.
- Identify the key types of bee mites: Acarine, Varroa, and Tropilaelaps .
- Describe the damage caused by each type of mite.
- Recognize the symptoms of mite infestation in a honeybee colony.
- Understand the life cycles of the pest.
- Apply effective management strategies to control mite populations.

2. Sub topics

- Different types of mite.
- Sign and symptoms of mite infestation.
- Difference between three mites.
- Management of mite infestation.

3. Methods and materials

3.1 Training methods

- Lecture
- Brainstorming/experimentation
- Group discussion
- Visit to apiary to identify mites.
- Practical exercises

3.2 Training materials

- Projector, power point slides, pictures
- Marker pen, brown paper, pen and masking tape, meta card
- Videos showing lifecycle of acarine, varroa and tropilalaeps.
- Sample of mites
- Hive inspection materials.
- Menthol/Sancho, cotton, needle, matchstick box, apistan

3.3 Time

Theory: 50 minutes

Practical: 30 minutes

Discussion: 10 minutes

3.4 Place: Training hall, bee farm/apiary

4. Activities and exercises

4.1 Inform the participants about the lecture/practical exercises included in the training and obtain information about the level of knowledge of the participants on the subject.

4.2 Presentation

Give short presentation on the on the identification of mites, symptoms of mite infestation and management of mite as outlines in the resource materials.

4.3 Practical exercises

After theoretical session take participants to apiary for practical exercise. Open mite infested hive and show the sign and symptoms of mite infestation. Demonstrate mite management technique to participants. Teach participants to apply menthol for acarine infestation and apistan for varroa mite.

4.4 Discussion

After returning from the apiary organize in depth group discussion to know whether participants can identify mites, symptoms of mite infestation and manage mite infestation. If not, further clarify.

5. Detail schedule

S.N.	Subject matter	Description	Time	Materials
1	Introduction (Acarine, Varroa and Tropilaelaps	Ask participants to write different types of mite attacking honey bees.	10 minutes	Marker, pen, meta card
2	Identification, Damage symptoms and management of acarine mite	Describe its location and life cycle, emphasize its importance as a major threat, describe its morphology, life cycle, and feeding habits.	15 minutes	Projector, PPT slides, photo, video
3	Identification, Damage symptoms and management of Varroa mite.	Discuss about the visible mites on bees or brood, deformed bees, scattered brood pattern, reduced bee population and integrated management options of varroa mites.	15 minutes	Projector, PPT slides,
4	Identification, Damage symptoms and management of Tropilaelaps	Discuss about the rapid colony decline, brood mortality and other damage symptoms and management of Tropilaelaps mite.	10 minutes	Projector, PPT slides, photo, video
5	Practical exercise	Take participants to apiary for practical exercise. Open mite infested hive and show the sign and symptoms of mite infestation. Demonstrate mite management technique to participants. Teach participants to apply menthol for acarine infestation and apistan for varroa mite	30 minutes	➢ Sample of mites ➢ Hive inspection materials. ➢ Menthol/ Sancho, cotton, needle, matchstick box, apistan
6	Discussion		10 minutes	

6 Resource materials:

6.1 Introduction

Honeybee health is crucial for both pollination services and honey production. Bee mites, particularly Varroa destructor, pose a significant threat to honeybee colonies by weakening colonies and transmitting viruses worldwide. While Acarine and Tropilaelaps mites can also cause problem. Understanding mite biology, damage, and effective management strategies is essential for beekeepers to maintain healthy and productive hives. Effective management requires understanding mite biology, symptoms, and integrated control strategies.

6.2 Types of mites

1. **Varroa mite (Varroa destructor)**
   The most well-known and destructive mite species, the Varroa mite attaches itself to adult bees and larvae, feeding on their bodily fluids. This weakens the bee and compromises its immune system, leading to colony collapse. Varroa mites are responsible for spreading various viruses, including deformed wing virus (DWV), which causes deformities in bees, further weakening the colony.

2. **Tropilaelaps mites**
   Tropilaelaps mites are similar in behavior to Varroa are problematic in Nepal. They are harder to control and often infest drone brood. These mites have a wider host range, including other species of bees, and pose a severe threat to colonies when present.

3. **Tracheal mites (Acarapis woodi)**
   Tracheal mites live in the respiratory system of honey bees, causing bees to breathe abnormally and exhibit labored flight. These mites often affect weaker colonies and can contribute to a slow collapse over time if not managed.

6.3 Identifying mite infestation

Early detection is key to effective mite control. Regularly inspect colonies for the following signs:

- Deformed wings or bodies: Bees may have misshapen or shriveled wings, indicating a viral infection transmitted by mites.
- Spotty brood pattern: The brood pattern may be irregular, with empty cells scattered among capped brood, suggesting mite-related brood mortality.

- Visible mites: Reddish-brown mites may be seen on adult bees or larvae, especially in heavily infested colonies.
- Reduced colony vigor: The colony may appear weak, with a declining bee population, reduced honey production, or sudden hive abandonment.



Figure 60: Varroa mite and its damage in larva and pupae of honeybee

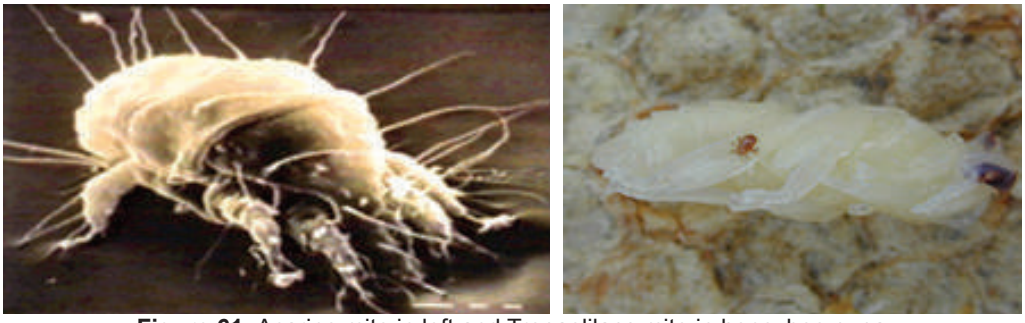


Figure 61: Acarine mite in left and Tropaelilaps mite in honeybee pupa

6.4 Difference among these three mites

The differences on these three mites are shown in the following table

Table 14: Different type of mites and features their features

Feature	Varroa destructor (Varroa mite)	Acarapis woodi (Acarine/ Tracheal mite)	Tropilaelaps spp. (Tropilaelaps mite)
Differentiation in Identification	Large (visible), reddish-brown, oval, found externally on adult bees and in brood cells. Slower movement.	Microscopic (invisible), translucent-white, oval, found internally in the trachea of adult bees. Requires dissection and microscopy.	Smaller than Varroa, elongated, light to reddish-brown, very fast-moving, primarily found on brood (larvae and pupae). Adults may be seen on adult bees briefly.

Feature	Varroa destructor (Varroa mite)	Acarapis woodi (Acarine/ Tracheal mite)	Tropilaelaps spp. (Tropilaelaps mite)
Damage Symptoms	Weakened bees, reduced lifespan, deformed wings (DWV), premature death, brood deformities/death, colony collapse.	Often no external signs initially. Heavy infestations: crawling bees, inability to fly ("K-wing"), disjointed wings, distended abdomens, lethargy, poor spring buildup, high winter mortality. Tracheal damage visible microscopically.	brood damage: malformed/ dead larvae and pupae, reduced brood production, weakened colonies, colony collapse (especially without brood). May weaken adult bees.
Life Cycle	Phoretic stage on adult bees, enters brood cells to reproduce. Eggs laid on larva, offspring develop and mate within capped cell. Mites emerge with adult bees. Brood-dependent for reproduction but can survive on adults.	Females enter young bee trachea, lay eggs. Larvae develop into adults within the trachea, feeding on hemolymph. Mating in trachea, pregnant females infest new young bees. Entire cycle inside the adult bee's respiratory system.	Females enter brood cells before capping, lay eggs on larva. Rapid life cycle within capped brood. Heavily reliant on brood; short phoretic stage on adults. Cannot survive long periods without brood.
Monitoring Tools	Alcohol wash, sugar shake, sticky boards (under hive), visual inspection of bees and brood.	Bee dissection and microscopic examination of trachea. Sampling crawling or non-flying bees.	Uncapping brood cells to observe fast-moving mites on larvae and pupae. Sticky boards less effective.

Feature	Varroa destructor (Varroa mite)	Acarapis woodi (Acarine/ Tracheal mite)	Tropilaelaps spp. (Tropilaelaps mite)
IPM Method of Management	Cultural/ mechanical (screened bottoms, drone brood removal), biological (resistant bees, predatory mites/fungi), chemical (organic acids, synthetic acaricides, essential oils).	Primarily chemical (menthol, formic acid, vegetable oil patties), selecting resistant stock, maintaining strong colonies. Brood breaks may have some impact by reducing young bee availability for infestation.	Brood cycle interruption (queen caging), chemical controls (formic acid, synthetic acaricides where effective), biotechnical methods focused on brood manipulation. Less established biological controls.

6.5 Simple detection methods:

6.5.1 Sugar roll test:

- Collect approximately 100 adult bees in a jar.
- Add 1-2 tablespoons of powdered sugar to the jar.
- Let the jar stand for 1 minute. Add water to the jar and swirl gently.
- Pour the water through a fine mesh screen or white cloth.
- Count the mites that are dislodged and retained on the screen.
- A threshold of 3 mites per 100 bees generally indicates a need for treatment.

6.5.2 Alcohol wash:

- Collect approximately 300 adult bees in a jar.
- Add 70% ethyl alcohol to the jar.
- Gently shake the jar for 1 minute.
- Pour the alcohol and bees through a mesh screen.
- Count the mites that are dislodged and retained on the screen.

1.6 Mite management

6.6.1 Prevention strategies:

- Preventing mite infestations is always preferable to treating them.
- Consider these strategies: Use resistant bee strains: *Apis cerana* exhibits some natural resistance to Varroa. Promote the use of local *Apis cerana* and explore the potential of resistant *Apis mellifera* strains.
- Maintain strong colonies: Ensure colonies have adequate food (honey and pollen), a healthy queen, and a balanced population of bees.
- Practice good hygiene:
- Keep hives clean and well-ventilated. Avoid overcrowding, which can stress bees and increase mite problems.
- Quarantine new colonies: Isolate new colonies for 2-3 weeks and monitor for mites before introducing them to established apiaries.

6.6.2 Non-chemical control methods

Non-chemical methods are an important part of sustainable mite management, especially for *Apis cerana* and in situations where chemical use should be minimized.

6.6.2.1 Drone brood removal

- Mites, especially Varroa, prefer drone brood for reproduction.
- Insert a frame to encourage drone comb production.
- Remove and destroy (freeze or scrape) the capped drone brood every 2-3 weeks to eliminate a significant portion of the mite population.

6.6.2.2 Mechanical controls

- Screened Bottom Boards: These allow some mites to fall through the hive and prevent them from returning to the bees. Ensure the screen mesh size is appropriate to prevent bees from falling through.



Figure 62: Screened bottom board

- Powdered sugar dusting: Dusting bees with powdered sugar can dislodge mites, causing them to fall off. Apply 1-2 times per month. Use fine-grade powdered sugar.

6.6.2.3 Heat treatment

- Use solar-powered heating to raise the hive temperature (around 40°C) for 2-3 hours to kill mites. Monitoring of hive temperatures carefully

is necessary to avoid overheating and harming the bees. This method may not be suitable for all hive types or climates in Nepal.

6.6.2.4 Herbal/Natural remedies

- Thymol: Thymol is a natural compound found in thyme oil that can kill mites. Apply thymol-based products (e.g., Apiguard) according to the manufacturer's instructions.
- Oxalic acid: Can be dripped or vaporized. Dribble: Mix oxalic acid with sugar syrup and apply between brood frames. Vaporization: Heat oxalic acid crystals to create a vapor that kills mites. Apply during bloodless periods (e.g., after honey harvest) for best results.
- Neem or Tobacco extracts: Some studies suggest that extracts from neem or tobacco may have acaricidal properties. These treatments require careful testing and application, as they can also harm bees if not used correctly. Start with small-scale tests.

6.6.2.4 Chemical treatments

should be used judiciously as part of an IPM strategy, primarily when mite levels exceed economic thresholds and non-chemical methods are insufficient.



Figure 63: Apistan

- Formic acid: Available in liquid formulations. Place pads or dispensers inside the hive, following safety guidelines. It can be harmful to bees and beekeepers if not handled properly.
- Oxalic acid: Effective against Varroa mites, especially during brood less periods. Apply by dribbling a solution into the hive or by vaporization
- Synthetic acaricides: Amitraz: Available in strip form (e.g., Apivar).
- Use only approved products and strictly follow label instructions to minimize the risk of mite resistance and contamination of honey.
- Rotate chemical treatments to prevent mites from developing resistance.

Safety tips:

- Always wear appropriate protective gear (gloves, eye protection, and respirators) when handling chemical treatments.

- Avoid contaminating honey with chemicals. Remove honey supers before applying treatments and follow recommended withdrawal periods.
- Store chemicals safely, out of reach of children and animals.

6.6.2.5 Cultural practices for management

- Adapt mite management practices to the specific conditions and beekeeping traditions in Nepal:
- Traditional Hives: For fixed-comb hives, consider using smoke with neem leaves or eucalyptus to help repel mites, although this method's effectiveness is limited.
- Hive Design Transition: Encourage the adoption of movable-frame hives to allow for better mite monitoring and targeted treatments.
- Seasonal Timing: Time mite treatments to coincide with periods of low brood rearing, such as after the main honey harvest (October-November) in many parts of Nepal.

6.6.2.6 Integrated pest management (IPM) in Nepal

- The most sustainable approach to mite management is to combine multiple control methods within an IPM framework:
- Monitor mite levels regularly:
- Perform sugar roll or alcohol wash tests monthly, or more frequently during peak mite seasons.
- Set treatment thresholds: Determine acceptable mite levels for your apiary based on local conditions and bee species. A general guideline is to treat when mite levels exceed 3 mites per 100 bees.
- Implement cultural and mechanical controls as a first line of defense.
- Use chemical treatments judiciously, only when necessary, and rotate them to prevent resistance.
- Evaluate treatment effectiveness:
- Adjust your IPM plan as needed based on monitoring results.
- Recognizing the signs of a mite infestation early can prevent severe damage to the colony. Some common symptoms include general decline in hive strength, abnormal bee behavior, and poor honey production. The differences in symptoms is given below.

Case Study

Below are a few notable case studies on bee mite management:

Case Study 1: Integrated pest Management in Germany (2012-2014)

Objective: The study aimed to develop an effective IPM approach for managing Varroa mites in beekeeping operations.

Methods: The researchers combined several methods to control Varroa, including:

Chemical treatments: Using formic acid to control Varroa infestations.

Biological control: Introducing predatory mites (Amblyseius species) as a biological control agent.

Brood interruption: Techniques such as splitting colonies or removing brood to disrupt the life cycle of Varroa mites.

Results: The combined approach resulted in a significant reduction in Varroa mite populations. The study emphasized that the most effective method involved a mixture of chemical, mechanical, and biological strategies. However, researchers also noted that long-term use of chemicals could lead to resistance, which highlighted the need for sustainable solutions and continuous monitoring.

Conclusion: An integrated approach that combines various control methods was the most effective way to manage Varroa mites. Regular monitoring and a dynamic approach to treatment were essential to maintaining healthy colonies.

Case study 2: Using *Metarhizium anisopliae* to control Varroa mites (Australia, 2015-2017)

Objective: This study aimed to evaluate the use of the entomopathogenic fungus Metarhizium anisopliae as a biological control for Varroa mites in honeybee colonies.

Methods: The researchers applied fungal spores of *Metarhizium anisopliae* to hives and monitored the impact on Varroa mite populations. They tested different formulations and application methods to assess the fungus's ability to spread and infect the mites effectively.

Results: The fungus showed promising results, with a notable reduction in Varroa mite populations in treated hives. However, the study found that environmental factors like humidity and temperature played a significant role in the success of the fungus. The fungus was more effective in warmer, humid conditions.

Conclusion: While *Metarhizium anisopliae* demonstrated potential as a biological control agent, its success was dependent on environmental factors. The study concluded that fungal treatments could be a viable part of an integrated pest management strategy but needed to be used in conjunction with other methods to ensure long-term efficacy.

Case study 3.: **Chemical control with oxalic acid in Canada (2018-2020)**

Objective: This case study evaluated the use of oxalic acid as a treatment for Varroa mites in commercial beekeeping operations in Canada.

Methods: Oxalic acid was applied using various methods, including vaporization and trickling, to treat Varroa infestations in honeybee colonies. The study compared different dosages and application techniques, along with the effects on bee health and colony strength.

Results: Oxalic acid was found to be highly effective in reducing Varroa populations, with the vaporization method being the most efficient. However, repeated treatments were necessary for effective long-term control. The treatment did not negatively impact bee health when used properly, but it was not a stand-alone solution; other treatments and monitoring were also required.

Conclusion: Oxalic acid, when used correctly, can be a highly effective tool in controlling Varroa mites. However, it should be part of an ongoing pest management program, as Varroa mites can develop resistance to treatments over time.

Case Study 4.: The Role of genetic resistance in Varroa Mite Management (United States, 2016-2019)

Objective: Researchers in the United States studied the potential of breeding honeybee colonies with natural resistance to Varroa mites as a long-term management solution.

Methods: The study focused on selecting and breeding honeybee colonies that exhibited natural resistance to Varroa mites. These bees were selected for traits such as grooming behavior, hygienic behavior (removal of infected brood), and mite tolerance. The researchers then compared the performance of these colonies with non-resistant colonies over several seasons.

Results: The study showed that colonies with genetic resistance to Varroa mites were able to maintain lower mite levels and healthier hive populations. However, even with resistant colonies, periodic treatments were still required to keep mite levels under control. The research demonstrated that while genetic resistance is a promising strategy, it is unlikely to be a standalone solution.

Conclusion: Genetic resistance can play an important role in managing Varroa populations and should be incorporated into long-term management strategies. However, it should be combined with other control methods to ensure the sustainability of honeybee populations.

Case study 5.: varroa management in small-scale beekeeping (UK, 2020-2022)

Objective: The study explored alternative Varroa mite management methods for small-scale and hobbyist beekeepers in the UK, focusing on non-chemical and sustainable approaches.

Methods: The study tested a range of non-chemical methods, including:

Drone brood removal: Using drone brood as a natural way to trap Varroa mites.

Culling and splitting hives: Reducing brood volume to break the reproductive cycle of Varroa mites.

Mite-resistant bee breeds: Introducing colonies of bees with known resistance traits.

Results: The combination of drone brood removal and splitting colonies proved effective in keeping mite levels at manageable levels. Mite-resistant bee breeds showed promise, although they required more time to establish in the population.

Conclusion: Small-scale beekeepers can manage Varroa effectively using non-chemical approaches. The study highlighted the importance of regular monitoring and adaptive management, as well as the potential for sustainable, non-chemical strategies in hobbyist beekeeping.

6.7 Challenges of bee mite management in Nepal:

- **Prevalence of different mite species:** Nepal faces challenges from various bee mite species, including *Varroa destructor* (a major threat to *Apis mellifera*) and *Tropilaelaps mercedesae* (a significant issue for *Apis mellifera* in the Terai region). *Varroa jacobsoni* is also found in *Apis cerana* colonies, although it often causes less notable damage due to lower infestation levels.
- **Impact on both introduced and native Bees:** Both the introduced European honeybee (*Apis mellifera*) and the native Asian honeybee (*Apis cerana*) are susceptible to mite infestations, though the specific mite species and their impact can differ.
- **Limited resources and awareness:** Beekeepers in Nepal, particularly those using traditional methods with *Apis cerana*, may have limited

access to information, resources, and modern mite management techniques.

- **Risk of chemical resistance and residues:** The reliance on chemical treatments for mite control in *Apis mellifera* poses a risk of mites developing resistance and leaving chemical residues in bee products like honey and beeswax.

6.8 Current mite management practices in Nepal (based on available information):

- **Chemical control in *Apis mellifera*:** Commercial beekeepers managing *Apis mellifera* often use chemical acaricides to control mite infestations. However, the specific chemicals used and the extent of their application can vary. Some studies mention the use of synthetic acaricides without specifying types.
- **Traditional methods for *Apis cerana*:** Beekeepers using traditional log and wall hives for *Apis cerana* may have limited mite management practices. Some natural resistance or behavioral adaptations of *Apis cerana* might help regulate mite populations to some extent.
- **Organic acid treatments:** Research has explored the potential of organic acids like formic acid as alternative and sustainable methods for controlling *Tropilaelaps mercedesae* in *Apis mellifera* colonies in the mid-hill regions of Nepal. Formic acid demonstrated promising efficacy in reducing mite infestation.
- **Plant-based treatments:** Studies have also investigated the acaricidal properties of plant-based products like neem seed powder and even animal products like cow urine for managing *Tropilaelaps mercedesae*. While these showed some efficacy, formic acid was generally found to be more effective.
- **Limited use of other IPM strategies:** While Integrated Pest Management (IPM) principles are advocated globally for sustainable mite control, their widespread adoption in Nepal might be limited due to various socio-economic and knowledge-related factors. However, some beekeepers are reported to use oxalic acid for mite control.
- **Monitoring practices:** The importance of monitoring mite levels to determine the need for treatment is recognized. Techniques like sugar rolls and alcohol washes, commonly used elsewhere, might be relevant in the Nepalese context, although the extent of their use isn't explicitly detailed.

1.9 Potential and recommendations:

- **Promoting sustainable IPM strategies:** There's a need to promote and implement IPM strategies that combine various control methods, including biological, cultural, and chemical (used judiciously), to minimize reliance on synthetic acaricides.
- **Education and training:** Providing beekeepers with education and training on modern mite management techniques, including monitoring, alternative treatments, and best practices, is crucial. The Apiculture Development Centre in Godawari, Lalitpur, offers training on bee disease and mite management.
- **Research on native bee mite interactions:** Further research is needed to understand the interactions between different mite species and native Nepalese honeybee populations like *Apis cerana* to develop effective and sustainable management strategies that consider their specific biology and behaviors.
- **Development of mite-tolerant stocks:** Exploring the potential for identifying and propagating mite-tolerant bee stocks, particularly for *Apis mellifera*, could offer a long-term sustainable solution.
- **Caution regarding introduced mites:** The introduction of *Apis mellifera* has also brought new mite challenges like *Tropilaelaps clareae* to regions where they weren't endemic, highlighting the need for careful management practices to prevent their spread.

Sample questions for practice.

1. Discuss the life cycle of varroa mite.

2. Discuss the damage symptoms of acarine mite.

3. What are the integrated management options of mites?

Session 17

Honey bees internal and external enemies

1. Learning objectives

By the end of the session, the participants will be able to:

- Identify honeybee pests inside and outside of the hive
- Describe the damage signs and symptoms of pests.
- Adopt control measures against them

2. Sub topics

- Identification of internal and external enemies of honeybees.
- Damage sign and symptoms.
- Management

3. Methods and materials

3.1 Training methods

- Lecture
- Brainstorming
- Group discussion
- Observation
- Practical Exercise

3.2 Training materials

- Projector, Power points, Slides, Pictures.
- Marker, Brown paper, Pen, Masking Tape, Meta Card
- Hive inspection materials and tools
- Mosquito bat
- Hornet trap
- Hornet killing bat
- Small bowls

3.3 Time

Theory: 60 minutes

Practical: 20 minutes

Discussion: 10 minutes

3.4 Place: Training hall, Apiary

4. Activities and exercise

4.1 Inform participants about the topics covered in the training and inquire about their level of knowledge on the subject matter.

4.2 Presentation

Give a short presentation on identification, damage sign and symptoms and management of internal and external parasites of bee hive as outlined in the resource materials.

4.3 Practical exercise.

Divide the participants into 3 groups and complete the following tasks during practical exercises.

- Show pictures and samples of living pests or enemies inside and outside the beehive to identify them.
- show the damage sign and symptoms by internal and external enemies of beehive.
- Demonstrate methods for managing pests inside and outside the beehive.

4.4 Discussion

Use in depth discussion and question/answer to discover whether the participants can recognize different enemies, their damage symptoms and management techniques.

5. Detail schedule

S.N.	Subject matter	Description	Time	Materials
1	Introduction	Make participants to write down what they know about the bee enemies.	10 minutes	Marker Pen, Meta card.

S.N.	Subject matter	Description	Time	Materials
2	Identification of internal enemies, their damage symptoms and management techniques.	Discuss methods for identifying internal enemies such as wax moth, wax beetle, ant, wall lizard cockroach etc. and methods of management techniques.	25 minutes	Projector, Power point slides, Pictures, Videos.
3	Identification of external enemies, their damage symptoms and management techniques.	Discuss methods for identifying external enemies such as wasp, hornet, pine marten, honeybee eater birds, bear etc. and methods of management techniques.	25 minutes	Projector, Power point slides, Pictures, Videos.
4	Practical exercise	If possible, take participant to the bee farm to identify bee enemies, show them the damage symptoms and teach management methods.	20 minutes	Sample of bee enemies.
7	Discussion		10 minutes	

6. Resource materials

6.1 Introduction

All animals, birds and insects that directly or indirectly harm bees are bee enemies. They harm bees both inside and outside the hive. The identification, damage and management of some of the bee pests are as follows.

6.2 Internal enemies

6.2.1 Ant

This is a small creature belonging to the carnivorous insect class. It lives in groups and build nests both above and below the ground. There are different types of ants, but their damage nature is the same. They love sweets, so as

soon as they smell honey, they line up and enter the beehive and start eating honey. They damage larva as well as adult.

Management:

- Weeds around the beehive should be removed and kept clean.
- The hive should be placed on a 4-legged stand to prevent ants from climbing and entering the hive.
- Grease the legs of the stand or pour water into a steel or aluminum bowl and place the beehive on top.



Figure 64: Bee Ant

- When extracting honey or applying sugar syrup, do not spill syrup around or inside the hive. If syrup is spilled, it should be cleaned up immediately with water.

6.2.2 Wax moth

The wax moth is a type of nocturnal moth that lives in bee hives. It damages the honeycomb by webbing and leaving the comb with no space to raise brood and store honey. Two types of wax moths infest bee colonies. The symptoms of damage caused by both types of moths are similar.

6.2.2.1 Greater wax moth

This wax moth is found in warm places. The female wax moth enters the hive at night through the entrance and other holes of the hive. The female wax moth goes out at night to mate with the male.



Figure 65: Wax Moth

After mating, a female wax moth lays about 400 to 500 eggs. The larvae hatch from the eggs in 5-8 days, and it takes 18-20 days for the larvae to reach the pupal stage. However, if the weather is cold, it can take up to a month.

6.2.2.2 Lesser wax moth

It is mostly found in the mountains and lakes. This butterfly is cream-colored and has a yellow head. It is small in size and has a long body. An adult female lays 250-300 eggs. It attacks weak hives and its larvae like to feed on old honeycomb. Its larvae cause damage similar to that of the greater wax moth.

Sometimes, when lesser wax moth larvae invade the brood cells of bees, the cells remain open during the pupal stage, resulting in the problem of bald brood. Similarly, the larvae of the small wax moth invade and tunnel inside the pupal cells of the bees, and the worker bees remove the lids of those cells, resulting in the problem of bald brood.

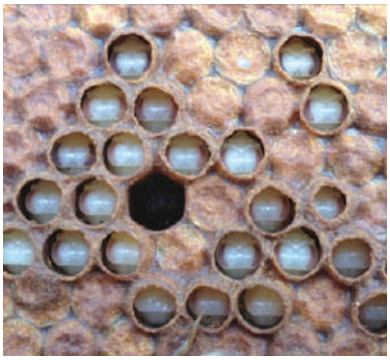


Figure 66: Bald Brood Disease

Management:

- Keep the hive healthy and strong and remove any uncovered frame.
- Make the entrance to the beehive small and seal any holes or cracks in the hive.
- Clean the dirt on the beehive's bottom board from time to time.

6.2.3 Death's head hawk moth

This is a large moth which enters the hive at night through the entrance and other openings and eats honey. Since its proboscis is thin, the bees do not even know that it has stolen honey. A moth can eat about 7-10 grams of honey.



Figure 67: Death's head hawk moth

Management:

6.2.4 The best way to control bee hives is to keep the hive entrance small and to seal the holes in the hive.

6.2.5 Wax beetle

This is an insect belonging to beetles. Its outer wings are hard and the inner wings are soft and transparent. This insect hides in the corners of the hive and damages the honeycomb. When inspecting the beehive, wax beetle is found hiding. It eats the bee pollen and also damages the bee eggs and brood.

Management:

- Keep the beehive clean.
- Maintain strong colony.
- Seal the holes and cracks in the beehive.
- Open the beehive only when necessary.

- Wax moths can be controlled to some extent by using traps. For this, cut a half-inch pipe into a 3-4-inch-long piece, close the mouth on one side, and place some food mixed with some flour inside the hive in the evening and destroy the wax moths collected in the pipe the next day.



Figure 68: Wax Beetle

6.2.6 Phorid fly

It is similar to fruit fly and measures 2-6 mm in length. This fly runs more than it flies. It survives by feeding on decaying organic matter found around beehives. Some species are parasites of bees. The female flies lay eggs in the abdomen of the bee, and within 24 hours, the larvae hatch. The larvae eat and kill the larva and adult bees. The fine white maggots can be seen in the brood cells.



Figure 69: Phorid Fly

Management:

- Keep hive clean and colony strong.
- In severe infestation smoke can be given repel flies.

6.3 External enemies.

6.3.1 Hornet and wasps.

They are social and predatory insects. They capture flying bees and feed to their larva. In severe infestation honey bees can abscond.



Figure 70: Hornet

Management:

- Destroy their colony.
- Kill wasp and hornet by using mosquito bat.
- Install hornet trap.
- Reduce the hive entrance size.

6.3.2 Pine marten

It is one of the major enemies of honeybee and can be found everywhere. It is smoky in color and has black and white stripes on its body. It causes great damage by overturning or digging holes in beehives and eating honey, pollen, and brood. If beehive entrance is large it inserts its tail into a beehive and shakes. By doing this, the bees will cling to the tail to sting, and then it pulls tail out and eat all the bees that are stuck in the tail.



Figure 71: Pine Marten

Management:

- Secure the beehives by pressing them down with stones or other heavy objects so that hive cannot be knocked over by the pine marten.
- Make the hive entrance smaller.
- Keeping dogs in the apiary may scare pine marten.
- Place a branch/stem of cactus on the hive.

6.3.3 Birds

Bee- eater birds catch and eat bees. Black Drongo (Chibe chara), Meropidae Green bird, long legged bird etc. damage honey bee colony. When there are few insects around, and especially on cold and cloudy days, they prey on adult bees around the hive.

Management:

- It is better to chase them away than to kill them.
- Remove bird shelter near the apiary.
- Keep scare crow to scare them away

6.3.4 Bear

It destroys beehives and eats the bees, along with the comb and honey.

Management:

- Bears can be scared away by a watchman or dog;
- Place scarecrow in the apiary.



Figure 72: Bear

- The hives can be protected to some extent by placing a heavy stone or wooden plank over the top cover of hive or tying the hive with a hive belt.
- Avoid commercial beekeeping in an area where the bear population is hi gh.

6.3.5 Wall lizard, Garden lizard

They are reptiles having long tail, scaly body, and four sticky feet for climbing. Since they are carnivores, they damage bees by eating them.



Figure 73: Lizard

Management:

- Keep the hive clean and colony strong.
- scare away any frogs and lizards that are seen hunting or catching bees.

6.3.6 Spider

A spider is an eight-legged insect. It builds webs inside and outside beehives and on trees. When bees fall into these webs, it kills and eats them.



Figure 74: Spider

Management:

- Make beehive entrance small.
- Remove any spider webs inside or outside the hive.
- Use a long stick with a brush on the end to remove webs from tall trees.

Sample questions for practice?

1. What are the major enemies found inside beehives?
2. How honeybee colony can be prevented from bear attack?
3. How ant attack should be managed in honeybee colony?

Session 18

Bee pasture and the importance of bee in pollination

1. Learning objectives

By the end of the session, the participants will be able to:

- Identify flowering plants and pollination mechanism.
- Describe the need of preparing flowering calendar and identify honey potential plants.
- Estimate pollination deficit in crop and increased yield by pollination services.
- Explain the role of native bees and biodiversity conservation.

2. Sub topics

- Introduction and importance of bee pasture
- Bee pasture sources
- Bee pasture calendar preparation
- Role of bees in pollination (introduction, deficit of pollination in crops)

3. Methods and materials

3.1 Training methods

- Lecture
- Brainstorming/experimentation
- Group discussion
- Practical Exercise
- Visits and observation of practices to conserve native bees and biodiversity

3.2 Training materials

- Projector, power point slides, pictures
- Marker pen, brown paper, pen and masking tape, meta card

- Samples/videos of bees and flowering plants
- Male and female flower parts, and pollinators body specialized parts posters.
- Microscope/hand lens

3.3 Time

Theory: 50 minutes

Practical: 30 minutes

Discussion: 10 minutes

3.4 Place: Training hall, bee farm, laboratory

4. Activities and exercises

4.1 Inform the participants about the lecture/practical exercises included in the training and obtain information about the level of knowledge of the participants on the subject.

4.2 Presentation

Give a short presentation on the bee pasture, male and female parts of flower, specialized parts of bees, flowering calendar, honey potential plants, pollinators pollination and crop production, pollinators and biodiversity conservation as outlined in the resource materials.

4.3 Group division/practical exercises

Divide the participants into 4 groups and complete the following tasks during the practical exercises.

1. Identify bee pasture/bee visiting plants.
2. Identify male and female flower parts and specialized bees' parts matching with poster.
3. Flowering calendar preparation of flora available in the backyard, crop field vicinity.
4. Visit and observe the bee and biodiversity conservation sites.

Take participants to the sample collection lab and bee farm for practice and demonstrate samples bees. Similarly, introduce to bee pasture/bee visiting flowers and their male and female parts. In the vicinity, make participants to observe bees visiting flowers and prepare a list of bee preferred plants. If

available, use binocular / hand lens to observe the pollination process more clearly.

4.4 Discussion

After returning from the bee farm, organize group presentation to present the results of their observations. Ask participants about bee plants, male and female flower parts, plant calendar, honey potential plants, bee conservation, to find out whether they are clear and to discuss topics to clarify if they are not clear.

5. Detail schedule

S.N.	Subject matter	Description	Time	Materials
1	Pasture, bee plants	Ask participants to write name of flowering plants visited by bees.	5 minutes	Marker, pen, meta card
2	Flowering calendar	Discuss with participants to prepare flowering calendar in their locality.	10 minutes	Projector, PPT slides, photo, video
3	Honey potential plants	Discuss with participants to identify honey potential plants in their locality.	15 minutes	Projector, PPT slides,
4	Male, female flower parts and, specialized bee parts	Discuss with participants to identify male, female flower parts and, specialized bee parts	10 minutes	Projector, PPT slides, photo, video
5	Native bees and biodiversity conservation	Discuss with participants about native bees and biodiversity conservation	10 minutes	Projector, PPT slides, photo, video
6	Practical exercise	Organize participants in four groups and visit to crop fields and conservation sites to observe and identify bees, bee visiting plants, honey potential plants, if possible with the help of binocular/hand lens.	30 minutes	Bees, bee flora, honey potential plants, conservation areas
7	Discussion		10 minutes	

6. Resource materials

6.1 Bee pasture

No creature can survive without food. Food is essential for all kinds of organisms. Bees collects food from flowering plants, and store in hive for use throughout the year. The more we have cooked honey in bee hive and the more beekeeper's benefit. Bee pasture thrive the best in areas from 25ºC to 35ºC. When the air temperature is less than15ºC and more than 40ºC, bees do not forage. Bees also do not forage during cloudy, windy, and rainy days. Favorable weather and environment are necessary for bees for collection and the accumulation of honey in the hive.

6.2 Bee pasture source

The plants in which bees depend for nectar, pollen, and propolis collection are termed as bee plant sources. Both sources like nectar for energy and pollen for protein and vitamins are necessary for bees. Bees even collect honeydews (sugary substances) deposited by other insects (like aphids) in the hive. Also, bees especially introduced honey bees (*Apis mellifera* L.) collect propolis from plants and use in sealing crack and services in hive.

Nepal harbors various kinds of bee plants which flower during different seasons, which as a whole serve as bee foraging sources throughout the year except during cold season.

6.3 Foraging preference

Different types of flowering plants, also known as bee pastures, are prevalent in beekeeping areas and bees show preference to visit these florae to collect nectar and pollen among the flowering sources. Among the types of bees, their preferences differ, and they visit other flower sources as well in case of unavailable preferred floral plant sources. As species of bees and flowering plants differ in crop and bee pasture areas, flower foraging, crop pollination, honey and pollen collection also differ accordingly.

6.4 Bee pasture management

Bee pasture can be managed in two ways.

6.4.1 Planting bee preferred (honey and pollen) plants

The bee's necessary diet requirement differs in different types of plants. The bee-diet rich sources are chilaune, *Schima wallichi* DC (Korth), katus, *Castanopsis indica* (Roxb. ex Lindl.), chiuri, *Bassia butyracea* Roxb., tuni, *Toona ciliata* M. Roemer, mayal, *Pyrus pashia* L., chutro, jamun, (), rudilo, Pogostemnon

glaber Benth., bottlebrush, *Grevillea robusta* A. Cunn. ex. R. Br., eucalyptus, (), citrus, *Citrus spp*., litchi, *Litchi chinensis* Sonner, clover, (), rapeseed, *Brassica campestris* var. *toria* L., sunflower, *Helianthus annus* L., buckwheat, *Fagopyrum esculentum* Moench etc. Therefore, bee pasture can be increased by planting these plants in kitchen garden, road side, upland terrace etc.

6.4.2 Migrating bee colonies to rich nectar and pollen plant sources

Bee colonies can be provided good food sources by transferring them to wild or farming areas. The number of colonies required in any location depends on the pasture source and flowering period, for which number of bee's colonies can be kept supported during flowering period.

Preparation of flowering plants of a particular place is necessary to identify bee flora and their flowering period. The sample of bee pasture is presented in Table 15 and the available rich sources bee flora with their honey production potentiality in Table 16. Therefore, flowering times (months/season) and honey potential differ according to prevailing weather, geographical locations, farming system, and local pasture source.

Table 15: Bee pasture calendar (sample)

SN	Name of plant	M-A	A-M	M-J	J-J	J-A	A-S	S-O	O-N	N-D	D-J	J-F	F-M	Remarks
1	Mustard, *Brassica compestris* L.													
2	Maize, *Zea mays* L.													
3	Chiuri, *Aesandra butyracea* (Roxb.)													
4	Ritha, *Sapindus mukorossi* Gaertn.													
5	Orange, *Citrus reticulate* Blanco													
6	Paiyou, *Prunus cerasoides* D. Don.													
7	Rudilo, *Pogostemon glaber* Benth.													
8	Walnut, *Juglans regia* L.													
9	Sisso, *Dalbergia sisso* Roxb.													
	Total	0	2	2	0	1	2	3	3	3	3	6	3	

Table 16: Bee plants as potential sources of honey production per hectare

SN	Plant name	Scientific name	Honey potential (Kg/hac.)	Mellifera colony/ ha	Factors
1	Mustard	*Brassica compestris* L.	50-100	3-5	Good irrigation
2	Eucalyptus	*Eucalyptus spp.*	1000-1500		Age and size of tree
3	Litchi	*Litchi chinensis* Sonner	500-1000	1-2	Healthy plants
4	Sisso	*Dalbergia sisso* Roxb.	200-300		Good rain in winter
5	Neem	*Azadiracta indica* A. Juss.	100-200		Large healthy plants
6	Ritha	*Sapindus mukorossi* Gaertn.	300-500		Age of plants
7	Barro	*Terminalia chebula* Retz.	100-300		Healthy trees
8	Berseem	*Trifolium alexandrium* L.	300-500		Good irrigation
9	Cotton	*Gossypium spp.*	100-300		Good irrigation
10	Khair	*Acacia catechu* (L.f.) Wilid	100-300		Rain during flowering
11	Clover	*Trifolium rapens* L.	200-300		Good irrigation
12	Sunflower	*Helianthus annus* L.	100-200	4-5	Good irrigation

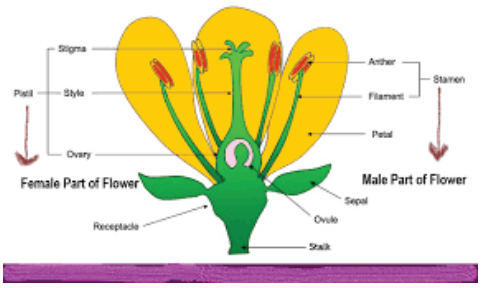
6.5 Role of bees in pollination

6.5.1 Pollination

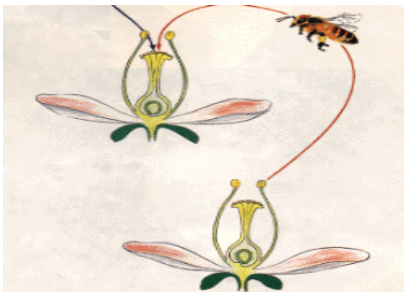
The process of transferring pollen from male part of flowers to female part of same or other flower is called pollination. In case of flowering plants, there is no fruit or seed formation without pollination, which cause deteriorating in plants and such suffering may cause their disappearance from this earth.

Different parts of flower and pollination process is presented in Figure 75. The process of male pollen dropping into female ovary within the same flower or

same plant is termed as self-pollination. While the pollen carrying from one male flower to another female flower on the same plant or to another plant of the same species, is called cross-pollination. Plants produce nectar, juice, smell, flavors and different colored flowers to attract pollinators. Flowering plants are pollinated in the process of visiting flowers by bees and assuring their pollination services, which later develop into fruits and seeds.



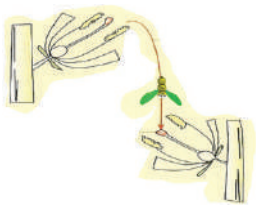
Different parts of a flower



Pollination



Self-pollination



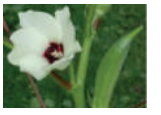
Cross-pollination

Figure 75: Different Parts of the Flower and Pollination Process

6.5.2 Significance of pollination

Plants cannot move; they are fixed in one place, while pollens are transportable. Pollen transport also needs various means. So, in plant kingdom, all flowering plants are threatened if not pollinated by some means, which is significant for continuity and strengthening diversity in the plant kingdom. The pollination mechanism strengthens and expand the conservation and stability of biodiversity by strengthening plant and pollinators mutual relationships.

The yield of self-pollinated plant is always poor both in quality and quantity, while the cross-pollination increases hybrid vigor in plants with qualitative and quantitative traits. In fact, one - third of human diet are obtained from pollinators' services in nature. Therefore, pollinators help to provide healthy food and support food security Figure 76.

			
Chiuri: *Diploknema butyracea* (Roxb.) H.J.Lam.	Indian squirrel tail*: Colebrookea oppositifolia* Smith	Sunflower: *Helianthus annus* L.	Sesame: *Sesamum indicum* L.
			
Banana: *Musa paradisiaca* L.	Albizia: *Albizia julibrissin* Durazz	Pogostemon: *Pogostemon glaber* Benth	Fire flame bush: *Woodfordia fruitcosa* (L.) Kurz
			
Fingermillet: *Eleusine coracana* (L.) Geartn.	Buckwheat: *Fagopyrum esculentum* Moench	Pea: *Pisum sativum* L.	Pigeon pea*: Cajanus cajan* (L.) Millsp
			
Greengram: *Phaseolus radiates* L.	Soybean: *Glysine max* (L.) Merr	Lentil: *Lens culinaris* Medikus	Okra: *Abelmoschus esculentus* (L.) Moench
			
Cucumber: *Cucumis sativus* L.	Coriander: *Coriandrum sativum* L.	Bottle gourd: *Lagenaria siceraria* Molina) Standl.	Litchi: *Litchi chinensis* Sonner

			
Bottlebrush: *Callistemon citrinus* (Curtis) Skeels	Neem; *Azadirachta indica* A.Juss.	Silkwood tree: *Bombex ceiba* L.	Chinaberry: *Melia azedarach* L.
			
Sal tree: *Shorea robusta* Guartn	Pogostemon: *Pogostemon glber* Benth	Drumstick: *Moringa oleifera* Lam	Wooly leucas: *Leucas lanata* Benth
			
Rapeseed: *Brassica campestris var toria* L	Eucalyptus: *Eucalyptus citriodora* Hook	Sisso: *Dalbergia sissoo* Roxb.	Epilepil: *Leucaena tricodes* (Jacq.) Benth

Figure 76: Bee flora for beekeeping, crop pollination, and honey production

Pollinated plants produce good quality fruits and high vigor seeds with good shape, size and attractive looking. Thus, the pollination is an important process in crop cultivation, production and biodiversity enrichment.

Pollination service in plants are obtained from pollinating insects, air, water, and gravity, etc. About 80% of the pollination of all plants, 75-85% is performed by insects, of which 80% of pollination is from bees. Hence, the bees are considered effective and reliable pollinator in the world. Their pollination services worth much more (20-120 times) than their valuable product honey. Farmers in the developed world are aware of the value of crop pollination, which contribute them quality products through bee colony rental pollination services.

The number of different species of pollinators are declining due to misuse of pesticides, destruction of jungle, forest fire, and change in farming system. In such a case, it is necessary to aware beekeepers on the importance of the domesticated bees for their conservation and pollination services. Because the honey bees are the best and reliable pollinators.

Table 17: Farmers benefiting from crop pollination

a. Fruit crops

SN	Crops	Increase (%)
1	Apple	18.00-69.50
2	Almond	50.00-75.00
3	Apricot	5.00-10.0
4	Cherries	56.00-1000
5	Citrus	7.00-223.00
6	Grapes	23.00-54.00
7	Guava	12.00-30.00
8	Litchi	453.00-10,246
9	Plums	536-1,655

b. Vegetable crops

SN	Crops	Increase (%)
1	Cole crops	100.00-300.00
2	Radish	22.00-100.00
3	Carrot	9.00-135.00
4	Turnip	100.00-125.00
5	Cucumber & squashes	21.00-6,700
6	Onion	353.00-9,878
7	Cabbage	100-300.00

c. Oilseed crops

SN	Oilseed crops	Increase (%)
1	Mustard	13.00-222.00
2	Safflower	4.00-114.00
3	Sunflower	21.00-3,400
4	Sesame	24.00-40.00
5	Niger	17.00-45.00
6	Linseed	2.0-49.00

d. Fodder crops

SN	Crops	Increase (%)
1	Alfalfa	23.00-19,733
2	Berseem	193.00-6,800
3	Clovers	40.00-33,150
4	Vetches	39.00-20,000
5	Birds foot	3.00-1000

e. Miscellaneous crops

SN	Miscellaneous crops	Increase (%)
1	Buckwheat	63.00-100.00
2	Coffee	17.00-39.00
3	Cotton	2.00-50.00
4	Field beans	7.00-90.00

6.5.3 Bees the best pollinators

Apis cerana L. and *A. mellifera* are domesticated bees. They kept in bee hives, and so they can be managed as per need of crop growers for pollination. The bees can work well in various climates (summer, winter) and geographical areas from terai to hills. They visit many flowers and pollinate them in a short period of time, due to their good foraging speed of the well-structured hairy body. Since the body of the bee has long body hairs, they carry many pollen grains which assures good pollination. Large number of worker bees are built up during flowering time, which confirm good coverage of large crop areas. They display consistency in foraging and are reliable pollinators till they find crop flowers. Disposition made up to a few days of memory (4-5 days) of pollinating crop flowers. Bees have well developed communications system and work in harmony in the same manner visiting different commodities. At the same time, worker bees are also heavy collector of honey and pollen which are beneficial to beekeepers. Therefore, bees are the best pollinators and reliable managed pollinating agents of various cultivated crops.

6.5.4 Managing bees for pollination

Strong healthy bee colonies with good colony performance are required for good pollination. For this, the queen should be highly prolific with good quality egg laying. It is also important to feed bees to build up their population and keep ready for effective pollination. The weather should be favorable for visiting flora.

The time and good practices of keeping healthy colonies, the bee foraging area and knowledge of available flora is equally important. Closer the bee colonies to the crop farming, more effective bee pollination and good quality of the produce (Table 18).

Table 18: Increase in quality by bee pollination

S.N.	Crops	Increased quality
1	Mustard	Increased in amount of oil
2	Citrus	Increase in amount of juice by 67.6%, Uniform size and increase in sweetness.
3	Peach, Plum	Increase in weight of fruit by 21.3%
4	Litchi	Increase in juice and sweetness
5	Tobacco	Increase in nicotine
6	Coffee	Increase in caffeine
7	Seeds	Increase in germination, storage, disease and insect resistance.

Sample questions for practice.

1. Write down the names of honey producing and wild bees commonly available in your locality.
2. Draw neat diagrams and label male and female flower parts.
3. Prepare a flowering calendar, estimate beekeeping and honey production potential.

Session 19

Wax processing and comb foundation preparation:

1. Learning objectives

By the end of the session, the participants will be able to:

- Elaborate the wax processing method.
- Process old honeycomb and wax.
- Elaborate the technique of comb foundation preparation.
- Prepare and use comb foundation.
- Safely store wax and comb foundation.

2. Sub topics

- Techniques of wax processing.
- Methods of comb foundation preparation.
- Steps of comb foundation preparation.
- Use and Storage of wax and comb foundation.

3. Methods and materials

3.1 Training methods

- Lecture
- Brainstorming
- Group discussion
- Practical exercise for wax processing, comb foundation preparation and use.

3.2 Training materials

- Projector, Power points, Slides, Pictures.
- Marker, Brown paper, Pen, Masking tape, Meta card
- Videos of wax processing and comb foundation preparation.

- Modern bee hive with colony.
- Wax processing and comb foundation preparing materials such as old wax, bucket, gas/heater, white muslin cloth, wooden stick, knife comb foundation preparing machine.

3.3 Time

Theory: 20 minutes

Practical: 2 hour 30 minutes

Discussion: 10 minutes

3.4 Place: Training hall, apiary, lab

4. Activities and exercise

4.1 Inform participants about the topics covered in the training and inquire about their level of knowledge on the subject matter.

4.2 Presentation

Give a short presentation on methods of wax processing, use of wax, preparation of comb foundation and its storage as outlined in the resource materials.

4.3 Group division/practical exercises.

Divide the participants into 4 groups and complete the following tasks during practical exercises.

1. Wax Processing.
2. Preparation of comb foundation.
3. Installation and use comb foundation.
4. Safe Storage of wax and comb foundation.

Take participants to Laboratory for practical exercise. Process old honey comb and wax to prepare new wax. Use newly processed wax to form comb foundation. Teach participants to install the comb foundation on frames.

4.4 Discussion

After returning from the laboratory make one person from each group to present about the activities that took place during the practical exercises. Use in depth discussion and question/answer to discover whether the participants have understood about wax processing, comb foundation preparation and installation.

5. Detail schedule

S.N.	Subject matter	Description	Time	Materials
1	Wax Processing, Use and Storage of Wax.	Make participants to write down what they know about the Wax Processing, Use and Storage of Wax and discuss about the session.	10 minutes	Marker Pen, Meta card.
2	Preparation, use and storage of comb foundation.	Elaborate and discuss about the preparation, use and storage of comb foundation.	10 minutes	Projector, Power point slides, Pictures, Videos.
3	Practical Exercise.	Divide participants in group and take to laboratory for processing of old wax and comb foundation preparation.	2 hours and 30 minutes	old wax, bucket, gas/ heater, white muslin cloth, wooden stick, knife comb foundation preparing machine.
4	Discussion		10 minutes	

6. Resource materials.

6.1 Wax processing.

Worker bees produce wax, 12-day-old worker bees can produce more wax, and wax production gradually decreases as the bees age. Beeswax from honey frames, combs collected during honey extraction from traditional hives, combs left by wild bees, combs obtained during wild bee honey extraction, combs from absconded hives, and old combs are the sources



Figure 77: wax melting

of wax production. The wax obtained from these sources are processed to prepare pure wax which can then be used to make comb foundation.

6.1.1 Method of wax processing.

- Make small pieces of old combs and soak 24 hours then remove the dirt particles.
- Pour the clean comb into wide pot, add water and put into gas/heater to melt the wax.
- Stir the wax continuously while melting it and place the melted wax in a clean cloth/muslin cloth and squeeze it out with the help of two wooden sticks.
- Remove the remaining waste wax from the jute sack or cloth after squeezing and place the filtered wax solution in a clean container and keep it indoors or in the shade for 24 hours.



Figure 78: Wax Pouring

- As the wax stored in this way hardens and forms a lump, scrape off any dirt or other debris







Figure 79: Wax Processing

- stuck to the base of the wax that has already formed a lump with a sharp knife.
- Place the prepared clean and dry wax block in a plastic bag, close the bag tightly, store it in a room, and use it to prepare comb foundation as needed.

6.1.2 Things to consider during wax processing.

- Since wax is acidic, copper, brass, zinc, or iron utensils should not be used when processing it.
- When processing wax, use a wide-mouthed vessel made of silver, steel, tin, or plastic.

- Do not heat the wax over high heat or allow it to boil.
- Allow the melted wax to cool on its own, as cooling it too quickly will cause it to break.
- Do not heat wax for too long, as it may change its smell and color.

6.2 Comb foundation.

The comb foundation is a predetermined structure made of wax and is a yellow, flexible and strong sheet made of wax. The comb foundation is installed in a brood frame/honey frame so that it fits into the groove of the top bar and is held in place with the help of wire. It has a hexagonal cell pattern printed on it. The comb foundation is made of pure beeswax according to the size of the honeycomb, and the bees build the cells on this to lay eggs or collect honey. This saves the time, effort, and energy of worker bees and increases honey production. Using a comb foundation makes it easier to extract honey by placing the frame in a honey harvester.

6.2.1 Use of comb foundation:

In some cases, honeybee makes different sized and that are not uniform. To avoid this situation, beekeepers should use a base circle in their hives.

Since the comb foundation is connected to the wire, it becomes stronger and easier to extract honey using a honey extractor. The comb does not break when extracting honey.

The use of a comb foundation further enhances the purity and quality of the honey produced.

The comb will not be damaged/broken during bee migration.

The hive inspection will be easier as worker make straight comb.

6.3 Methods of comb foundation preparation.

The comb foundation can be prepared by two methods.

6.3.1 Roller machine

Since the surface of the roller machine is made in a hexagonal cell pattern, it creates a comb foundation with the same pattern printed on it.

- First prepare wax sheet.
- Put prepared sheet in roller machine and roll using handle.



Figure 80: Roller Machine

- Hexagonal cell shape is printed on the wax sheet.
- Cut wax sheet in shape of frames.

6.3.2 Comb foundation press machine.

This machine consists of a metal frame with a handle that must be operated by the person making the comb foundation. The surface of the press machine is made in a hexagonal cell pattern. It is used as follows.



Figure 81: Foundation machine

- Wax is melted and poured over the machine.
- Press the top of the machine downwards with the help of the handle.
- After some time, the liquid wax cools and turns into a solid sheet.
- Due to pressure, the shape of a hexagonal cell is imprinted on the wax sheet.
- In this way, the comb foundation is prepared with the help of a press machine.

6.3.3 Installation and use of comb foundation.

- Take the frame and attach the comb foundation to the frame by placing it in the groove cut at the bottom of the top bar.
- Place the installed frame in middle of the colony.
- During the season of abundant nectar and pollen flow, two or more frames with comb foundation can be placed at the same time.

To make it easier for the bees to work, soak old comb foundation in warm water for a while, then place them in the shade before placing to hive

6.3.4 Storage of wax and comb foundation.

Wax and comb foundation can be stored at normal room temperature, but it is important to pay attention to its storage as it is susceptible to insect attacks such as wax moths, wax beetle, and mold problems. Therefore, it is important to pay attention to its storage. For this,

- To protect against damage by insects such as wax moths and wax beetle, do not store wax in open place.
- Storage place should be dry and cool.
- No chemical pesticides or other odorous chemicals should be kept in the storage room.

- It is better to keep the wax and comb foundation wrapped in old newspaper sheets instead of keeping them open.
- As time passes, the wax hardens and starts to break. If this happens, the wax can be re-melted and used.

Sample question for practice.

1. What kind of wax should be collected for processing and what attention should be paid to while processing the wax?
2. In what ways can a base wheel be made from processed wax?
3. How can a base wheel be connected to a square and used in a beehive?

Session 20

How to transfer bees from a traditional hive to a modern hive

1. Learning objectives

By the end of the session, the participants will be able to:

- Explain how to transfer bee colonies from a traditional to modern hive.
- Transfer bee colonies from a traditional to modern hive.

2. Sub topics

- Introduction
- Time and weather
- Preparation
- Method of transferring the hive
- Precautions to be taken
- Management after transferring bees in the hive

3. Methods and materials

1.1 Training methods

- Lecture/Presentation
- Brainstorming
- Group review/interaction
- Practice for practical knowledge

1.2 Training materials

- Projector, Power point slides, pictures
- Marker pens, brown paper, pens and masking tape, meta cards
- Apiculture Development Center publications, videos
- A traditional beehive with bee colony and an empty modern hive
- Materials for inspecting the hive
- Queen gate and feeder, strong cotton thread, sharp knife, scissors, etc.

1.3 Time

Theory: 20 minutes

Practical: 60 minutes

Discussion: 10 minutes

1.4 Place: Training hall, Apiary with log/mole hive

3. Activities and exercise

4.1 Provide participants with information on the topics covered in the training and obtain information about the participant's level of knowledge on the subject matter.

4.2 Presentation

Give short a presentation on the how to transfer the bee colony from traditional to modern beehive, methods and preparation for transferring the colony and precautions as outlined in the resource material.

4.3 Group division/practical exercise

Divide the participants into 4 groups and complete the following tasks during practical exercises.

- Have the group review and present the method of transferring bee colony from traditional hives to modern hives, the appropriate weather and time for moving beehives, the precautions to be taken when transferring colony, and the management of the beehives after transferring them.
- Practice transferring bee colony from traditional hive to modern one.

1.3 Discussion

After returning from the apiary, one person from each group will present the findings of the observations in a documented format. To obtain information on whether the participant can facilitate other participants in transferring colony from traditional hive to modern hive, whether the ability to transfer colony is clear, and to further review issues that are not yet clear.

5. Detail schedule

S.N.	Subject matter	Description	Time	Materials
1	Information on the method of transferring colonies from traditional hives to modern hives	Have the participants write down what they know about how to transfer bees from old hives to modern hives, and provide information about the appropriate weather and time for transferring the colonies, as well as pre-preparation, precautions, and post-transferring management.	20 minutes	Marker pens, meta cards, projector, power point slides, pictures, videos .
2	Practical practice of transferring colonies	Transferring colonies from traditional hives to modern hives and managing them after the transfer	60 minutes	Modern beehive, beehive with bees, sting sewing thread, knife, comb and beehive inspection materials
3	Discussion		10 minutes	

6. Resource materials

6.1 Introduction

More than 25 % of the total numbers of native bee colonies of the nation still rears in traditional log and mole hives in Nepal. Bees reared in the traditional way cannot increase income, are more prone to swarming, abandonment, and other bee problems and it is difficult to effectively monitor and properly manage the colonies. So, it seems necessary to shift bee colonies from traditional hives to modern hives to adopt modern beekeeping practices fot its commercialization.

6.2 Preparation for transferring bee colonies

a) Collect the necessary materials: a traditional bee hive or a bee hive with bees, a modern beehive, hive tool, a knife, thread (thread for weaving or sewing quilt or jute thread), a queen cage, a queen gate, a smoker, etc.

b) Arrangement of technicians: Keep an experienced bee technician and one assistant.

6.3 Points to consider while transferring bee colonies to modern hives

6.3.1 Before transferring the colony

- Condition of the colonies: Healthy and strong colonies, and have healthy broods, and have sufficient adult bees, broods, and food for the bees.
- Suitable weather: Warm, sunny, but not windy or rainy days.
- Suitable time: Afternoon.

6.3.2 During transferring the colony

- Use smoker properly at the time of colony transfer.
- Use of a bee veil and gloves mandatory
- Use a sharp long knife to cut the combs
- Remove the combs from the traditional hive
- Remove the top of the comb (honey existing portion) and be careful to save brood of the comb.
- Use a strong thread to tie the combs and, tie the brood comb tightly to the top bar of the frame.
- Tie the frames tightly with thread so that they do not overlap and remain within the frame shape.
- Place the brood frames and bees in a modern hive, make sure that there is no leakage of honey.
- Search for the queen and place her in a queen cage and place her in a modern hive, and remove her from the cage after transferring the colonies.
- Hide the old hive elsewhere and place a modern hive in that location and use a queen gate for 2-3 days.

6.3.3 After transferring the colony

The beekeeper should manage the hive as mentioned below.

- Use queen gate at the entrance of a modern hive for preventing the queen from escaping from the hive.
- Use dummy board if there are less than 8 frames bees in the hive.
- Clean the hive after 3 days of transferring the bee colonies and remove the unoccupied combs/frames too.
- Inspect the hive if the queen bees have laid eggs or not. But do not inspect unnecessarily.

6.4 Steps for colony transfer

Colony transfer should be completed in the shortest possible time. Otherwise bees become angry and interfere the work.



Figure 82a: Colony transfer

- Smoke lightly to the entrance of a traditional hive as shown in Figur 82a.
- Open slowly one of the lids (right or left side of the entrance) and smoke lightly in the hive) after opening the lid.
- Use a sharp knife to cut the combs and cut the combs carefully (do not fall or break) as shown in Figures 82b and 82c.



Figure 82b



Figure 82c

- Remove the honey parts from the combs and fit the combs in the frame of a modern hive carefully as shown in Figures 82d and 82e.
- Tie the combs with thread in two places so that the comb does not move and place the combs in the modern hive so that they do not touch each other as shown in Figure 82f.

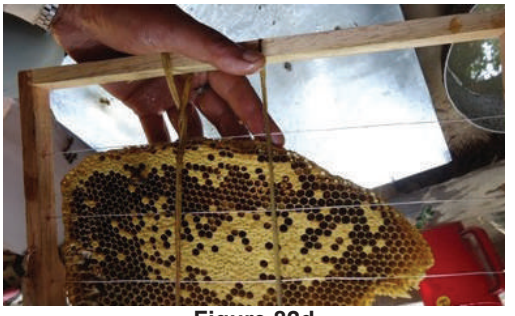


Figure 82d



Figure 82e

- Bees are shifting in the modern hive from the traditional hive slowly by hand. At this time check carefully whether the queen bee has come in contact with the bees or not.
- Finally, place the modern hive with bees in the same place as the traditional hive remained before.



Figure 82f

- Spread a sheet of paper or newspaper on the ground and knock out the remaining bees from the traditional hive after shifting the bees.
- Take the traditional hive elsewhere to hide it.
- Use the queen gate for 2-3 days to avoid the escaping of queen bee from the modern hive.

Sample questions for practice

1. What are the preparations and necessary materials to shift bee colonies from a traditional hive to a modern hive?

2. What should be considered when transferring the bee colonies in the modern hive?

3. How should the hive be managed after transferring it?

Session 21

Equipment and materials for quality queen production

1. Learning objectives

By the end of the session, the participants will be able to:

- Identify the different equipment and materials required for quality queen production.
- Know about the different standard of equipment.
- Use the queen production equipment.

2. Sub topics

- Identification and quality of equipment used in quality queen production.
- Usefulness and method of use.

3. Methods and materials

3.1 Training methods

- Lecture
- Brainstorming
- Group discussion
- Observation
- Practical Exercise

3.2 Training materials

- Projector, Power points, Slides, Pictures.
- Marker, Brown paper, Pen, Masking tape, Meta Card
- Equipment for quality queen production.

3.3 Time

Theory: 50 minutes

Practical: 30 minutes

Discussion: 10 minutes

3.4 Place: Training hall, Apiary, Place with equipment.

3. Activities and exercise

4.1Inform participants about the topics covered in the training and inquire about their level of knowledge on the subject matter.

4.2 Presentation

Give a short presentation on identification, quality standards and method of use of equipment as outlined in the resource materials.

4.3 Practical exercise.

After theoretical presentation take participants to a place where equipment is kept or bring the equipment to training hall for demonstration and identification. Explain their usefulness and method of use.

4.4 Discussion

Use in depth discussion and question/ answer to discover whether the participants can identify the equipment, explain their usefulness and method of use.

5. Detail schedule

S.N.	Subject matter	Description	Time	Materials
1	Introduction	Make participants to write down what they know about the equipment used in quality queen production.	5 minutes	Marker Pen, Meta card.
2	Presentation on equipment and their usefulness.	Discuss about the identification, quality standard, usefulness and method of use of every equipment.	45 minutes	Projector, Power point slides, Pictures, Videos.
3	Demonstration	Demonstrate each equipment to participants. Let them handle and try out different pieces of equipment while discussing among themselves.	30 minutes	➢ Equipment for quality queen production.
4	Discussion		10 minutes	

6.Resource materials.

6.1 Introduction

Quality queen production in beekeeping involves careful selection, rearing, and management techniques to ensure a strong, healthy, and productive queen bee. This process includes selecting a robust colony for grafting, using specialized hives for rearing, and ensuring proper mating of the queen. Quality queen production equipment typically includes items for rearing, such as queen rearing kits, grafting tools, queen cells, and queen cages. Other important items include queen excluders, nucleus colonies, and tools for marking and catching queens.

6.2 Equipment and materials used in quality queen production.

6.2.1 Burr comb

Burr comb, also known as bridge or brace comb, is honeycomb built by bees in areas of the hive where it's not intended, such as between frames or below inner cover. Since its smell is attractive and pleasant, such wax can be collected, processed, and stored. When required the wax can be indirectly heated to make queen cup required for quality queen production.



Figure 83: Burr Comb

6.2.2 Dipping rod

It is wooden stick used to make queen cup. Its surface is rounded and smoothed to create an artificial queen cup. When making cups, special attention should be paid to their height, as if they are too tall, worker bees will start biting. To make such cups, first place a small container of pure wax in a pot of hot water and melt it thoroughly then dip the wooden stick in cold water and squeeze out the excess water. Then straighten the stick and dip it in hot wax 3 times.



Figure 84: dipping rod

First time: 6-7 mm deep

Second time: 4-5 mm deep

Third time: 3-4 mm deep

After dipping it 3 times, take it out, soak it in cold water for a while, take it out, and gently twist the wax cup with your hands. These wax cups have a thin upper part and a thick lower part. In this way, several wax cups can be made and the same size can be selected, and as many cups as required can be attached to the grafting frame.

6.2.3 Artificial queen cup

Queen cups are small cup made from plastic or wax that are attached to grafting frame in order to place grafted larva**.**



Figure 85: Grafting frame

6.2.4 Grafting frame

This is of same size as the brood frame, but it has two bars that are nailed to either side with 1.5 cm nails so that it can be rotated around as needed.

6.2.5 Cup stick

Cup sticks are used to attach artificial queen cups to grafting frame. Both sides pointed small bamboo sticks with diameter 2 cm can be used as cup stick. First cup sticks are attached to grafting frame with the help of wax then artificial queen cups are attached above these cup sticks.



Figure 86: grafting needle

6.2.6 Grafting needle

Grafting needle is a tool designed to ensure minimum damage to larva during its transfer from mother colony to grafting frame. It has soft silicon-based tip that mimics the natural shape of the larva. It can be made of plastic or silver.

6.2.7 Queen cell protector

It is used to cover or protect queen cell in the grafting frame. After 8-9 days of grafting these queen cell protectors are capped outside the queen cell in order to prevent damage to another queen cell after emerging one queen.



Figure 87: Queen cell protector

6.2.8 Queen clip

In beekeeping, a queen clip is small spring-loaded metal or plastic clamshell-shaped clip designed to pick up or contain a queen bee. It has slits in its sides that worker bees can pass through to attend to queen's needs or to receive queen substance, but the queen bee cannot pass through it.



Figure 88: Queen clip

6.2.9 Queen cage

A small mesh container used when transporting queen bees or introducing new queen bees into a hive without queen bee. A beehive can be transported for short distances by placing a beehive, 4-5 worker bees, and some honey in a cotton bag in a beehive cage.



Figure 89: Queen cage

When introducing a new queen into a beehive without queen cells, this cage is placed between two squares in the middle of the brood chamber. After the worker bees accept the new queen, the queen is taken out of the queen cage and released into the beehive

6.2.10 Nicot queen rearing set

This queen rearing set is used in the non-grafting technique of healthy queen production. It is plastic box that can hold up to 120 queen cups. It is secured in middle of the brood frame. Queen is picked up with the help of queen clipper and placed inside this box. Then the box is placed inside hive and the queen is forced to lay eggs inside this box. Worker bees can go inside the box and feed queen bee but queen cannot come out of this box. Once queen lay eggs on the queen cups, the cups can be transferred to grafting frame and given to nursery hive for queen rearing.



Figure 90: Nicot queen rearing set

6.2.11 Magnifying glass

Magnifying glass can be used for easy recognition of 1-day old larva. It has light on front portion and put on the head of the person doing grafting.

6.2.12 Mating hive

It is used to rear queen cell or virgin queen until it gets mated by the drone bees. It contains a hive with young worker bees and brood. Artificially produced queens are placed in the mating hive 1-2 days before they emerge from the queen cell. After the queen is born, the bees in the hive take care of the queen, and a few days after the queen emerges, she mates with the drone and begins laying eggs. Once she starts laying eggs well, the queen can be sold or moved to another hive to be used.

1.1.13 Queen marking pen

These pens are used to mark queen in order to locate them inside hive and easy identification during hive inspection.

6.2.14 Incubators



Figure 91: Incubators

After successful grafting worker start to feed the grafted larvae and build queen cell around the larva. The grafted cells mature almost at the same time and if we do not have sufficient nucleus hives or mating hives, after emergence of one queen other queen cells can be damaged. In such condition incubators can be used to rear the mature queen cell before emergence of new queen. All the queen cells are kept inside queen cell protector and placed to incubator. The incubator provides 34 + 1 C and 50% relative humidity which is ideal for queen emergence.

6.2.15 Mother colony

These are the colonies from which one day old larvae are selected and grafted. These colonies must be healthy, highly productive, resistant to disease, less aggressive and genetically pure.

6.2.16 Nursery colony.

These are the queen less colonies used to rear the grafted larvae.

Sample questions for practice.

1. How artificial queen cups are made by using wax?
2. What is the use of mating hive?
3. What are the qualities of mother colony?

Session 22

Selecting mother colonies for artificial queen production

1. Learning objectives

By the end of the session, the participants will be able to:

- Describe how to select effective mother colonies for artificial queen rearing in the apiary.
- Apply the different techniques for testing hygienic behavioral/ characters of the bee colonies found in the apiary.

2. Sub topics

- Introduction
- Need of mother colonies selection
- Materials required for hygienic behavioral test
- Procedure of test
- Finding

3. Methods and materials

1.1 Training methods

- Discourse/Presentation
- Brainstorming
- Group review
- Practical exercises
- Review and Q&A

1.2 Training materials

- Projector, Power Point slides, pictures, videos
- Marker pens, brown paper, pens and masking tape, meta cards
- Beehives
- Hive inspection materials

- Tissue paper, sharp pin, liquid nitrogen, sharp knife, Refrigerator, Record file etc

1.3 Time

Theory: 20 minutes

Practical: 60 minutes

Discussion: 10 minutes

1.4 Place: Training hall, Apiary, Laboratory

4. Activities and exercise

4.1 Provide participants with information on the topics covered in the training and obtain information about the participants' level of knowledge on the subject matter.

4.2 **Presentation**

Give short presentation on the importance and need for mother colonies selection, materials required, and methods for testing the hygienic behavior of the existing colonies of the apiary as outlined in the resource materials.

4.3 Group division/practical exercise

Divide participants into 4 groups and take them to apiary. Demonstrate each group how to do paper and pining test. Make them do these tests by assigning two hives for each group. If possible show them liquid nitrogen and freezer method.

4.4 Discussion

After returning from apiary provide participants 5 minutes of review time and ask each group to make a 1-minute presentation. Review if there are any points that have not been covered in the participants' presentation. Review and ask questions to clarify any additional questions the participants may have.

5. Detail schedule

S.N.	Subject matter	Description	Time	Materials
1	The importance and need of mother colonies selection	Ask participants to write down what they know about mother colonies selection for artificial queen rearing.	10 minutes	Marker pen, Meta card.

S.N.	Subject matter	Description	Time	Materials
2	The materials required for hygienic behavior test of colonies in the apiary	Enlist the materials and its preparation	10 minutes	Projector, Power point slides, Pictures, Videos.
3	Practical Exercise	Take participants to apiary in groups and assign 2 hives per group to apply hygienic behavior test.	60 minutes	Tissue paper, pin, sharp knife, 3-inch diameter pipe, fridge
4	Discussion		10 minutes	

6. Resource materials

6.1 Introduction

Hygienic behavior is a genetic trait of the honey bees. It is the combined behavior of individuals within the bee societies that determine the survival and development of the colony. In honey bees, individual behaviors include nest building, foraging, storing and ripening food, nursing the broods, temperature regulation, hygiene and defense. It is main defense against various brood diseases and mites.

6.1.1 Significance of hygienic behavior test

- Maintain the genetic traits of bees or to improve their lineage.
- Genetic improvement, research or modification of bee species.
- Increase the quality of production

6.1.2 Traits of hygienic mother colonies

- Ability to produce and increase the productivity of honey and bee products.
- Ability to fight or tolerate diseases and parasites (Higher immunity power).
- Less aggressive or calm nature.
- Good wax production capacity and proper skill in using wax.
- Ability to survive under adverse weather conditions.
- Racial purity.

- In addition, worker bees are selected based on the color of their abdomen, tongue length, body length, wing span, and body hair length.

6.2 Hygienic behavior test methods

6.2.1 Paper method

- Place the tissue paper on top bar of the brood chamber of the bee hive.
- Observe the tissue paper after 24 hours that you put inside the hive.
- Calculate how much percentage of the paper has been removed by the worker bees.
- If the bee hive that has been cleaned of the paper in higher percentage is considered as healthy and strong colony and this colony can be selected as mother colony for queen production.



Figure 92: Hygienic behavior test by using paper method

1.1.2 Pinning method

- Select the sealed brood cells from a hive.
- Pierce 20-25 pupal cells with a needle that you selected one.
- Make a marking the part pierced cells with the marker pen.
- Keep the pierced cells frame in the hive for 24 hours.
- Observe the sealed brood cells after 24 hours that you make pierce on it.
- Calculate the percentage of the cells that worker bees have been cleaned.
- A colony that has a high percentage of cell cleaning will be excellent for selecting mother colonies.

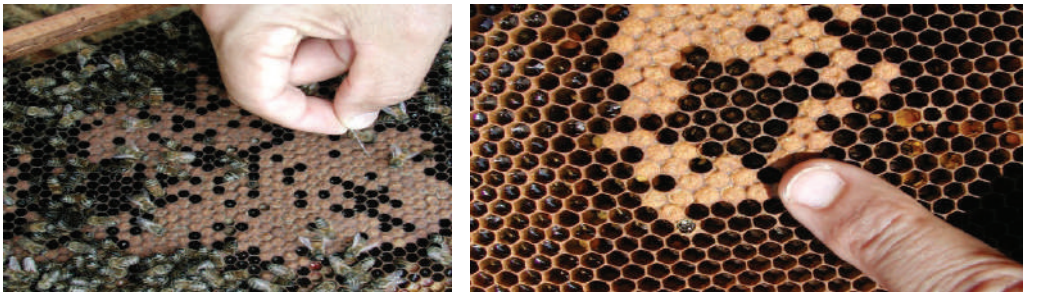


Figure 93: Hygienic behavior test by using pinning method

1.1.3 LNKB (Liquid nitrogen killed brood) test

- Take a sealed brood frame from the strong and hygienic colonies of the apiary
- Place a pipe over the comb and pour Liquid Nitrogen on it.
- Leave the comb in the hive for 24 hours.
- Observe what percentage of the cells are cleaned after 24 hours.
- Record the number of cells that cleaned by worker bees in the hive.
- A colony that has a high percentage of cell cleaning will be excellent for selecting mother colonies.



Figure 94: Hygienic behavior test by using liquid nitrogen method

1.1.4 FKB (Freezer killed brood) test

- Cut the sealed brood comb from strong colony into a piece of square shape, containing 100 cells.
- Place the cut piece of comb in a freezer at -10° F for 24 to 48 hours.
- Fit the piece back into the original comb frame.
- Place it in the hive for 24 hours.
- Observe the comb in the hive after 24 hours.
- Calculate the number of cleaned cells.
- A colony that has a high percentage of cell cleaning will be excellent for selecting mother colonies

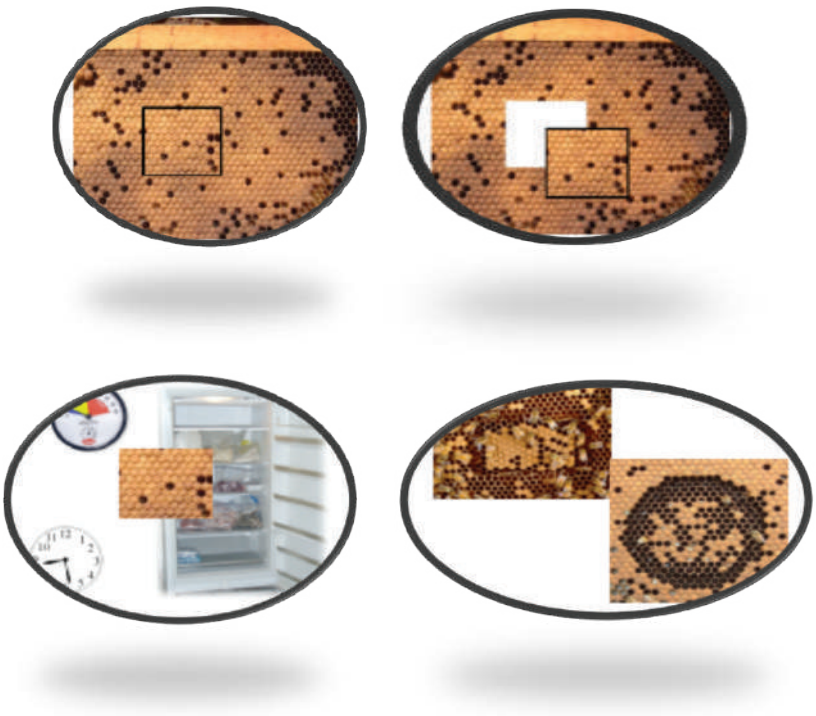


Figure 95: Hygienic behavior test by using the freezer method

Sample questions for practice.

1. Explain the importance and need of mother colonies' selection while rearing an artificial queen in the apiary.
2. Mention the material required for mother colonies selection.
3. Describe the different methods of hygienic behavior test of bee colonies in the apiary.

Session 23

Production of day-1 larvae and their selection method

1. Learning objectives

By the end of the session, the participants will be able to:

- Explain the procedure of day-1 larvae production techniques for rearing the artificial queen in the apiary.
- Describe the criteria of larvae selection for grafting.
- Select day-1 larvae for grafting in order to prepare queens artificially.

2. Sub topics

- Introduction
- Day-1 larvae production
- Required materials
- Method

3. Methods and materials

1.1 Training methods

- Lecture
- Brainstorming
- Group discussion/Interaction
- Practical exercise

1.2 Training materials

- Projector, Power points, Slides, Pictures, Videos.
- Marker, Brown paper, Pen, Masking tape, Meta-card
- Mother colonies, old frame, Sugar syrup, Hand sprayer
- Hive inspection materials and tools

1.3 Time

Theory: 20 minutes
Practical: 60 minutes
Discussion: 10 minutes

1.4 Place: Training hall, apiary and Lab

3. Activities and exercise

3.1 Inform participants about the topics covered in the training and inquire about their level of knowledge on the subject matter.

3.2 Presentation

Give short presentation on introduction, day-1 larvae production method and required materials as outlined in the source material.

3.3 Group division/practical exercise

Divide the participants into 4 groups, take to apiary and complete the following tasks during practical exercises.

1. Selection of mother colony.
2. Put old comb empty frame in the middle of brood chamber in the hive. Before using this frame, it should spray with sugar solution slightly.
3. Mark the inserted old comb frame.
4. Watch the marked frame after 4-5 days to notice one day old larvae.

Then provide information about the introduction and production method of day-1 larvae for grafting and provide materials for each group for doing practical exercise in the apiary.

4.4 Discussion

To obtain information on whether the participant is clear about how to facilitate other participants about day-1 larvae production in the apiary and to further review any unclear topics.

4. Detail schedule

S.N.	Subject matter	Description	Time	Materials
	Introduction and Importance	Ask participants to write down what they know about the one-day larvae production techniques.	10 minutes	Marker pen, Meta card.
2	Materials required for 1day larvae rearing	Enlist the material required	10 minutes	Projector, Power point slides, Pictures, Videos.

S.N.	Subject matter	Description	Time	Materials
3	Practical exercise	Divide participants into four groups and take to apiary. Demonstrate them how to select or produce one day old larva for	60 minutes	Old comb, sugar syrup, mother colonies, hive inspection tools
4	Discussion		10 minutes.	

6. Resource materials

1.1. Introduction

Day-1 larvae production is a crucial activity for artificial queen production. It is the technique in which a beekeeper produces queen from selected mother colonies at his choice. Although it is said that queen is produced artificially, the nurse bees themselves feed royal jelly and make warm the grafted brood in the hive.

1.2 Material required

- Strong and hygienic mother colonies
- Old frame with comb
- Hive inspection materials
- Sugar syrup
- Hand sprayer

1.3 Method for preparing day-1 old larvae

- Place the sealed brood comb at the side end of the brood chamber for preparing old frame.
- Place the old frame in the middle of the brood chamber of the selected mother colonies.
- Spray sugar syrup on the comb slightly, before placing the frame in the colonies. It helps the worker bees to clean the cells immediately and the queen starts to lay eggs.
- Inspect the hive to see queen activities whether the queen has laid eggs or not.

- Experienced beekeepers can identify 1-2-day old larvae and can directly graft 1-2-day old larvae from selected brood without performing the above-mentioned steps.
- Feed sugar syrup 2 days before grafting that makes us easier to graft because the worker bees will feed the young larvae abundantly.



Figure-96: Day-1 larvae grafting

- Take the larvae from different healthy colonies, not from the same colony to minimize inbreeding in bees.

6.4 Selection of larvae for grafting

- Select the larvae for grafting that have aged 12 to 18 hours.
- Select the larvae as young as possible for grafting.
- According to Weiss, the age of larvae is 24 to 36 hours, are considered best in case of *A. melifera*.

The relationship between the age at which larvae are selected and the queen that emerges from them has been found to be as follows.

Table 19: Relationship between age of laruae and queen in graffing technique.

Age of larvae (hour)	3	12	24	36	48	60	72
Weight of unmated queen (mg)	165	162	162	150	142	132	121

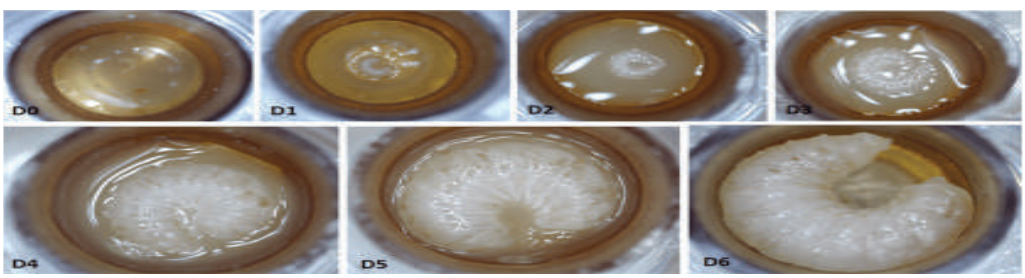


Figure 97: Different size of larvae by age

Sample questions for practice.

1. What are the importance and need of day-1 larvae production while rearing artificial queen in the apiary?
2. Mention the materials required for day-1 larvae production.
3. Describe the methods of day-1 larvae production.

Session 24

Queen bee production through grafting (Doolittle method)

1. Learning objectives.

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

- Explain the principles and importance of queen bee production.
- Identify the necessary materials and tools for queen grafting using the Doolittle method.
- Demonstrate the correct technique for transferring young larvae into queen cups.
- Understand the subsequent steps involved in raising grafted queen cells.
- Appreciate the practical considerations for successful queen rearing in the local context.

2. Sub topics.

- Introduction of Doolittle method.
- Materials and tools for queen grafting.
- Queen grating procedure
- Post- grafting management.

3. Methods and materials

3.1 Training methods

- Lecture
- Brainstorming/experimentation
- Group discussion
- Visit to lab and apiaries
- Practical exercise

3.2 Training materials

- Projector, power point slides, pictures, videos
- Marker pen, brown paper, pen and masking tape, meta card

- Live honeybee colony with young larvae (1-2 days old): Select a healthy, productive colony with desirable traits as the source of larvae.
- Queen cups: Plastic or wax queen cups (provide both, if possible, for comparison).
- Cell bar frames: Frames designed to hold queen cups.
- Grafting tool: Stainless steel grafting tool or plastic tools
- Magnifying glass or Head-mounted magnifier: To aid in selecting young larvae.
- Royal jelly (optional but beneficial for practice): Fresh or preserved royal jelly diluted with distilled water.
- Water spray bottle: To keep larvae moist.
- Small container with water: For rinsing the grafting tool.
- Paper towels: For drying hands and tools.
- Nucleus hive or queen less colony: Prepared to receive the grafted larvae (demonstration purposes).
- Smoker and fuel: For calming bees.
- Bee brush: For gently moving bees.
- Protective gear: Bee suits, veils, and gloves for participants and instructor.

3.3 Time

Theory: 20 minutes

Practical: 60 minutes

Discussion: 10 minutes

1.5 Place: Training hall, bee farm, laboratory

4. Activities and exercises

4.1 Inform the participants about the lecture/practical exercises included in the training and obtain information about the level of knowledge of the participants on the subject.

4.2 Presentation

Give short presentation on the on introduction to Doolittle method, materials and tools needed for grafting, queen grafting procedure and post-grafting management of queen cell as outlines in the resource materials.

4.3 Group division/practical exercises

Divide the participants into 4 groups and complete the following tasks during the practical exercises.

1. Identify major tools needed for queen grafting
2. Transfer larvae from mother colony to grafting frame
3. Put grafted frame in nursery colony and remove emergency queen cell.

Take participants to the lab and demonstrate the major queen grafting tools and make them prepare grafting frame. Guide them to stick queen cups in grafting frame then take them to apiary and select day-1 old larva from mother colony and graft those larvae into earlier prepared grafting frame. Put grafted frame in nursery hive and remove emergency queen cells.

4.4 Discussion

After returning from the lab and bee farm, organize group presentation to present the results of their observations. Ask participants about grafting techniques, things to consider during and after grafting, queen cell making process to find out whether they are clear about the session.

5. Detail schedule

S.N.	Subject matter	Description	Time	Materials
1	Introduction	Ask participants to write down key information on queen grafting	5 minutes	Marker, pen, meta card
2	Materials and tools for queen grafting	Discuss with participants about the materials needed for queen grafting specially focused on queen cups, cup sticks and grafting frame	5 minutes	Projector, PPT slides, photo, video
3	Queen grafting procedure.	Briefly discuss about selection of 1-day old larva, things to consider during larva transfer and management of nursery hive after grafting.	10 minutes	Projector, PPT slides, videos

S.N.	Subject matter	Description	Time	Materials
4	Practical Exercise	Take participants to the lab and demonstrate the major queen grafting tools and make them prepare grafting frame. Guide them to stick queen cups in grafting frame then take them to apiary and select 1day old larva from mother colony and graft those larvae into earlier prepared grafting frame. Put grafted frame in nursery hive and remove emergency queen cells.	60 minutes	Live honeybee colony with (day-1) old young larvae Magnifying Glass or Head-Mounted Magnifier Grafting frame Wax Grafting needle Moist towel
5	Discussion		10 minutes	

6.Resource materials

6.1 Introduction

Queen rearing is the process of producing queen bees in a controlled manner for the purpose of maintaining healthy colonies, increasing honey production, or expanding your apiary. The larvae grafting method is one of the most commonly used techniques for queen production. It is the process of transferring young larvae from worker cells to artificial queen cell cups to be raised into queen bees This method allows beekeepers to select larvae of the desired age and rear them into queens.

The **Doolittle grafting method**, a variation of larvae grafting, is often used to rear queens from larvae that are less than 24 hours old.

6.2 Understanding queen rearing

The importance of queen rearing:

- Genetic improvement: Allows for the selection of desired traits such as disease resistance, high honey production, and calmness.
- Replacement of weak queens: Ensures strong, productive colonies.
- Expansion of colonies: Supports beekeepers who want to grow their operation.

6.3 Larvae grafting method

The larvae grafting method involves transferring young larvae (less than 24 hours old) from a brood frame into specially prepared queen cups, where they will be reared into queen bees. These grafted larvae are then placed into a queen less colony or nucleus (nuc), which will raise them as queens.

6.4 Essential tools and materials

- **Grafting frame:** A frame with movable middle bars
- **Grafting needle:** A small, fine-tipped tool used to carefully pick up larvae.
- **Queen cups:** Special cups designed to hold the larvae in position as they develop into queens.
- **Grafting tray**: A tray that holds the queen cups and larvae.
- **Magnifying glass or light source:** To help see small larvae clearly.
- **Honeybee brood frame:** A frame containing young larvae that are less than 24 hours old.
- **Queenless colony (nuc):** A colony without a queen that will raise the grafted larvae into queens.
- **Water or honey**: To lubricate the grafting tool to prevent larval damage.
- **Hive tools:** To remove frames and inspect the hive.



Figure 98a: Queen cup sets



Figure 98b: Queen cup sets

6.5 Step-by-step guide to the grafting method

Step 1: Prepare the necessary tools

- Clean and prepare your grafting tools: Make sure the grafting tool is clean and free of debris.
- Lubricate the grafting tool: Dip the tool into water or honey to help it pick up the delicate larvae without causing damage.



Figure 99: Larava grafting

Step 2: Identify suitable larvae

- Locate a healthy brood frame: Choose a frame that has larvae that are less than 24 hours old (these larvae should be pearly white and curled at the bottom of the cell).
- Inspect for larvae in the correct age range: Larvae that are younger than 24 hours' old are the ideal for grafting, as they have not yet been fed royal jelly and are highly receptive to queen rearing.

Step 3: Graft the larvae

- Select larvae: Using the grafting tool, carefully select 24-hour old larvae.
- Transfer larvae into queen cups: Gently scoop the larvae onto the grafting tool, ensuring that you do not damage the delicate larvae. Transfer the larvae into the queen cups, ensuring the larvae is positioned at the bottom of the cup. Careful practice and gentle movements is necessary to avoid harm to the larvae, as it can be easily damaged.

Step 4: Place the grafted cups in the queen less colony

- Prepare the queen less colony: Ensure that the colony is queen less and has plenty of worker bees, brood, and stores (pollen and honey) to support queen development.
- Insert the grafting frame containing queen cups: Place the grafting frame into the queen less colony or nucleus hives. The worker bees will begin to feed the larvae royal jelly and raise them into queen bees. The absence of a queen stimulates the worker bees to raise queens from the grafted larvae.
- Ensure correct conditions: The queen cups should be placed in a warm environment with a consistent temperature (around 34°C or 93°F). Ensure that the humidity is high enough to prevent the larvae from drying out.

6.6. Monitoring the queen cells

- Check after 3-5 days: Regularly monitor the grafted larvae to check if they are being fed royal jelly and progressing towards queen cell formation. Successful queen cells will have larvae fed with royal jelly and will begin to develop into queen cells.
- Inspect for healthy development: After 5 days, the larvae should be sealed in their queen cups. These sealed cells will soon develop into fully formed queen bees.



Figure 100: Grafted queen cells ready for emerging virgin queens

6.7 Harvesting and mating the queens

- Harvest the queen cells: When the queen cells are capped, carefully remove them from the colony and place them in a mating hives or queen mating station.
- Queen mating: The queens will need to mate with drones in order to become fertile. This can take place in a mating apiary or a well-established drone population.
- Monitor the mated queens: After mating, you can introduce the queens back into their respective hives to start laying eggs.

6.8 Troubleshooting common issues

- Larvae rejection: If the larvae are not accepted by the colony, it could be due to improper timing (larvae too old or too young), poor colony health, or insufficient worker bees.
- Poor development: If the queen cells are not developing properly, check the environmental conditions (temperature, humidity) and ensure there is adequate food for the bees.
- Worker bees not feeding royal jelly: If the larvae are not being fed properly, the queen less colony may not be strong enough or have the right conditions to raise queens. Ensure that the colony is strong and healthy.

6.9 Tips for Success

- Work in a calm, controlled manner: Grafting requires patience and steady hands. Avoid rushing the process to minimize stress on the larvae.
- Use young larvae: The younger the larvae (within 24 hours), the better the chance for success.
- Maintain a stable environment: Ensure that the queen less colony is warm, has proper ventilation, and sufficient bees to care for the grafted larvae.

6.10 Conclusion

The larvae grafting method is a reliable technique for producing high-quality queens. It requires practice, patience, and attention, but it offers beekeepers a way to raise queens on demand. By following the steps outlined in this handout, you will be able to effectively graft larvae and rear queen bees for colony management, genetic improvement, and increased honey production. Larval grafting using the Doolittle method is a valuable skill for any beekeeper aiming for greater control over their apiary. By understanding the principles, mastering the technique, and considering the specific conditions in ADC Godawari, Nepal. We can successfully raise high-quality queen bees and contribute to the health and productivity of our honeybee colonies. Remember that practice and patience are key to becoming a proficient queen breeder.

Sample questions for practice.

1. What are the tools and materials needed for queen grafting?
2. Describe the steps of queen grafting.
3. Explain the things to be considered during larva grafting.

Session 25

Feeding management for newly emerged queen bees

1. Learning objectives.

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

- Understand the critical role of proper feeding in the development and mating success of newly emerged queen bees.
- Identify the appropriate types and methods of feeding virgin queens.
- Demonstrate practical techniques for feeding queens in different management systems (nucleus hives, mating nucs, queen banks).
- Understand the importance of timing and consistency in feeding.
- Recognize signs of inadequate feeding and implement corrective measures.
- Adapt feeding strategies to the local context and available resources in Nepal.

2. Sub topics.

- Introduction and importance of post emergence-feeding.
- Types of feed and feeding methods for virgin-queens.
- Feeding queens.
- Timing, consistence and troubleshooting in feed management.

3. Methods and materials

3.1 Training methods

- Lecture
- Brainstorming/experimentation
- Group discussion
- Practical exercise.

3.2 Training materials

- Projector, power point slides, pictures, videos
- Marker pen, brown paper, pen and masking tape, meta card

- Newly emerged virgin queen bees (in various stages of management):
  - Queens in small nucleus hives (mating nucs).
  - Queens in queen banks (if applicable).
  - Queens in individual queen cages (for demonstration).
- Sugar Syrup: Prepared in different concentrations (e.g., 1:1 for stimulation, slightly thicker for sustenance). Ensure the water used is clean.
- Protein supplement (Pollen substitute): Prepared pollen patties or dry pollen substitute.
- Queen Cages: For holding queens for a certain period of time.
- Mini feeders: Small entrance feeders, frame feeders, or specialized queen cage feeders.
- Small sponges or Cotton balls: For placing sugar syrup inside queen cages.
- Small containers/Lids: For offering protein supplement.
- Water source: Small dishes with pebbles or sponges to prevent drowning.
- Smoker and fuel: For calming bees during hive manipulation.
- Bee brush: For gently moving bees.
- Protective gear: Bee suits, veils, and gloves for participants and instructor.

3.3 Time

Theory: 20 minutes

Practical: 60 minutes

Discussion: 10 minutes

3.4 Place: Training hall, bee farm, laboratory

4. Activities and exercises

4.1 Inform the participants about the lecture/practical exercises included in the training and obtain information about the level of knowledge of the participants on the subject.

4.2 Presentation

Give short presentation on importance of post emergence-feeding, types of feed and feeding methods for virgin-queens, feeding queens and timing, consistence and troubleshooting in feed management as outlines in the resource materials.

4.3 Practical exercises

After theoretical session take participants to the lab to prepare feed for queen bees and then take to apiary to apply different methods of feeding to virgin queen. Demonstrate each method by practically doing them.

4.4 Discussion

After returning from the lab and apiary, select one leader to summarize the session both theory and practical then organize in depth discussion to know the level of their understanding.

5. Detail schedule

S.N.	Subject matter	Description	Time	Materials
1	Introduction & Importance of post-emergence feeding	Explain the nutritional need of virgin queen and negative effect of nutritional deficiency in overall development and egg laying.	10 minutes	Projector, PPT slides, photo, video
2	Timing, Consistency, and Troubleshooting in feed management	➢ Discuss on lethargic or weak queens, reduced activity in the nucleus hive, lack of interest in feeding. ➢ Discussion troubleshooting why dry fed, mold growth, robbing, pest attraction. ➢ Discuss the availability and quality of sugar and pollen sources	10 minutes	Projector, PPT slides, photo, video
3	Practical exercise			
		➢ Explain the use of different sugar syrup for stimulating colony activity and queen development, slightly richer ratios for sustained feeding). ➢ Demonstrate how to use and fill small entrance feeders for nucleus hives.	30 minutes	Feeding equipment Queen Cages, Mini Feeders: Small entrance feeders, frame

3.1	Types of feed and feeding methods for virgin queens	➢ Show how these frame feeders queen cage, feeders sponges/cotton balls and pollen patties in cages can be used in larger mating nucleus or queen banks.		feeders, or specialized queen cage feeders, small Sponges or Cotton Balls and small pollen Patties:
3.2	Feeding queens	➢ Show participants how to prepare sugar syrup and pollen patties and safely introduce them to the nucleus hives. ➢ Demonstrate how to place sugar syrup-soaked sponge /cotton balls and small amounts of pollen substitute inside queen cages; Emphasize the importance of regularly checking and replenishing feed in queen banks. ➢ Show how to provide a small source of water within the cage if the queen will be held for an extended period.	30 minutes	Feeding equipment Queen Cages: Mini Feeders: Small entrance feeders, frame feeders, or specialized queen cage feeders, small Sponges or Cotton Balls and small pollen Patties:
7	Discussion		10 minutes	

6. Resource materials.

6.1 Introduction:

Following successful queen grafting and emergence, proper feeding is crucial for the development, ovary maturation, and successful mating of virgin queen bees. This handout outlines the essential types of feeds and effective feeding management strategies for newly emerged queens in various beekeeping systems. Ensuring adequate nutrition during this critical period significantly impacts the queen's future productivity and longevity.

6.2 Why proper feeding after emergence is vital:

- Ovary development: Newly emerged queens require ample nutrition, particularly protein, for the full development of their ovaries, which is essential for egg-laying capacity.
- Pheromone production: Adequate feeding supports the production of queen pheromones, which are vital for attracting drones during mating flights and maintaining colony cohesion later.
- Energy reserves: Sufficient carbohydrate intake (sugar) provides the energy needed for flight, including crucial mating flights.
- Overall health and vigor: Well-nourished queens are generally stronger, more resilient, and have a higher chance of successful mating and a longer productive lifespan.

Critical needs of virgin queens:

- Energy for mating flights (up to 2 km/day).
- Pheromone production to establish colony cohesion.

Consequences of poor feeding:

- Weak queens, failed mating, premature supersedure of colony collapse.

1.3 Types of feed for virgin queen bees:

6.3.1 Sugar syrup (Carbohydrate source):

- Purpose: Provides energy for the queen's metabolic processes and flight.
- Concentrations:
  - 1:1 Sugar to water (by volume): Primarily used for stimulating colony activity and general feeding. Can be suitable for newly emerged queens, especially in mating nucs with attendant bees.
  - Slightly richer mixtures (e.g., 2:1 Sugar to Water): Can provide a more concentrated energy source, particularly useful when queens are held in cages or queen banks with limited access to natural forage.
- Preparation: Use clean water and granulated sugar. Ensure the sugar is fully dissolved.

1.1.2 Protein supplement (Pollen substitute):

- Purpose: Provides essential amino acids, fats, vitamins, and minerals crucial for ovary development and overall physiological health.

- Forms Available in Nepal:
  - Pollen patties: Commercially available or homemade mixtures containing pollen substitute (soy flour, brewer's yeast, etc.) mixed with sugar syrup.
  - Dry pollen substitute: Powdered form that can be offered dry or mixed with syrup.
- Importance: Especially critical when natural pollen sources are scarce or unavailable.

6.3.3 Water:

- Purpose: Essential for all biological processes, including hydration and temperature regulation.
- Provision: Ensure a clean and accessible water source is always available, especially in warmer weather.

6.4 Feeding methods for virgin queens:

The feeding method will depend on how the virgin queen is being managed:

6.4.1 In small nucleus hives (Mating nucs):

- Mini entrance feeders: Small, inverted jar feeders placed at the hive entrance. Easy to use for providing sugar syrup. Ensure a tight seal to prevent robbing.
- Frame feeders (Division board feeders): Placed inside the hive body, these feeders can hold larger quantities of sugar syrup. Suitable for slightly larger mating nucs.
- Small pollen patties: Place a small piece of pollen patty directly on the top bars of the frames, within reach of the bees and the queen.
- Open feeding (Sugar syrup - Use with caution): In situations with many colonies, a communal feeder can be used, but this can attract pests and encourage robbing if not managed carefully. Not generally recommended for small mating nucs.
- Water source: Provide a small dish of water near the hives, especially during dry periods.

6.4.2 In queen cages (Holding or introduction):

- Sugar syrup in sponge /Cotton balls: Saturate a small, clean sponge or cotton ball with sugar syrup and place it inside the queen cage. This provides a readily accessible food source for the queen and attendant bees. Replenish daily or as needed.

- Candy plug (for Introduction cages): While primarily for slow release, the candy plug also serves as a food source during the introduction period.
- Small amount of pollen substitute: A tiny pinch of pollen substitute can be placed inside the cage if the queen is to be held for an extended period. Avoid overfilling, as it can become dry and inaccessible.
- Specialized queen cage feeders: Small, commercially available feeders that attach directly to queen cages.

6.4.3 In queen banks (If applicable):

- Communal sugar syrup feeders: Larger feeders placed within the queen bank hive, accessible to all caged queens.
- Pollen substitute trays or feeders: Provide pollen substitute in small trays or dedicated feeders within the queen bank. Ensure it remains accessible and doesn't dry out excessively.
- Water source: A small dish with pebbles or a sponge can provide a safe water source within the queen bank.

6.5 Types of feeding method and pros and con

Table 20: Feeding method and pros and cons

Feeder Type	Best For	Pros	Cons
Frame feeder	Mating nucs/small colonies	Safe, internal, reduces robbing	Takes up brood space
Entrance feeder	Quick access in warm weather	Easy to refill	Attracts robbers, risk of drowning
Division board	Large colonies	High capacity	Complex installation
Queen cage plug	Introducing caged queens	Direct feeding during transit	Short-term use only

6.6 Timing and consistency of feeding:

- Immediately after emergence: Begin feeding as soon as the queen emerges, whether she is in a mating nuc or being held in a cage.
- Consistent supply: Ensure a continuous supply of both carbohydrate and protein sources, especially during the pre-mating period.
- Regular checks: Monitor feed levels regularly (at least every few days) and replenish as needed.
- Pre-mating flight readiness: Ensure queens have ample energy reserves (sugar syrup) before they embark on their mating flights (typically 5-10 days after emergence).

- Post-mating: Continue providing adequate feed even after the queen begins laying to support her egg production and overall health.

Timing and schedule

- Pre-emergence (3–5 Days Before): Ensure starter colonies/nucs are well-fed to nurse bees.
- Post-emergence (0–10 Days): Feed daily for 7–10 days until mating is confirmed. Monitor syrup/pollen consumption (adjust quantities as needed)

6.7 Recognizing signs of inadequate feeding:

- Lethargic or weak queens: Queens may appear sluggish or less active.
- Reduced activity in nucleus hives: The attendant bees may appear less active if the queen is not well-fed.
- Lack of interest in feeding: If the provided feed remains untouched for extended periods, it could indicate a problem.
- Poor ovary development (Difficult to observe directly): May manifest later as poor laying patterns or a drone-laying queen.

6.7.1 Troubleshooting feeding issues:

- Dry feed: Remoisten sugar syrup or pollen patties with a small amount of water.
- Mold growth: Remove and replace any moldy feed immediately. Ensure good ventilation.
- Robbing (Sugar syrup): Use entrance reducers, feed in the late evening, and avoid spills to minimize robbing.
- Pest attraction (Pollen Substitute): Offer small amounts and avoid leaving it exposed for long periods. Consider using enclosed feeders.
- Crystallized sugar syrup: Replace with fresh syrup. Using warm water to dissolve sugar can help prevent crystallization.

6.7.2 Troubleshooting common issues

Table 21: Common issues and its remedy

Issue	Solution
Bees ignoring feed	Check feeder placement; ensure syrup is fresh (1:1 ratio).
Robber bees	Reduce hive entrance; use internal feeders.
Queen rejection	Verify workers are feeding her; add nurse bees to nuc.
Moldy patties	Replace immediately; store substitutes in airtight containers.

6.8 Conclusion:

Consistent and appropriate feeding management is a cornerstone of successful queen rearing. By understanding the nutritional needs of newly emerged queens and implementing effective feeding strategies tailored to your management system and local conditions in ADC Godawari, we can significantly increase the chances of producing healthy, well-mated queens that will contribute to strong and productive honeybee colonies. Regular observation and timely intervention are key to ensuring optimal queen development.

Sample questions for practice.

1. Describe the importance of proper feeding to virgin queens.
2. What are the types of feed for virgin queen?
3. Explain the different feeding methods for virgin queen bees.

Session 26

Management techniques of grafted queen bees, queen banking, and distribution management

1. Learning objectives.

By the end of the session, the participants will be able to:

- Understand the critical steps in managing grafted queen cells from capping to emergence.
- Describe the effective techniques for establishing and maintaining queen banks.
- Identify suitable methods for storing and distributing virgin and mated queen bees.
- Appreciate the importance of timing and careful handling throughout the process.
- Adapt management strategies to the local context and available resources in Nepal.

2. Sub topics

- Introduction
- Grafted queen management.
- Queen banking techniques.
- Queen marking and distribution management.

3. Materials and methods

3.1 Training methods

- Lecture
- Brainstorming/experimentation
- Group discussion

3.2 Training materials

- Projector, power point slides, pictures
- Marker pen, brown paper, pen and masking tape, meta card
- Photo videos of queen banking and queen marking techniques.

- Capped queen cells: A frame with several capped queen cells ready for emergence.
- Queen cell protectors: Plastic or wire cages to protect queen cells from emerging queens.
- Queen banks (if applicable): A functional queen bank setup with attendant bees and feeding provisions.
- Queen cages: Jenter cages, hair roller cages, or similar for holding and transporting queens.
- Marking tools: Queen marking pens (various colors).
- Small nucleus hives (Mating nucs): Prepared nucs for introducing virgin queens.

3.3 Time

Theory: 80 minutes

Discussion: 10 minutes

3.4 Place: Training hall

4. Activities and exercises

4.1 Inform the participants about the lecture included in the training and obtain information about the level of knowledge of the participants on the subject.

4.2 Deliver lecture on the subject

Give a short presentation on the introduction, grafted queen management, queen banking techniques, queen marking and distribution management as outlined in the resource materials.

4.3 Discussion

Organize a fun quiz or question-answer session where one group asks questions to another based on the session topics. Use the responses to evaluate the level of learning and clarify any misunderstandings.

5. Detail schedule

SN	Subject matter	Description	Time	Materials
1	Introduction and importance	Emphasize the need for careful handling and protection of developing queen cells.	5 minutes	Projector, PPT slides, photo, video

SN	Subject matter	Description	Time	Materials
2	Grafted queen management	➢ Explain how to identify queen cells that are close to emergence (darker color, slight movement if observed carefully). ➢ Show how to carefully place queen cell protectors over capped queen cells on the frame. ➢ Explain that protected queens will emerge within their individual protectors. ➢ Demonstrate how to carefully remove a queen cell protector containing a newly emerged virgin queen. ➢ Stress the fragility of virgin queens and the importance of gentle handling (holding by the thorax, avoiding pressure on the abdomen).	10 minutes	Projector, PPT slides, photo, video, queen cell, queen cell protector.
3	Queen banking techniques	➢ **D**emonstrate how to introduce caged virgin queens into the bank. Explain methods like using a frame with holes or specialized queen bank frames. ➢ Explain the importance of regularly checking the bank for queen health and acceptance. ➢ Discuss the typical duration for holding queens in a bank (ideally not exceeding a few weeks).	15 minutes	Projector, PPT slides, queen bank frames.

SN	Subject matter	Description	Time	Materials
5	Queen marking and distribution management	➢ Explain the benefits of marking ➢ Show the proper technique for gently catching and marking a virgin queen using a marking pen ➢ Demonstrate how to place a few attendant worker bees (nurse bees from the queen bank or a gentle colony) and a food source (sugar candy) into the cage with the queen. ➢ Explain how to store caged queens in a cool, dark, and well-ventilated place for a short period before distribution. Provide them with access to food and water if held for more than a few hours.	10 minutes	Projector, PPT slides, photo, video
6	Discussion		10 minutes	

6. Resource materials.

6.1 Introduction

Queen bee management encompasses several crucial techniques to ensure healthy and productive colonies**. Proper management techniques of grafted queen bees** involve nurturing the delicate grafted larvae in queen less colonies, providing them with ample royal jelly, and ensuring optimal temperature and humidity for their development into healthy queen cells. These cells are then carefully transferred to mating nucleus or queen less hives at the appropriate time.

Queen banking is a method used to hold multiple mated queen bees in a queen less colony for a short period. This allows beekeepers to have a supply of queens available for introduction into new hives or to replace failing queens,

ensuring a continuous supply without the immediate need for grafting. Finally, **distribution management** focuses on the logistics of transferring queen bees or queen cells from the rearing location to where they are needed, whether it's within the beekeeper's own apiary or to customers. This includes careful packaging, temperature control during transport, and timely introduction to their new colonies to maximize acceptance and survival.

6.2 Queen marking

Queen marking in beekeeping involves applying a small, visible mark, usually a colored dot or number, to a queen bee to help beekeepers identify and track her age, presence, and health in the hive. This practice helps with hive management and is beneficial for beekeepers, not the bees themselves.

6.2.1 Benefits of queen marking:

- **Identification:** Marking makes it easier to locate the queen during hive inspections, which can be helpful for beekeepers.
- **Age determination:** A color-coded system can indicate the year the queen was born, allowing beekeepers to track her age and potential for replacement.
- **Health monitoring:** Marking can also help track the queen's health and productivity over time.
- **Breeding projects:** For specific breeding projects, numbering can help identify individual queens for research or documentation purposes.

6.2.2 How to mark a queen bee:

- **Immobilize the queen:** Carefully trap or catch the queen to prevent her from moving.
- **Apply the mark:** Use a non-toxic, water-based paint pen or a small, color-coded number sticker to apply the mark to the queen's thorax (chest).
- **Dry the mark:** Allow the paint to dry completely before releasing the queen back into the hive.

6.2.3 Queen marking colors and numbers:

- **Color code**: A standard international system uses colors to indicate the year the queen was born, with colors cycling through white, yellow, red, green, and blue.
- **Number code**: Numbered discs or stickers can be used to track individual queens, particularly in breeding programs

6.3 Queen banking

Queen banking is the temporary storage of queen bees in a queen less colony.

6.3.1. Importance of queen banking

- Allows for the storage of excess queens.
- Ensures a supply of queens for future use.
- Facilitates the distribution of queens.

6.3.2. Procedure

1. **Preparation:**
    - Prepare a queen less bank colony with ample nurse bees.
    - Provide the bank colony with sufficient food resources.
2. **Queen introduction:**
    - Place the queens in individual cages.
    - Introduce the caged queens into the bank colony.
3. **Maintenance:**
    - Monitor the bank colony regularly.
    - Ensure the queens are being cared for by the nurse bees.
    - Provide additional resources as needed.

6.3.3. Factors affecting queen banking success

- Colony strength: a strong bank colony is essential.
- Food resources: adequate food ensures queen survival.
- Queen health: healthy queens are more likely to survive.
- Duration of banking**:** long-term banking can reduce queen quality.

6.4. Distribution of mated queens

Distribution is the process of transferring queen bees from the rearing or banking colony to their final destination.

6.4.1. Importance of distribution

- Ensures that queens reach beekeepers in a timely manner.
- Maintains queen health and quality during transit.
- Supports the growth and sustainability of beekeeping operations.

6.4.2. Procedure

1. **Preparation:**
   - Prepare queen cages with candy and attendant bees.
   - Ensure the queens are healthy and ready for transport.
2. **Packaging:**
   - Package the queens in well-ventilated containers.
   - Label the packages with appropriate information.
3. **Transportation:**
   - Transport the queens in a timely and safe manner.
   - Protect the queens from extreme temperatures and physical shock.
4. **Delivery:**
   - Deliver the queens to the recipient.
   - Provide instructions for queen introduction.

6.4.3. Factors affecting distribution success

- Packaging: Proper packaging protects queens during transit.
- Transportation: Timely and safe transport is crucial.
- Environmental conditions: Temperature and humidity during transit.
- Handling: Gentle handling minimizes stress and damage.

6.5. Conclusion

Proper management of grafted queens, queen banking, and distribution is essential for successful queen rearing operations. By following the procedures outlined in this handout, participants can increase their success in producing, storing, and distributing high-quality queen bees.

Sample questions for practice.

1. What are the benefits of queen marking?
2. Describe the factors affecting queen banking success.
3. Explain the procedure of queen bee distribution.

Session 27

Benefit-cost analysis of beekeeping business

1. Learning objectives

By the end of the session, the participants will be able to:

- Analyze cost and benefit of the production honey bee business
- Describe the variable and fixed cost items in honey bee business
- Calculate and explain about benefit cost ratio (B/C ratio)

2. Sub topics

- Variable and fixed cost items in honey bee business
- Calculate and explain about Benefit cost ratio (B/C ratio)
- Practical exercise

3. Methods and materials

3.1 Training methods

- Lecture
- Brainstorming
- Group discussion
- Experience sharing
- Practical exercise

3.2 Training materials

- Projector, Power points, Slides, Pictures.
- Marker, Brown paper, Pen, Masking tape, Meta card
- Cost of Production formats
- Business plan template
- Cost of production of Honey bee

3.3 Time

Theory: 60 minutes

Practical: 20 minutes

Discussion: 10 minutes

3.4 Place: Training hall

4. Activities and exercise

1.1 Inform participants about the topics covered in the training and inquire about their level of knowledge on the subject matter.

1.2 Presentation

Give a short presentation on the introduction, cost items, benefit items, B:C ratio calculation and case study regarding to benefit cost analysis of beekeeping business in Nepal as outlined in the resource materials.

1.3 Group division/ practical exercise.

Divide the participants into 2 groups (Interviewer and Farmer), complete the following tasks during practical exercises.

1: To prepare the questionnaire for cost of production (COP) and orientation to the group members about COP (Group A)

2: To take interview with the farmers (Group B)

Take participants to open space, orient one group about cost of production formats/questionnaire and another group as a farmer group raising honey bee. Group A (Interviewer) should prepare the final report and analyze the B/C ratio.

1.4 Discussion

After returning from open space, organize group presentation to discuss on the result of cost of production based on their interview. Use in depth discussion and question and answer to discover whether the participants can fill the formats properly, understand the terms and terminology used in formats, calculate B:C ratio.

5. Detail schedule

S.N.	Subject matter	Description	Time	Materials
1.	Introduction	Ask participants to write down what they know about the benefit-cost analysis	5 minutes	Marker Pen, Meta card, Power point.
2	Cost items of the beekeeping business	Discuss the fixed cost and variable cost involved in the beekeeping business.	20 minutes	Projector, Power point slides, ictures, Videos.

S.N.	Subject matter	Description	Time	Materials
3	Revenue from the beekeeping business	Discuss the items from which revenue can be generated.	20 minutes	Projector, Power point slides, Pictures, Videos.
4	B:C ratio analysis	Discuss the method of B: C ratio calculation	15 minutes	Projector, Power point slides, Pictures, Videos.
5	Practical exercise	Divide the participants into two groups and orient them on how to perform about interview and answer representing farmers and explain the variable and fixed items. How to ask with farmers, short brief and collect data in the formats.	20 minutes	Questionnaire formats Data entry Cost calculation, B/C ratio.
6	Discussion		10 minutes	

6. Resource materials.

6.1 Introduction:

A benefit-cost analysis (BCA) is a systematic process for evaluating the economic feasibility of a project by comparing its total expected benefits to its total costs. This is achieved by converting both benefits and costs into a common monetary value, allowing for a determination of whether the benefits outweigh the costs, making it a valuable tool for decision-making in business and public policy. BCA is used to weigh the pros and cons of a project or investment, helping to decide whether to proceed with it. It involves a structured process of identifying, quantifying, and comparing expected benefits and costs. Benefit-cost analysis of the beekeeping business is done to find out the profitability of the apiculture enterprises.

6.2 Benefit cost analysis

The cost and benefit sides are separately computed, and the benefit side is divided by the cost side to compute the B-C ratio. The benefit-cost ratio is computed by using the formula.

B/C = TR / TC; where *(B/C = Benefit Cost Ration; TR = Total Revenue; TC = Total Cost)*

Benefit-cost ratio should be more than 1, preferably more than 1.5; the higher the better. Benefit-cost analysis is applied as an appropriate tool to evaluate the apiculture enterprises and their feasibility.

6.2.1 Cost of beekeeping business

The cost items are grouped into two categories: Fixed costs and Variable costs. To find out the total cost (TC), the total fixed cost (TFC) is added to the total variable cost (TVC).

TC = TFC + TVC

Likewise, average cost (AC) was obtained by adding average fixed cost (AFC) and average variable cost (AVC) as TC = TVC + TFC, and AC = ATC + AVC. Where, AC = TC/No. of colonies

Fixed Cost Items

Ca = Fixed cost, i.e. C1 + C2 + ---C15

C1 = Purchasing cost of the bee colony, C2 = Cost of bee hive,
C3 = Cost of hive tool, C4 = Cost of smoker,
C5 = Cost of honey extractor, C6 = Cost of bee veil
C7 = Cost of uncapping knife, C8 = Cost of stand
C9= Comb foundation machine C 10= Queen gate
C=11 Queen cage C12= Feeder
C13=Honey Filtration Tank C14=Honey Processing Plant
C15=Swarming Bag,

Fixed Cost Calculation

Fixed costs are the costs of the bee farm, which do not vary with the level of output. The fixed cost is calculated by dividing their original cost by the number of years of life expectancy of the equipment.

Beekeepers may borrow tools like a hive tool and a smoker from their friends free of cost. The cost of the beehive and stand will be high because each bee farm individually needs these tools. But other tools, like a smoker, a bee veil, a honey extractor, etc., could be shared with others. With the increase in the number of bee colonies, the cost of these items gradually decreased.

Variable cost items.

Cb = Variable cost, i.e.C16 + C17 + ---C21

C16 = Supplement feeding, C17 = Drugs, C18 = Comb foundation,
C19 = Transportation, C20 = Labor, C 21=Land rent in migration site

Labour Cost

Most of the beekeepers are marginal farmers, and they are involved in agricultural work only for 3-4 months a year. Thus, they utilize their spare time and generate their income through beekeeping. Most of the beekeepers work for themselves. If additional manpower is needed, they usually take the help of other family members (women and even their children) and utilize their family members. But their labor cost should be considered and calculated.

6.2.2 Benefit / Revenue from beekeeping business

Total benefit (B) = B1 + B2 + B3 + B4, where,

B1 = benefit from honey,

B2 = benefit from wax and,

B3 = benefit from colony sale,

B4 = benefit from other bee products (pollen, royal jelly, propolis, bee venom and others.)

Honey, wax, and colony selling are the main revenue sources of apiculture industries. In addition, apiculture also contributes to ecological, environmental, and other socio-economic fields, which are difficult to assess.

6.2.3 Benefit Cost Ratio

The benefit-cost ratio is computed by using the formula

B/C = TR / TC

= (B1 + B2 + B3 + B4) / (Ca+ Cb) **(>1 preferably > 1.5)**

B/C = Benefit Cost Ration; TR = Total Revenue; TC = Total Cost)

Table 22: Cost-benefit analysis of a beekeeping business (25 colonies of *Apis cerena*) - (Example)

Fixed Cost

S.N.	Particulars	Quantity	Rate Per Unit	Amount	Useful Life	Per Year Expenses
1	Cost of honeybee frame: (25 X 5 frame)	125	1,000	125000	5	25000
2	Cost of hives	25	4,000	100,000	5	20,000

S.N.	Particulars	Quantity	Rate Per Unit	Amount	Useful Life	Per Year Expenses
3	Metallic stand cost	25	500	12,500	5	2,500
4	Hive feeder cost	25	300	7,500	3	2,500
5	Protective equipment-Bee suits	1	5,000	5,000	3	1,667
6	Honey extractor	1	18,000	18,000	5	3,600
7	Bee gloves	2	300	600	2	300
8	Hive tools	1	300	300	3	100
9	Bee veils	2	600	1,200	2	600
10	Uncapping knife	1	500	500	2	250
11	Queen gate	10	100	1,000	2	500
12	Queen cage	10	100	1,000	2	500
13	Swarming bag	1	700	700	3	233
14	Honey filtration tank	1	20,000	20,000	5	4,000
15	Bucket for honey collection	10	500	5,000	3	1,667
16	Comb foundation machine	1	8,000	8,000	5	1,600
	Total			**306,300**		**65,017**

Variable Cost

S.N.	Particulars	Unit	Quantity	Rate Per Unit	Amount
1	Sugar	Kg	125	115	14,375
2	Drugs				3,000
3	Comb foundation	Kg	12	800	9,600
4	Labour	Days	120	755	90,600
5	Packaging cost				15000
	Total				**132,575**

Revenue

S.N.	Particulars	Unit	Quantity	Rate Per Unit	Amount
1	Honey	kg	250	1000	250000
2	Wax	Kg	5	1000	5000
3	Bee colony		20	5000	100000
	Total				**355000**

- Per Year Fixed Cost: 65017
- Variable Cost: 132575
- Total Cost: 197592
- Total Revenue: 3,55,000
- Estimated production of Honey: 10 kg/hive
- Number of Hives: 25
- Total estimated production of honey: 250
- Per kg Cost: Rs.790.39
- B:C ratio: Total Revenue/Total Cost = 355000/197592 = **1.79**

Table 23: Cost-benefit analysis of a beekeeping business (25 colonies *of Apis mellifera*) - (Example)

Fixed Cost

S.N.	Particulars	Quantity	Rate Per Unit	Amount	Useful Life	Per Year Expenses
1	Cost of honey bee frame : (25 X 5 frame)	125	800	100,000	5	20,000
2	Cost of hives	25	5,000	125,000	5	25,000
3	Metallic stand cost	25	800	20,000	5	4,000
4	Hive feeder cost	25	300	7,500	3	2,500
5	Protective equipment-Bee suits	2	5,000	10,000	3	3,333
6	Honey extractor	1	30,000	30,000	5	6,000
7	Bee gloves	2	500	1,000	2	500
8	Hive tools	3	300	900	3	300
9	Bee veils	2	600	1,200	2	600
10	Uncapping knife	2	500	1,000	2	500

S.N.	Particulars	Quantity	Rate Per Unit	Amount	Useful Life	Per Year Expenses
11	Queen cage	10	100	1,000	2	500
12	Swarming bag	1	700	700	3	233
13	Honey filtration tank	1	20,000	20,000	5	4,000
14	Bucket for honey collection	20	500	10,000	3	3,333
15	Comb foundation machine	1	10,000	10,000	5	2,000
16	Pollen trap	1	1,000	1,000	3	333
	Total			**339,300**		**73,133**

Variable Cost

S.N.	Particulars	Unit	Quantity	Rate Per Unit	Amount
1	Sugar	Kg	250	115	28,750
2	Drugs				5,000
3	Comb foundation	Kg	25	800	20,000
4	Transportation				50,000
5	Labor	Days	120	755	90,600
6	Rent in migration site				10,000
7	Packaging cost				40,000
	Total				**244,350**

Revenue

S.N.	Particulars	Unit	Quantity	Rate Per Unit	Amount
1	Honey	kg	750	800	600,000
2	Wax	Kg	5	1,000	5,000
3	Pollen	kg	1	4,500	4,500
	Total				**609,500**

- Per Year Fixed Cost: 73133
- Variable Cost: 244350
- Total Cost: 317483
- Total Revenue: 609500

- Estimated production of Honey: 30 kg/hive
- Number of Hives: 25
- Total estimated production of honey: 750
- Per kg Cost: Rs.423.31
- B: C ratio: Total Revenue/Total Cost = 609500/317483 = **1.92**

Since the B: C ratio for both *Apis cerena* and *Apis mellifera* beekeeping is greater than 1.5, we can say that the beekeeping business is profitable.

Note: Cost of Royal jelly extractor, pollen trap, bee venom collector, and propolis trap can also be included in fixed cost if the beekeeper intends to harvest these bee hive products.

Sample questions for practice.

1. Explain the cost items of the beekeeping business.
2. What are the revenue items of the beekeeping business?
3. Describe the decision criteria of B: C ratio.

Session 28

Beekeeping entrepreneurship and institutional development

1. Learning objectives

By the end of the session, the participants will be able to:

- Explain the concept, features, and benefits of beekeeping as a business.
- Describe about business registration, operation, and management.
- Understand the institutional development of beekeeping Business.
- Explain and apply basic concepts of record-keeping in beekeeping enterprises.

2. Subtopics

- Concept of beekeeping and entrepreneurship
- Registration of beekeeping enterprises
- Enterprises registration, operation, and management
- Institutional development of beekeeping
- Record-keeping in beekeeping enterprises

3. Methods and materials

3.1 Training methods

- Lecture / presentation
- Brainstorming
- Group review
- Practical exercises

3.2 Training materials

- Projector, Power point slides, visuals/charts
- Marker pens, Brown paper, Pens, Masking tape, Meta cards

3.3 Time

- **Theory:** 80 minutes
- **Practical:** 80 minutes
- **Discussion:** 20 minutes

3.4 Place: Training hall

4. Activities and exercises

4.1 Inform participants about the topics covered in the training and inquire about their level of knowledge on the subject matter. Provide an overview of the session content and Conduct an icebreaker or simple discussion to assess participants' current knowledge and expectations.

4.2 Presentation

Give short presentation on the beekeeping and entrepreneurship, registration process for beekeeping business or groups, roles and responsibilities in group operation and management, importance of coordination among stakeholders, infrastructure needs and institutional development for beekeeping and basic record-keeping practices as outlined in the resource materials.

4.3 Group division/practical exercises

Divide participants into 4 groups and assign each group one of the following practical tasks.

Group Task 1: Identify the main features and benefits of beekeeping as a business
Group Task 2: Identify key stakeholders in beekeeping and areas where coordination is essential.

After completing the task organize group presentation. Select a group leader from each group and make them to present what they have listed in the chart paper. After presentation discuss with other participants and any additional insights

4.4 Discussion:

Organize a fun quiz or question-answer session where one group asks questions to another based on the session topics. Use the responses to evaluate the level of learning and clarify any misunderstandings.

5. Detail schedule

SN	Subject matter	Description	Time	Materials
1	Beekeeping entrepreneurship	Ask participants questions related to the concept of entrepreneurship to initiate discussion.	5 minutes	Marker pens, meta cards

SN	Subject matter	Description	Time	Materials
		Provide information on beekeeping entrepreneurship. Discuss different types of businesses related to beekeeping and raise awareness.	20 minutes	Projector, Power point slides, pictures
		Divide participants into 2 groups for a group activity on features and benefits of beekeeping. Have each group present and add any additional insights.	20 minutes	Chart paper, markers
2	Registration and management of beekeeping enterprises	Facilitate a discussion on the importance of registering enterprises or groups.	25 minutes	Chart paper, markers, Slides, visuals,
3	Group and cooperative management in beekeeping	Provide detailed information on the process and importance of group/ enterprise registration and its management.	15 minutes	Slides, visuals, examples
	Coordination among stakeholders	Conduct a group activity to identify key stakeholders and potential areas of coordination. Facilitate group presentations and further discussion.	25 minutes	Chart paper, markers, Slides, visuals,
4	Infrastructure needed for institutional development	Engage participants by asking questions to guide the discussion on infrastructure needs for institutional development in beekeeping, followed by detailed input.	20 minutes	Chart paper, markers, Slides, visuals,
5	Record keeping	Discuss the importance and need for record keeping. Assess participants' knowledge on types of records needed.	10 minutes	Chart paper, markers, Slides,

SN	Subject matter	Description	Time	Materials
		Provide detailed information on the importance of record keeping and examples of required records.	20 minutes	Sample record books/ files
6	Discussion	Divide participants into two groups on each side of the room. Each group will ask and answer questions to assess their understanding of the session content.	20 minutes	Questions, meta cards

6. Resource materials

6.1. Concept of beekeeping entrepreneurship

Beekeeping is an integral and essential part of the agricultural sector. It contributes significantly to improving farmers' livelihoods, strengthening rural economies, and supporting the overall economic development of the country. Traditionally focused on honey production, beekeeping has now expanded to include a variety of bee-based products, equipment manufacturing, training services, tourism development, and environmental conservation.

Beekeeping can be considered a sustainable agricultural enterprise as it offers multiple benefits. Bees not only produce honey through nectar collection but also play a vital role in pollination, which significantly increases the productivity of fruits, vegetables, oilseeds, and other crops. This enhances food production and contributes to food security.

6.1.1 Importance of beekeeping enterprise.

Beekeeping is not limited to honey production it can generate economic benefits through a range of products and services, including:

- **Honey and bee products:**

The main source of income is honey, which is highly valued for its health benefits. Other valuable bee products include beeswax, pollen, bee venom, propolis, and royal jelly. These products are used in medicine, cosmetics, and have high demand in international markets.

- **Beekeeping tools and equipment production:**

With the growth of the beekeeping industry, the demand for equipment is increasing. Entrepreneurs can earn additional income by producing and distributing hives, frames, extractors, smokers, protective gear, and other materials.

- **Quality bee breeding and sales:**

To increase productivity, breeding and selling high-quality queen bees and colonies is another income-generating opportunity. Providing bee colonies to new beekeepers can open new markets.

- **Api- tourism:**

Combining tourism with beekeeping, entrepreneurs can create bee parks and organize educational programs that showcase the lifecycle of bees and honey production. This generates income and employment at the local level.

- **Training, consulting, and research:**

Entrepreneurs can offer training and consulting services to beekeepers, women's groups, and youth entrepreneurs. This not only helps expand the business but also promotes agri-entrepreneurship. Research in this field can further enhance productivity and innovation. The Government of Nepal has been promoting beekeeping through various policies and programs; grants, training, hive distribution, market linkage, and research. Supported by the Ministry of Agriculture and Livestock Development, Agricultural Knowledge Centers, and various organizations, this sector is steadily growing. Beekeeping can be practiced individually or in groups with small or large investments. It also allows flexibility to manage alongside other occupations. Beekeeping empowers farmers and entrepreneurs, strengthens the local economy, and integrates agriculture, environment, and entrepreneurship into one sustainable model.

6.1.2 Characteristics and benefits of beekeeping

Beekeeping is an environmentally friendly, sustainable, and economically profitable agricultural-based business that has become a center of attraction for farmers, small entrepreneurs, and individuals interested in environmentally sustainable businesses in recent years. This business is easily integrated with modern agricultural systems and holds significant potential as a reliable source of income, particularly for rural women, youth, and small farmers.

One of the main advantages of beekeeping is that it can be started with low investment, meaning that there is no need for a large capital in the initial stages.

Beekeeping offers flexibility in gradually expanding the business with minimal cost, which is one of its key characteristics. Additionally, beekeeping works well in collaboration with other agricultural activities, such as fruit farming, vegetable farming, and flower cultivation, as bees help in the pollination process, potentially increasing overall agricultural production.

Characteristics:

- **Low cost, high return** – Beekeeping is a business that can be run with minimal investment, making it suitable for farmers and small entrepreneurs.
- **Multiple valuable products** – Beekeeping yields honey, wax, pollen, propolis, royal jelly, and bee venom, which are valuable raw materials used in various industries.
- **Environmentally friendly** – By aiding in pollination, bees contribute to increased crop yields, thus supporting organic farming systems.
- **Requires little land** – Compared to other livestock and agricultural businesses, beekeeping can be operated on less land.
- **Beneficial as an auxiliary business** – Beekeeping can be integrated with fruit farming, spice farming, and organic agriculture to create additional income sources.

Benefits:

- **Sustainable economic source** – Honey and other bee products can be sold at good prices in the market, providing a sustainable income opportunity.
- **Job creation** – As the business expands, local employment opportunities increase, making it beneficial for rural areas.
- **Support to agricultural production** – Bees help in pollinating crops, leading to increased yields, which boosts the income of farmers.
- **Health benefits** – Bee products have natural medicinal properties, contributing to better nutrition and enhanced immunity.
- **Export potential** – There is a strong demand in international markets for honey and other bee products produced in Nepal, offering an opportunity to develop this as an export business.

6.2 Registration, operation, and management of beekeeping enterprises

Although beekeeping can be operated individually or collectively, **registration of the enterprise** is essential to ensure sustainability, legal recognition, access to finance, technology transfer, and market expansion.

To run the beekeeping enterprise sustainably, it can be registered and operated as a **sole proprietorship, partnership, company, group, or cooperative**. For its professional operation, it must comply with relevant acts such as the **Cooperative act, Industrial enterprises act, and Environmental protection act**.

6.2.1 Benefits of registration.

- **Legal recognition and formalization:** -Legal registration is necessary to access various services, facilities, and grants provided by the government. If the beekeeping enterprise is registered as a group or institution, it can coordinate effectively with government and non-government organizations.
- **Access to finance and grant facilities:** - Once registered, the enterprise can access loans, grants, and insurance services from banks and financial institutions. Many government and development agencies provide targeted support (e.g., grants and concessional loans) to formally registered beekeeping groups or enterprises.
- **Market access and brand development:** - Only registered enterprises can ensure product certification and quality assurance. This helps beekeepers reach local, national, and international markets. If registered as a group or cooperative, collective marketing becomes possible, helping producers receive better prices.
- **Access to technology and training:** - To participate in training, capacity-building programs, and technology transfer opportunities provided by the government and development partners, group or enterprise registration is necessary. Once registered, it is easier to benefit from such programs and support.
- **Risk management and insurance:** - Beekeeping is subject to economic risks from diseases, pests, environmental effects, and market fluctuations. If registered as a group or institution, it is easier to access disaster management support and insurance schemes to ensure business continuity.
- **Long-term commercialization and expansion:** - An institutional structure is required to professionalize the business in the long run and attract investment, adopt new technologies, diversify production, and scale up operations. With registration, opportunities for production, processing, and export increase.
- **Government support: -** The Government of Nepal has recognized beekeeping as an important agricultural enterprise and launched several policy programs to support its promotion. Special priority is given to registered beekeeping groups or enterprises under these programs.

In summary, for sustainable operation, financial and technical assistance, business expansion, and legal security, registration of the enterprise or group is necessary. It helps organize the beekeeping enterprise and enhances the chances of long-term success.

6.3 Institution management in beekeeping

Ensuring the permanent success of an organization requires proper management and operation of groups and cooperatives. For this, the following aspects must be carefully considered:

- **Structure and responsibility distribution**: Clear organizational structure and distribution of responsibilities among members.
- **Annual work plans and meetings**: Regular planning and meetings to assess progress.
- **Accounting and transparency**: Maintaining proper financial records and ensuring transparency.
- **Training and skill development**: Regular training sessions to enhance knowledge and skills.
- **Market management**: Efficient market strategies for selling products.
- **Collaboration and networking**: Building strong relationships with other stakeholders.

6.4 Coordination among stakeholders

One of the key elements for the long-term success and sustainability of beekeeping is effective coordination and collaboration among various stakeholders. Beekeeping is not limited to an individual farmer or entrepreneur; successful operations require coordination between government bodies, NGOs/INGOs, research centers, private sector investors and service providers, and local communities.

Key stakeholders:

- **Ministry of Agriculture and Livestock**: Policy improvements and grant management for beekeeping.
- **Ministry of Forests and Environment**: Conservation of beekeeping areas and promotion of biodiversity.
- **Nepal Agricultural Research Council (NARC)**: Research and technology transfer related to beekeeping.
- **Cooperatives and NGOs**: Capacity building, training, and financial support for beekeepers.

- **Private Sector and Market Area**: Purchase, sale, and establishment of processing centers for bee products.

Potential areas for coordination:

- **Training and capacity building**: Regular training for beekeepers.
- **Grants and subsidized loans**: Financial support for business growth.
- **Technical assistance**: Promotion of modern beekeeping technologies.
- **Market development**: Expanding local, national, and international markets for bee products.

6.5. Necessary infrastructure for institutional development in beekeeping

To make beekeeping sustainable, modern, and institutionalized, the development of various infrastructures is essential. If these infrastructures are systematically developed, beekeeping can generate significant income and employment opportunities.

6.5.1 Physical infrastructure

- **Bee farms and hives**: Suitable locations must be selected to establish organized bee farms. High-quality and modern beehives (such as Movable Frame Hives) should be used, which positively impact the health and productivity of the bees.
- **Processing and storage centers**: For the clean, safe, and high-quality processing of honey and other bee products, equipment such as honey extractors, filtering machines, and packaging units must be arranged. Additionally, processed products should be stored in facilities that maintain appropriate temperature and humidity levels.
- **Research and training centers**: Scientific research and innovation are necessary for commercial beekeeping. Training centers should be established to provide new knowledge and skills to beekeepers, along with laboratories for bee disease research and treatment.

6.5.2. Technological infrastructure

- Modern Beekeeping Equipment: Stainless steel honey extraction devices, temperature and humidity control equipment, and bee health monitoring devices should be used.
- Digital Technology and Online Market Access: To modernize beekeeping, it is important to build websites and mobile applications for online market access. Implementing technologies like QR codes and digital labeling is necessary to ensure product traceability.

6.5.3. Managerial and legal infrastructure

- **Cooperative or company registration**: Beekeepers' groups should be formally registered as cooperatives or companies. This facilitates easier access to government and non-government support and grants.
- **Quality certification**: Honey and other bee products should obtain Nepal Standard (NS) certification, international certifications (such as ISO, HACCP), and organic certification to enhance competitiveness in the market.
- **Insurance and financial access**: To minimize risks associated with beekeeping, it is necessary to insure bees and beekeeping equipment. Additionally, arrangements must be made to access concessional loans and grants.

6.5.4. Environmental and biological infrastructure

- **Bee-friendly environment**: To ensure the long-term conservation and productivity of bees, programs must be launched to protect flowering plants and preserve bees' natural habitats.
- **Disease control system**: Systems for bee health monitoring and treatment should be developed, and the production and supply of organic medicines and bio-pesticides should be ensured, helping maintain product quality.

To institutionalize and sustain the beekeeping sector, it is crucial to develop physical, technological, managerial, legal, environmental, and biological infrastructures. Systematic development of these infrastructures can make the beekeeping industry more organized, modern, and profitable.

6.6 Record management in beekeeping business

To run a beekeeping business effectively, it is crucial to maintain systematic record management. Keeping records ensures financial transparency, tax compliance, legal adherence, and the long-term sustainability of the business. According to the regulations in Nepal, businesses must maintain proper financial records as per government guidelines.

6.6.1 Importance of record management:

- **Financial transparency**: Helps in tracking income, expenses, profits, losses, and cash flow.
- **Tax filing**: Facilitates easy tax filing and submission of required documents to government bodies.
- **Legal compliance**: Helps in fulfilling legal requirements such as company law, tax laws, and labor regulations.

- **Business planning**: Supports evaluation of business progress and future planning.
- **Dispute resolution**: Provides documentation in case of financial or legal disputes.

1.1.2 Key records to maintain:

6.6.2.1 Financial records:

- Cash book.
- Ledger.
- Bank statements.
- Sales and purchase bills.
- Profit and loss statements.
- Balance sheets.

1.1.1.2 Tax and legal records:

- Tax returns.
- VAT and TDS-related documents.
- Business registration certificate.
- Labor and employment records.

1.1.1.3 Operational records:

- Supplier and customer details.
- Contracts and legal agreements.
- Insurance documents.
- Business plans and policy documents.

Sample questions for practice.

1. What are the benefits of group registration?
2. Describe the importance of record management.
3. Explain the key stakeholders of co-ordination.

Session 29

Business plan for beekeeping business

1. Learning objectives.

By the end of the session, the participants will be able to:

- Explain the concept and importance of a business plan for beekeeping.
- Describe about the process and method of preparing and analyzing a business plan for beekeeping.
- Explain the procedures for accessing loans for a beekeeping business.

2. Subtopics

- Concept of business plan for beekeeping
- Preparation and analysis of beekeeping business plan
- Loan procedures for beekeeping business

3.Methods and materials

3.1 Training methods

- Lecture / Presentation
- Brainstorming
- Group Discussion
- Practical Exercises

3.2 Training materials

- Projector, Power point slides, Visual aids
- Marker pens, Brown paper, Pens, Masking tape, Meta cards

3.3 Time

- Theory: 60 minutes
- Practical: 100 minutes
- Discussion: 20 minutes

3.4 Place: Training hall

4. Activities and exercises

4.1 Provide participants with information about the contents of the session and assess their current level of knowledge on the subject.

4.2 Presentation

Present the concepts, importance of a business plan for beekeeping, preparation and analysis of the beekeeping business plan, and the loan procedures for beekeeping as outlined in the reference materials.

4.3 Group division/practical exercise

Divide participants in 4 groups and ask them to prepare a business plan for beekeeping, using the format provided in the reference materials. After completing the task organize group presentation. Select a group leader from each group and make them to present what they have listed in the chart paper. After presentation discuss with other participants and any additional insights.

4.4 Discussion

Conduct a review session to assess the extent of participants' learning on the subject matter. Use in depth discussion and question and answer to discover whether participants can prepare individual business plan.

5. Detail schedule

SN	Subject matter	Description	Time	Materials
1	Concept and Importance of a Business Plan for Beekeeping	Start the session by asking participants what a business plan is, why it is needed, and who needs it.	5 minutes	Marker pens, meta cards
		Discuss and provide additional information on the concept and importance of a business plan.	10 minutes	Projector, Power point slides, visual aids
2	Preparation and Analysis of Beekeeping Business Plan	Ask participants about the components of a business plan and explain its key elements (Introduction, Market, Production, Raw Materials and Labor Costs, Capital, Profit & Loss, Investment, Return, etc.).	40 minutes	Projector, Power point slides, visual aids

SN	Subject matter	Description	Time	Materials
		If possible, allow participants to prepare a plan individually; otherwise, form groups with similar business interests to prepare the plan collaboratively. The trainer will guide and support the process.	90 minutes	Projector, PowerPoint slides, visual aids, business plan format
3	Loan Procedures for Beekeeping	Ask participants why a loan is necessary for business and what the process for obtaining a loan is	5 minutes	Projector, Power point slides, visual aids
		Explain the methods and procedures for accessing business loans	10 minutes	Projector, Power point slides, visual aids
4	Discussion		10 minutes	

6. Resource material

6.1. Concept of a business plan

When any activity is carried out with the aim of earning a profit in a business-oriented way, it becomes essential to evaluate its economic and technical feasibility beforehand. A detailed document prepared for this purpose is known as a Business Plan.

The main purpose of preparing a business plan is to make clear estimations and develop strategies regarding the market, production, costs, income, potential risks, and operational procedures before starting the business.

Many businesses are found to start without a plan, but such businesses often lack proper understanding of the market situation, production capacity, cost estimation, and financial analysis. As a result, decisions are based more on assumptions than on assessments, leading to difficulties in managing risks and jeopardizing long-term sustainability.

Hence, preparing a structured business plan before starting a business helps clarify all aspects of the business, identify and minimize potential risks in advance, and lay the foundation for overall success.

In summary, a business plan is the backbone of any successful business. With a business plan, an entrepreneur becomes well-informed about various aspects of the business before getting started. It also makes it easier to communicate with banks, government offices, or partners using a written document. A business plan is typically based on the following components:

- Market plan
- Production plan
- Cost and Expense plan
- Financial plan
- Risk management plan

Although the way of calculating business components may vary across agriculture, services, and trading businesses, the process of business planning remains essentially the same.

6.1.1 Importance of a business plan

While preparing a business plan, attention should be given to various aspects that help simplify and strengthen business operations and management. Its key importance includes:

a. Assessment of economic and technical feasibility

- Helps determine whether the business is economically and technically viable.

b. Market study and forecast

- Increases awareness of all aspects of the market.
- Provides insights into potential customers, competitors, and market demand and supply.

c. Resource and asset management

- Assists in managing required land, buildings, machinery, tools, furniture, and vehicles.

d. Cost and expense management

- Offers details on initial investment, operational costs, and other expenses.
- Helps in determining production costs.

e. Financial management and investment planning

- Assists in estimating the amount of capital required to run the business.
- Provides a clear plan on how to manage financial resources.

f. Pricing strategy

- Helps set a sales price based on various factors.
- Supports the development of competitive pricing strategies.

g. Profit forecast

- Provides an estimate of income after business operation begins.
- Aids in analyzing profit and loss.

h. Risk management

- Helps identify potential business risks and find ways to mitigate them.

i. Expense control and profit maximization

- Supports the reduction of unnecessary costs.
- Contributes to sustainable business operations.

To operate the beekeeping business in an organized and sustainable manner, a business plan is extremely essential. It not only increases the chances of earning a profit but also helps in reducing risks.

6.2. Preparation and analysis of beekeeping business plan

Business plan

Business plan highlights (Summary)	
Name of the business	
Name of the entrepreneurs	
Location for business	
Product and service for sales	
Market area	
Production volume	
Total capital requirement	
Fixed capital	
Pre operation cost	
Working capital	
Total employee	
Direct	

Business plan highlights (Summary)	
Indirect	
Annual sales	
Annual expenses	
Direct expenses	
Indirect expenses	
Annual profit	
Return on investment	
Break-even point	

a. Entrepreneur's name, address, and introduction

Briefly introduce the entrepreneur with personal background and history of the proposed business.

b. Business idea (Describe your business idea)

c. Marketing plan

c.1 Market research

Product	Target customer	Competitor

c.2 Product

What product will be produced?

This section should include the following details about the product:

- Product description
- Size, type, packaging, and weight
- Monthly and annual production quantities
- Comparison of the proposed product with existing products in the market in terms of price and quality

c.3 Where will the business be established?

After selecting the business, the location must be decided. Consider the following while selecting the location:

- Proximity to raw materials
- Transportation facilities
- Accessibility and family convenience
- Market and distribution facilities

c.4 How will the product be promoted?

Describe the promotional methods to be used for marketing the product.

c.5 What is the production quantity – daily, monthly, or annually?

Clearly state the planned production volume over different timeframes.

d. Human resources (Staffing plan)

Use of Human Resources

Work	Require no.	Rate	Salary/ wage	SSF or other facilities	Total
Direct labour					
Worker					
Other worker					
Indirect labour					
Management					
Total					

e. Organization and management

e.1. Business registration and legal status

Explain how the business will be legally registered and its legal framework.

e.2. Human resource management

Detail:

- The workers and staff required to run the business
- How recruitment will be done

f. Cost estimation

f.1 Required fixed assets

List the fixed assets needed to start the business, along with their costs:

SN	Name of fixed asset	Quantity	Unite price	Total	Lifespan	Annual depreciation
	Total					

f.2 Required raw materials

SN	Raw materials	Quantity	Unit price	Total	Remarks
	Total				

f.3 Other Expenses (Overhead)

SN	Description	Amounts
1	Rent	
2	Guest hospitality	
3	Miscellaneous	
4	Utility	
5	Repair and maintenance	
6	Technical consultancy	
7	…….	
8	…….	
9	……..	

f.4 Per unit operating cost

Description	Cost
Raw materials	
Direct labor cost	
Total cost	
Total production	
Per unit cost	

g Financial plan

g.1. Total capital investment

This includes the total of all necessary expenses to run the business.

SN	Description	Amount	Amount
1	Fixed capital		
2	Pre-operational expenses		
3	Working capital		
3.1	Raw materials inventory		
3.2	Labor cost		
3.3	Other costs		
	Total capital required		

g.2 Sources of capital

Source	Amount (Rs.)	Percentage
Self-investment		
Loan		
Grant		
Total		

Bank Providing Loan: Loan amount: .....

Annual Interest Rate: Annual interest payable: **.....**

g.3 Fixed Costs

Description	Cost
Overhead costs	
Indirect labor costs	
Interest costs	
Depreciation	
Total fixed costs	
Total production	
Per unit fixed cost	

g.4 Total unit cost (Final cost)

Per Unit variable cost	
Per Unit fixed cost	
Total per unit cost	

g.5 Pricing

I have set the price of the product as follows: Selling Price: Rs. _____

g.6 Profit and loss statement

Description	Amount (Rs.)	Amount (Rs.)
Revenue from sales		
Less: Direct (variable) costs		
Annual raw material cost		
Direct labor cost		
Total direct costs		
Gross profit		
Less: Indirect (fixed) costs		
Indirect labor cost		
Other expenses		
Interest cost		
Depreciation		
Net profit before tax		

g.7 Return on investment (ROI)

Net annual profit ÷ Total capital investment × 100

g.8 Break-even point

Annual fixed and indirect costs ÷ (Sales revenue – Variable costs)

h. Risk

Risk management matrix

Possible risk	Likelihood	Effect	Action plan	Respon-sible

i. Conclusion

6.3. Loan provision process for beekeeping business

Like other businesses, a beekeeping business requires financial resources at every stage-from the initial setup to ongoing operations and future expansion. In the beginning, investments are needed for purchasing beehive boxes, beehives, necessary equipment, training, and technology. As the business expands, more capital is required to add additional boxes, establish processing centers, improve packaging, expand market access, and carry out branding activities.

In this context, various banks and financial institutions in Nepal have given special priority to beekeeping businesses, classifying them under agriculture and small enterprises. According to the policies of the Nepal Rastra Bank (Central Bank), agricultural loans are provided at concessional interest rates. In some cases, collateral-free loans are also available. Moreover, local governments, cooperatives, and microfinance institutions also offer loan facilities targeted at beekeeping businesses.

Therefore, individuals or groups interested in running a beekeeping business can take advantage of these opportunities and obtain the necessary loans to implement their business plans.

6.3.1 Steps for loan provision

6.3.1.1 Prepare a business plan

A business plan is the key document for anyone seeking a loan. It informs financial institutions about the feasibility, goals, strategy, and operational capacity of your business, thereby increasing the chances of loan approval.

Before applying for a loan, your business plan must include:

- Market area and sales strategy
- Details of required equipment and manpower
- Initial investment, operating costs, and expected income

6.3.1.2. Contact a nearby financial institution and submit required documents

Major loan-providing institutions include:

- Commercial Banks
- Development Banks
- Microfinance Institutions
- Cooperative Organizations

6.3.1.3. Loan appraisal process

- The financial institution will evaluate your:
- Business plan
- Feasibility and sustainability
- Experience
- Value of any collateral
- Repayment capacity

6.3.1.4. Loan approval and disbursement

- Once the plan is approved, a loan agreement is signed.
- The loan is disbursed either in a lump sum or in installments.

6.3.1.5. Monitoring and loan repayment

- The financial institution or cooperative monitors the progress of the business.
- Loan repayments must be made monthly or quarterly, as per the agreement.
- Failure to repay on time may result in additional interest or legal action.

6.3.2 Special facilities and opportunities

Concessional Interest Rates and Grants under Agricultural Loans

- According to Nepal Rastra Bank policy, loans are available at 5%–8% interest rates.
- Many local governments/municipalities run grant programs for purchasing beehive boxes.
- By combining loans and grants, it is easier to start and expand the beekeeping business.

Sample questions for practice.

1. What is the importance of Business plan for entrepreneurs?
2. Prepare a sample for a business plan.
3. Explain the steps of loan provision process.

Session 30

Honey value chain

1. Learning objectives.

By the end of the session, participants will be able to:

- Explain the concept and importance of the honey value chain.
- Identify key functions, actors, and supporters of the honey value chain in Nepal.
- Map the honey value chain.
- Explain the concept of traceability.

2. Sub topics

- Introduction to the Honey Value Chain.
- Honey value chain mapping.
- Honey value chain analysis
- Traceability.

3. Methods and materials

3.1 Training methods

- Lecture / Presentation
- Brainstorming

3.2 Training materials

- Projector, PowerPoint slides, Visuals/Charts
- Marker pens, Brown paper, Pens, Masking tape, Meta cards

3.3 Time

Theory**:** 80 minutes

Discussion**:** 10 minutes

3.4 Place: Training hall

4. Activities and exercises

4.1 Inform participants about the topics covered in the training and inquire about their level of knowledge on the subject matter.

1.2 Presentation

Give a short presentation on the introduction to the honey value chain, value chain mapping, vertical and horizontal linkage, and traceability, as outlined in the resource materials.

4.3 Discussion

Organize a fun quiz or question-answer session where one group asks questions to another based on the session topics. Use the responses to evaluate the level of learning and clarify any misunderstanding.

5. Detail schedule

S.N.	Subject matter	Description	Time	Materials
1.	Introduction	Introduce the subject matter to participants and discuss what they know about the honey value chain and traceability.	10 minutes	Marker pen, Meta card
2.	Honey value chain	Discuss the value chain of the honey sub-sector.	10 minutes	Projector, Power point slides, Pictures, Videos.
3	Value chain map of honey in Nepal	Explain the functions, actors, and supporters involved in honey value in Nepal	30 minutes	Projector, Power point slides, Pictures, Videos.
4	Value chain analysis	Discuss the vertical and horizontal linkage of honey value chain in Nepal	15 minutes	Projector, Power point slides, Pictures, Videos.
5	Traceability	Discuss the concept of traceability of Honey.	15 minutes	Projector, Power point slides, Pictures, Videos.
7	Discussion		10 minutes	

6. Resource materials

6.1 Honey value chain

6.1.1 Introduction:

The agricultural value chain encompasses all the activities and processes involved in bringing an agricultural product from production to the final consumer. It includes input supply, production, processing, distribution, marketing, and consumption. Value chain development focuses on improving the efficiency, sustainability, and profitability of these activities to benefit all stakeholders, including farmers, processors, traders, and consumers.

A value chain is the entire series of activities that create and build value at every step, with the support of both internal and external stakeholders in the value-creation process. Value chain activities include: design, production, marketing, distribution, and support to the final consumer. Value chain analysis encompasses the full range of activities and services required to bring a product or service from its conception to sale in its final markets – whether local, national, regional, or global.

The honey value chain is therefore the linkage of actors and stages through which honey passes, via homesteads and markets, towards consumption. The honey value chain has significant potential due to high-quality, diverse production, but overcoming regulatory, infrastructural, and market-access barriers is critical. Prioritizing quality assurance, certification in both international and domestic markets. The honey value chain in Nepal requires holistic upgrades across production, processing, marketing, and governance. Prioritizing quality, sustainability, gender equity, and institutional support can unlock domestic and export potential while safeguarding environmental and social equity.

6.1.2 Value chain mapping of the honey sub-sector

The flow of honey and other bee products in the market and the distribution of income from consumers to beekeepers/input suppliers are depicted in the value chain map. This map consists of three elements: functions, actors, and supporters. The enterprises performing the basic functions of a value chain are actors. At one stage in the value chain, they become owners of the (raw, semi-processed or finished) product and at the latter provide support services and represent the common interests of the value chain actors. The supporters remain outsiders to the regular business process and restrict themselves to temporarily facilitating a chain upgrading strategy. Typical facilitation tasks include creating awareness, facilitating, strategy preparation and action, and the coordination of support activities.

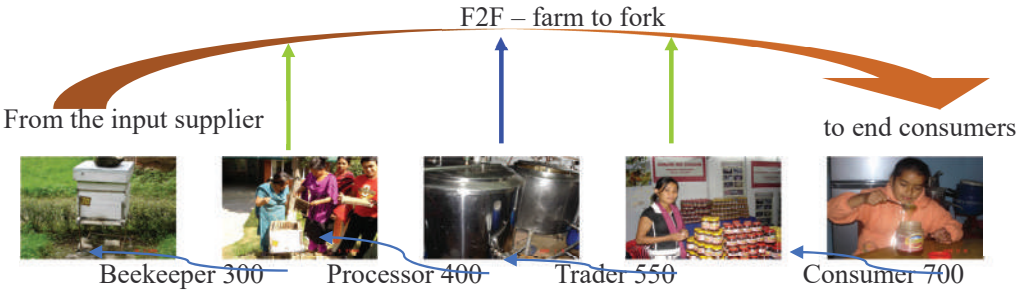


Figure 101: Honey value chain

The value chain functions involved in the honey value chain analysis are Input supply, production, semi-processing, collection and bulking, secondary bulking, refining, packaging, and final distribution. The major inputs needed for the beekeeping business are modern beehives, bee colonies, and hive equipment, which are provided by local craft person or beekeeping resource centers. Honey is produced by traditional bee hive owners, modern bee hive owners, and groups/cooperatives. Semi-processing, collection, and bulking are done by local bulking agents, cooperatives, and processing industries. Individual traders, wholesale and retail outlets are involved in the distribution of honey. Government programs, donor-funded programs, and NGOs are supporters helping in the production function. Similarly, Commercial banks, donor-funded programs, and cooperatives help in bulking, refining, and packaging functions. Before going to the end customer, the Department of Food Technology and Quality Control (DFTQC) certifies the honey quality.

Small-scale individual producers sell their honey directly to consumers. Selling honey at a roadside stall or market can bring the advantages of long opening hours and plenty of passing trade, without the overhead costs of a shop. Some large-scale producers who organized into cooperatives sell to cooperatives. There are department stores in Kathmandu, Pokhara, and other major cities to take care of the marketing aspect of honey. There is a chain of marketing sales outlets throughout the country owned by department stores such as Bhatbhateni, Big-mart, Namaste, Blue Bird, etc. These are the end markets comprising the domestic consumers, who use honey as table food, and the industries that use honey in food processing and preservation. Few export companies sell their products to other countries.

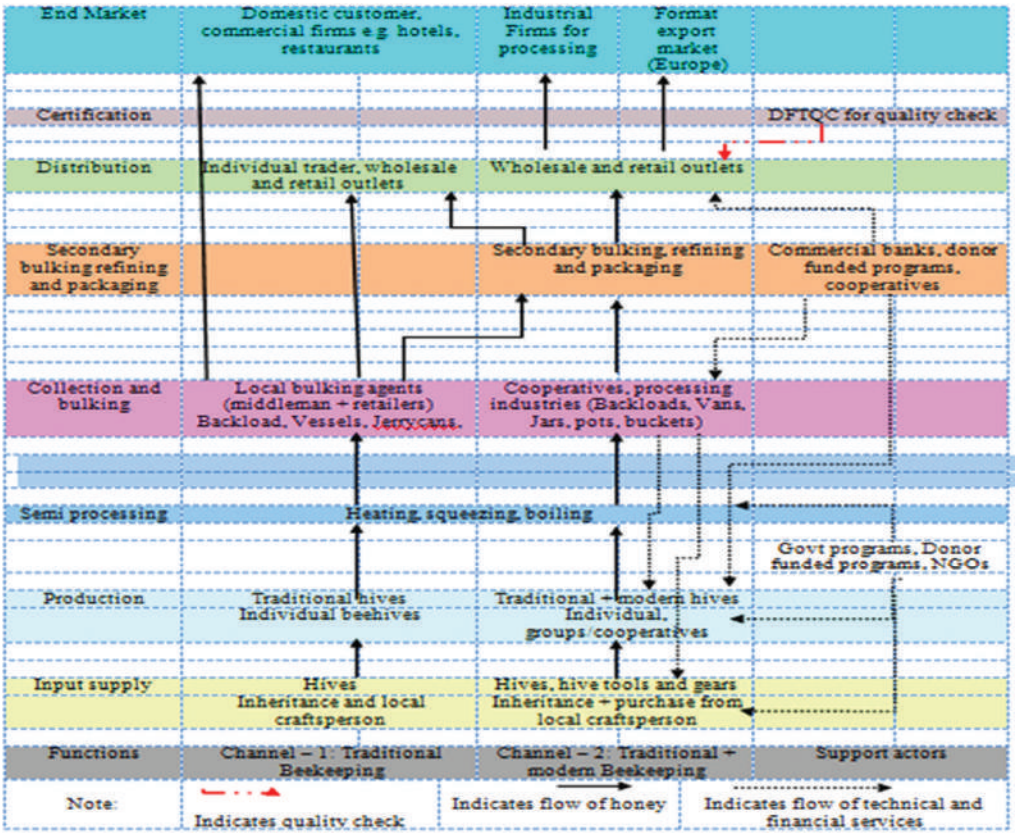


Figure 102 : Honey value chain mapping

6.1.3 Value chain analysis:

The value chain can be analyzed using the results of the mapping as a base. The analysis includes the following steps:

- Conduct a SWOT analysis (strengths/ weaknesses/ opportunities/ threats) over the whole chain
- Identify market opportunities and demand
- Identify market requirements
- Identify areas of comparative advantage
- Identify the competitive advantages of competitors
- Identify the weakest point/ leverage point in the chain
- Carry out a cost-benefit analysis and identify the breakeven point

6.1.4 Vertical and horizontal linkages

Vertical linkage depicts the relationship between various value chain actors acting at different levels. It persists among the input suppliers, producers,

wholesalers, retailers, and consumers. Here occurs the provision of service on a payment basis among the value chain actors in Nepal. Input suppliers provide the producers with required supplies and resources, and producers, in return, pay for the service they receive. Financial support to the farmers is not satisfactory. The extension service provided by the service providers is not adequate. A good relationship exists between producers and wholesalers. Wholesalers of Kathmandu and Pokhara directly contact the producers for buying honey, and delivery is made through public transportation. Wholesalers sometimes visit the producers themselves to buy the product. Payment for the product by wholesalers is done as direct cash payment or through cash deposits as well. The product is sold directly to the local consumers as well. Wholesalers then sell the product either to retailers or to hotels, restaurants, ayurvedic factories, etc., or to the final consumers after packaging the product in plastic or glass jars. Payment is generally made in cash.

In a honey value chain, **horizontal linkage** involves beekeepers and other actors at the same level of the chain, often through forming groups and cooperatives to strengthen their collective bargaining power and access to resources. Federation of Nepalese Beekeepers (FNBK), Nepal Beekeeping Central Cooperative Union (Coops Honey), Honey entrepreneurs' association are working in honey value chain.

6.2 Traceability

Traceability (or product tracing) enables the ability to track the movement of food products through specific stages of production, processing, and distribution. For producers, this enhances food safety, consumer trust, and market access by allowing rapid response to hazards and ensuring accurate labeling (e.g., organic, halal).

For producers, developing a traceability system involves clear objectives, robust recordkeeping, and integration into quality systems. When properly implemented, it enhances food safety, trust, and trade compliance while remaining flexible to the producer's capacity. The following are the key steps for producers to develop a traceability system.

6.2.1 Define scope & purpose:

- Determine whether traceability applies to all stages or specific stages of the food chain (e.g., from raw input to final distribution).
- Clearly define the objective—whether it's food safety, authenticity, recall efficiency, or market compliance.

6.2.2 System design:

- Set up records that can identify:
  - One step back (from where the food/product came).
  - One step forward (to where the food/product is going).
- This means keeping supplier logs, production batch records, and distribution details.

6.2.3 Transparency & documentation:

- Develop written procedures and documentation systems to show traceability compliance.
- Be ready to share this with competent authorities (national or international) upon request.

1.1.4 Integration with inspection & certification:

- Integrate traceability into broader food inspection or certification systems (e.g., HACCP, ISO 22000).
- Utilize audits and quality systems to validate traceability accuracy.

6.2.5 Adaptation to local capabilities:

- Ensure the traceability system is practical and economically feasible, especially for small-scale or developing-country operations.
- Prioritize flexibility and cost-effective tools (e.g., simple barcode or lot number tracking).

6.3 Best practices and considerations

- Don't overcomplicate: Use systems proportional to the level of risk and nature of the product.
- Training is critical: Staff must understand the importance of accurate record-keeping.
- Technology can help: Consider digital platforms for efficiency, but paper-based records can suffice if consistently maintained.
- Trade implications: A robust traceability system supports export market access and protects against rejections due to unverifiable claims.

Sample questions for practice.

1. What are the functions, actors, and supporters of the honey value chain in Nepal?
2. Explain about vertical and horizontal linkage in the honey value chain in Nepal.
3. Describe the steps to develop traceability.

Session 31

Instrumental insemination in queen bees

1. Learning objectives

By the end of the session, the participants will be able to:

- Explain the importance and need of the instrumental insemination in queen bees
- Describe the material required and its safe handling while doing instrumental insemination
- Select the matured and quality drone for semen collection

2. Sub topics

- Introduction, aim, benefit, material required, method of instrumental insemination.
- Drone selection
- Collection of sperm from selected drone
- Insemination of an unmated queen with collected semen
- Activities after completing artificial insemination:
- Method for checking the success of the artificial insemination process
- Management of successfully inseminated queen bees

3. Methods and materials

1.1 Training methods

- Lecture
- Brainstorming
- Group discussion/Interaction
- practical exercise

1.2 Training materials

- Projector, Power points, Slides, Pictures.
- Marker, Brown paper, Pen, Masking tape, Meta card
- Insemination set with instrument stand, needles and accessories

- Binocular microscope with 10x to 20x magnification and cold light
- Carbon dioxide source with flow regulator and tubing
- Sterile vials, pipettes and bulbs or syringes
- 95% ethanol
- Sterile tissues, cotton swabs and paper towels or wipes
- Queen cage, virgin queen, matured drone

1.3 Time

Theory: 30 minutes

Practical: 140 minutes

Discussion: 10 minutes

1.4 Place: Training hall, lab

3. Activities and exercise

3.1 Inform participants about the topics covered in the training and inquire about their level of knowledge on the subject matter.

3.2 Presentation

Give short presentation on the introduction, aim, benefit, material required, method of ii, drone selection, collection of sperm from selected drone, insemination of a unmated queen with collected semen, Activities after completing artificial insemination, Method for checking the success of the artificial insemination process, Management of successfully inseminated queen bees as outlined in the source material.

4.3 Group division/ Practical exercise.

After theoretical session, take participants to the laboratory or room having instrumental insemination machine. Show them different parts and their function. Then collect some mature drone and collect semen. Demonstrate the insemination process to participants.

4.4 Discussion

Organize discussion session to obtain information on whether the participant is clear about how to facilitate other participants about instrumental insemination and to further review any unclear topics.

4. Detail schedule

S.N.	Subject matter	Description	Time	Materials
1.	introduction, aim, benefit, material required, method of ii.	Make participants to write down what they know about the ii.	10 minutes	Marker Pen, Meta card. ii sets
2	Drones selection and Collection of semen from them.	Discuss about drone selection and its semen collection method	10 minutes	Projector, Power point slides, Pictures, Videos, apiary, drone rearing venue, Harbo- syringe
3	Insemination of a unmated queen, Activities after completing artificial insemination	Provide information about scope of beekeeping	10 minutes	Projector, Power point slides, Pictures, Videos. ii sets, CO2 gascylinder, Fresh semen,
4	Practical exercise	Take participants to the laboratory or room having instrumental insemination machine. Show them different parts and their function. Then collect some mature drone and collect semen. Demonstrate the insemination process to participants.	140 minutes	ii sets, CO2 gas cylinder, Fresh semen,
5	Discussion		10 minutes	

6. Resource materials

6.1 Introduction

The concept of instrumental (artificial) insemination has been developed in the world to improve the bee population. The fertilization process in bees takes

place outside the hive, at a height of 10 to 25 meters above the ground. During mating, 10 to 30 thousand males form a drone congregation area (DCA) in the vicinity, and a single female mate with 10 to 20 males.

The queen becomes mated within a week of birth and stores the sperm she needs for her entire life in her seminal vesicle. Thus, a certain percentage of the male's sperm is mixed into the queen's seminal vesicle. Instrumental insemination (II) helps control this random fertilization process in bees and help them choose the male that will mated them. The first instrumental insemination procedure was performed in 1926 by Dr. Lloyd Watson. It is a procedure that helps control mating in bees for research and breeding purposes. It requires proper instruction, equipment, practice, skill, hygiene, patience, and commitment.

Special equipment is needed to collect semen from the matured male, place the collected semen in the vagina, and stabilize the vagina of queen bee. The inseminated queen is then placed in a beehive with proper technique and care.

6.2 Objectives of instrumental insemination

- To control the mating process of honey bees
- To control the quality of males that a honey bee mates with, how many males it mates with, and how much semen it deposits in its seminal vesicles
- To improve the bee population by selecting high-quality males for mating with the queen bees
- To provide easy access to the queen bees needed by beekeepers
- To prevent the loss of queen bees that have gone to mate due to bad weather and to prevent the loss of colonies

6.3 Benefits of instrumental insemination in bees

- A single male can be impregnated with one or more females, and the unique characteristics of the male can be expanded and promoted.
- Hundreds of male sperm can be pooled and inseminated in multiple queens, which increases uniformity and efficiency for colony improvement and maintenance.
- The process of instrumental insemination provides the ability to keep semen fresh for many days and to transport it safely from one place to another without any parasitic attack.
- With the help of instrumental insemination, the genetic properties of the bee colony can be controlled by breeding high-quality queens.

- In the instrumental insemination process, when males are selected from disease-free queens and inseminated, the offspring born from the produced queens are less likely to be infected with diseases.
- Bees produced through instrumental insemination have the potential to produce many offspring because beekeepers can ensure that their bees' mate only with high-quality males.
- The best qualities are selected in the bees produced through instrumental insemination, which reduces the chances of absconding and swarming of colonies.

6.4 Materials required for instrumental insemination

The following materials are required for instrumental insemination.

- Complete set of insemination instrument with stand, needles and accessories
- Binocular microscope with 10X to 20X magnification and cold light
- Carbon dioxide source with flow regulator and tubing
- Sterile vials, pipettes and bulbs or syringes
- 95% ethanol
- Sterile tissues, cotton swabs and paper towels or wipes
- Queen cage
- Drone holding Cage and flight box

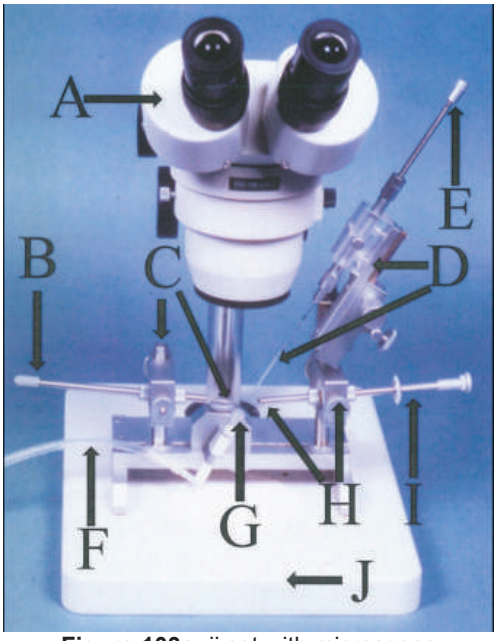


Figure 103a: ii set with microscope

A- A dissecting microscope

B- Handle for ventral hook

C- Ventral hook base (left C arrow) and ventral hook (right C arrow)

D- Syringe base (Upper D arrow) and syringe (lower D arrow)

E- Syringe plunger

F- Plastic tubing leading to CO2 source

G- Chamber in which queen is placed

H- Sting hook (left H arrow) and sting hook base (right H arrow)

I- Handle for sting hook

J- Microscope base

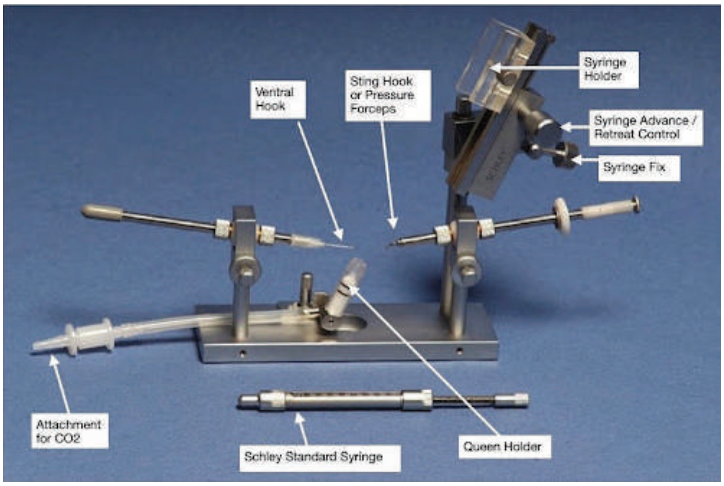


Figure 103b: Instrumental insemination set for virgin queen

Instrumental insemination process:

The artificial insemination process is mainly carried out in the following 3 main steps.

- Selection of the male
- Collection of semen
- Insemination of the female with the collected semen

6.5 Drone selection

It is very important task for selecting a matured male because semen cannot be collected from an immature male. Usually, a male is mature for insemination 14 days after birth. To identify mature males, a bank of males can be created and stored as soon as they are born, or males that have failed to mate the day before can be collected after 5 pm. After selecting a matured male, the endophallus, located in the posterior part of the male's abdomen, is inverted in two stages, partially and completely, so that the semen is visible outside.



Figure 104: Semen extraction

- Invert the male partially, as shown in Figure 104a, hold him by the neck and press on his abdomen, causing one pair of yellow cornea to emerge as shown in Figure 104b.
- Only if the male is mature, the testicles are yellow in color. The testicles of immature males have no color. After the testicles appear, the male is again held in the abdomen and pressed, causing the semen to appear outside, as shown in Figure 104c.
- This must be done with great care, otherwise the quality of the semen may be reduced by mixing it with the male's feces



Figure 105: Immature drone



Figure 106: Mature drone

6.6 Semen collection:

After the endophallus of a mature male bee is inverted, the semen is collected with the help of a needle/Harbo syringe and stored in glass tubes. The amount of



Figure 107: Contaminated Semen

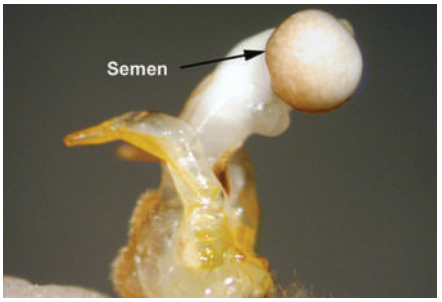


Figure 108: Pure Semen

semen obtained from each male varies, depending on the skill and experience of the person collecting the semen. Typically, about 1 microliter of semen can be collected from a male, and 8 to 12 microliters of semen are needed to inseminate a virgin queen.

When collecting semen, a little air is first collected in the needle, then a little saline solution is added, and the outer slippery layer of the semen is removed

and the semen is drawn into the needle. If the outer mucus layer is not removed, the needle will jam and semen collection will be difficult. The tip of the needle should not be allowed to dry while collecting semen, as sperm will die if the semen is dry and exposed to air.

6.7 Insemination of a female with collected semen:

The queen can be inseminated with semen collected 5 to 12 days after birth. The queen is inseminated with using carbon dioxide before insemination, which makes it easier to handle. Proper hygiene measures must be taken during this process.



Figure 109: Semen collection from drone

6.8 The process of conception

First, the queen is treated with carbon dioxide. Usually, 2 treatments are required. The first treatment is done 1 or 2 days before insemination, and the second treatment is done during insemination. The queen is treated by placing it in a jar or plastic bag filled with carbon dioxide. To make it easier to place the semen in the queen's seminal vesicle, the queen holder and the needle containing the semen are placed at an angle of 30 to 45 degrees with the instrument holder.





Figure 110: Separation of abdominal plates to expose

With the help of hooks and forceps, the abdominal layers are separated and the vagina of the queen is exposed. After opening the queen's vagina in this way, the collected semen is placed in a needle so that it reaches the uterus. About 8 to 12 microliters of semen is given to one female.

After insemination, the queen is removed from the holder, placed in a cage, and transfers in the nucleus hives.

6.9 Activities after completion of instrumental insemination:

Method of checking the success of the instrumental insemination procedure:

After artificial insemination is completed, the seminal vesicles of the female can be examined to determine whether the insemination process was successful. Sperm can be collected in the seminal vesicles within 40 hours after instrumental insemination. This test is a destructive procedure in which the queen dies and the tip of the queen's abdomen is cut and open to remove the sperm sac.

The seminal vesicle is a white, spherical organ about 1 mm in diameter. The seminal vesicle of an unfertilized virgin queen is empty and colorless, while the seminal vesicle of an inseminated queen is white.

1.9 Management of inseminated queens

After the insemination process is complete, the queen is placed in a queen cage and put in the nucleus hive. The queen begins laying eggs within 3 to 5 days of insemination. Once the queen begins laying eggs, the instrumental insemination process is considered to be completely successful. The queen produced through instrumental insemination can be sold or distributed to commercial farmers for breeding purposes.

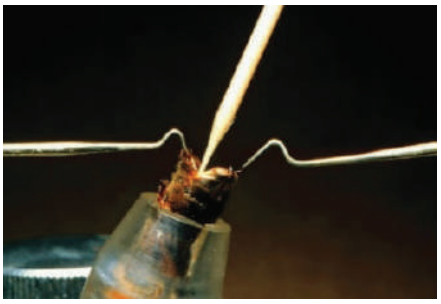


Figure 111: Insemination

Sample questions for practice

1. What are the main objectives of ii artificial queen in the apiary?
2. Describe the method of drone semen while doing ii in unmated queen bees.
3. Describe the insemination techniques in queen bees.

Session 32

Honeybee dance and bee pheromones

1. Learning objectives

By the end of the session, the participants will be able to:

- Explain the different types of dance of honeybees.
- Describe the different types of pheromones secreted by honey bees.
- Explain the function of these pheromones.

2. Sub topics

- Concept of honey bee dance and pheromones.
- Types and Importance of Honey bee dance.
- Analysis of different types of dance.
- Types and Importance of different pheromones secreted by different class of honeybees

3. Methods and materials

3.1 Training methods

- Lecture
- Brainstorming
- Group discussion
- Observation

3.2 Training materials

- Projector, Power points, Slides, Pictures.
- Marker, Brown paper, Pen, Masking tape, Meta card

3.3 Time

Theory: 80 minutes

Practical: 00 minutes

Discussion: 10 minutes

3.4 Place: Training hall

4. Activities and Exercise

4.1 Inform participants about the topics covered in the training and inquire about their level of knowledge on the subject matter.

4.2 Presentation

Give a short presentation on Concept of honey bee dance and pheromones, types and importance of Honey bee dance, analysis of different types of dance, types and Importance of different pheromones secreted by different class of honeybees as outlined in the resource materials.

4.3 Discussion

Use in depth discussion and question/answer to discover whether the participants have understood about honeybee dance and pheromones.

5. Detail schedule

S.N.	Subject matter	Description	Time	Materials
1	Introduction	Ask participants to write down what they know about the honeybee dance and pheromones.	10 minutes	Marker pen Meta card
2	Concept of honey bee dance	Discuss the concept of honey bee dance	10 minutes	Projector, Power point slides, Pictures, Videos.
3	Types and Importance of Honey bee dance.	Discuss different types of honey dance and their importance inside the colony by showing picture and videos of dance.	25 minutes	Projector, Power point slides, Pictures, Videos.
4	Concept and Types of Pheromones secreted by honeybees.	Elaborate the concept and types of pheromones secreted by queen, drone and worker bees along with their chemical composition.	15 minutes	Projector, Power point slides, Pictures, Videos.

S.N.	Subject matter	Description	Time	Materials
5	Importance and function of bee pheromones.	Elaborate the importance and function of different pheromones inside the bee colony	20 minutes	Projector, Power point slides, Pictures, Videos
6	Discussion		10 minutes.	

6. Resource materials.

6.1 Honey bee dance

Honey bee dance is the communication of information regarding to quality and quantity of the food source. The most important advantage of this social behavior is the ability to quickly mobilize large number of forager bees to gather floral resources that may only be available for a short period of time. The ability to communicate location with such precision is one of the most interesting behaviors of a very interesting insect. Austrian scientist *Karl von Frisch* first discovered and interpreted the honey bee dance and got Nobel prize in 1973. Honey bee can see UV light and identify direction according to solar navigation and earth's magnetic field.

6.1.1 Round dance

The bee round dance is a communication method used by honeybees to signal that a food source is located nearby, typically within 50 meters.

The forager bee performs the dance on the honeycomb by moving in a circular pattern, alternating between clockwise and counter-clockwise directions, and often sharing nectar with other bees to provide taste and scent information.



Figure 112: Round Dance

After the dance ends food is again distributed at this or some other place on the comb and the dance may be repeated three or (rarely) more times. The round dance does not give directional information. Bees elicited into foraging after a round dance fly out of the hive in all directions searching for the food source they know.

6.1.2 Waggle dance



Figure 113: Waggle dance

The waggle dance is a complex form of communication used by honeybees to inform their hive mates about the location of a food source, especially when it's farther than about 50 meters away. In this honey bee dance by making figure eight. The direction and duration of waggle runs are closely correlated with the direction and distance of the resource being advertised by the dancing bee.

Direction of the food source is indicated by the direction the dancer faces during the straight portion of the dance when the bee is waggling. If she waggles while facing straight upward, then the food source may be found in the direction of the sun.

If she waggles at an angle 60 degrees to the left of upward the food source may be found 60 degrees to the left of the sun.

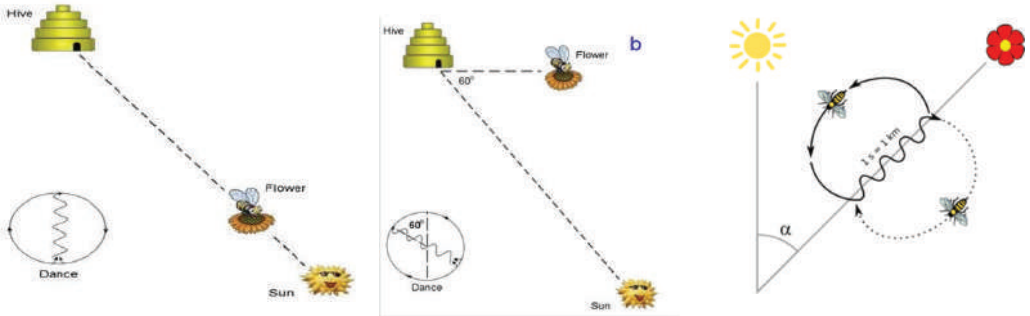


Figure: 114 Different angles in waggle dance

Waggle dance indicates

a) Direction:

Honey bee dance according the angle between food source and sun.

b) Distance:

Based on the waggle phase they communicate the distance of food source. Waggle phase is longer for the food which is far.

c) Quality:

The duration of the dance (total waggle runs) determines the quality o food sources**.**

d) Taste and smell:

Dancer gives free samples to waiting bees inside hives.

6.1.3 Tremble dance

This dance can take up to 30 minutes to perform. The bee shakes as she moves in a line across the hive, turning her body 45 degrees every minute or so. The tremble dance is used to communicate that more help is needed in receiving returning forager bees. Forager bees collect pollen and nectar and when they return to the hive, they pass on nectar and pollen to receiver bees at the entrance of the hive. If more bees are needed to collect at the entrance, the Tremble Dance is performed and new bees will stop what they're doing and help out. It involves shaking the body back and forth and rotating, indicating the need for more nectar receivers to unload the foragers.

Purpose: To get more bees to act as receiver bees and help unload nectar.

Trigger: A forager bee returns with high-quality nectar but has trouble finding a receiver to pass it to.

Effect: It dramatically increases the number of bees in the hive that are ready to receive nectar from returning foragers.

6.1.4 Sickle dance

The sickle dance of a honey bee is a crescent-shaped dance that communicates the location of food sources between 50 and 150 meters from the hive. It is a transitional dance between the simpler round dance (for very close food sources) and the more detailed waggle dance (for food sources farther away). The sickle dance indicates a distance similar to the waggle dance but lacks the "waggle" part in the middle.

Purpose: To communicate the location of food sources that are at an intermediate distance from the hive.

Description: A transitional dance between the round dance (for close food) and the waggle dance (for far food).

Shape: It is a crescent-shaped dance.

6.2 Bee pheromones.

Honey bee pheromones are chemical messengers secreted by queen, worker, drone, brood to elicit a response in other bees. Honey bees have one of the most complex phenomenal communication systems found in nature, possessing 15

known glands that produce an array of compounds. The chemical messages are received by the bee's antenna and other body parts. They are produced as a volatile or non-volatile liquid and transmitted by direct contact as a liquid or vapor.

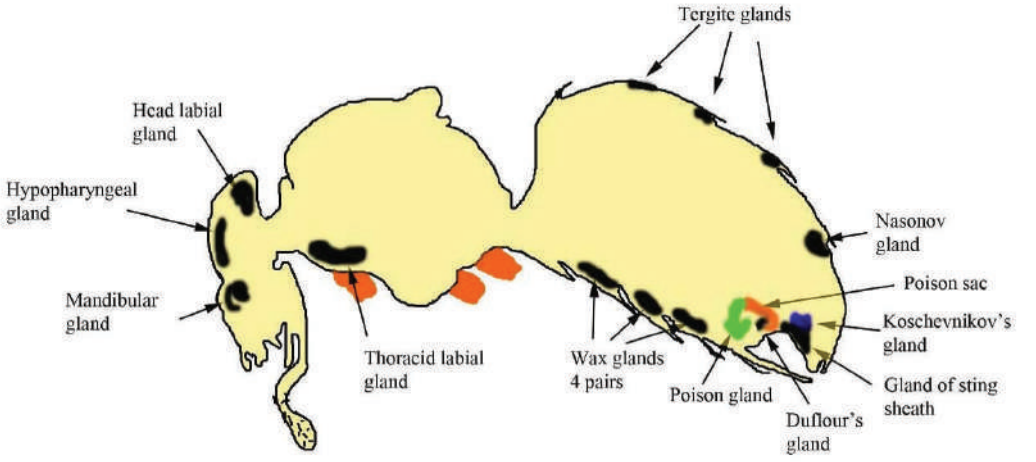


Figure 115: Different glands of bee body

Pheromones are grouped into releaser pheromones and primer pheromones. Releaser pheromones have temporary effect on recipient's behavior, and primer pheromones have a long-term effect on the physiology of the recipient. The pheromones may either be single chemicals or a complex mixture of numerous chemicals in different percentages.

6.2.1 Queen pheromones

6.2.1.1 Queen mandibular pheromone

Queen mandibular pheromone (QMP), emitted by the queen, is one of the most important sets of pheromones in the bee hive. It affects social behavior, maintenance of the hive, swarming, mating behavior, and inhibition of ovary development in worker bees. It contains 9-Oxodec-2-enoic acid (9-ODA), 9-Hydroxydec-2-enoic acid] (-9-HDA) 9-Hydroxydec-2-enoic acid] (+9-HDA), Methylparaben and 4-Hydroxy-3-methoxy phenylethanol.

6.2.1.2 Queen retinue pheromone- QRP

The combination of the 5 QMP compounds and the Methyl oleate, Coniferyl alcohol, Cetyl alcohol and α-Linolenic acid is called the queen retinue pheromone (QRP). These nine compounds are important for the retinue attraction of worker bees around their queen.

6.2.2 Worker pheromones

6.2.2.1 Alarm pheromone

Two main alarm pheromones have been identified in honeybee workers One is released by the Koschevnikov gland, near the sting shaft, and consists of more than 40 chemical compounds, including isopentylacetate (IPA), butylacetate, 1-hexanol, *n*-butanol, 1-octanol, hexyl acetate, octyl acetate, *n*-pentyl acetate and 2-nonanol. Alarm pheromones are released when a bee stings another animal, and attract other bees to the location and causes the other bees to behave defensively, i.e. sting or charge.

The other alarm pheromone is released by the mandibular glands and consists of 2-heptanone, which is also a highly volatile substance. This compound has a repellent effect and it was proposed that it is used to deter potential enemies and robber bees.

6.2.2.2 DuFour's gland pheromone.

The gland secretes its alkaline products into the vaginal cavity, and it has been assumed to be deposited on the eggs as they are laid. DuFour's secretions allow worker bees to distinguish between eggs laid by the queen, which are attractive, and those laid by workers. The complex of as many as 24 chemicals differs between workers in "queenright" colonies and workers of queen less colonies. In the latter, the workers' DuFour secretions are similar to those of a healthy queen.

6.2.2.3 Footprint pheromones.

This pheromone is left by bees when they walk on and is useful for other workers to find nectar source and hive entrance. In the queen, it is an oily secretion of the queen's tarsal glands that is deposited on the comb as she walks across it. This inhibits queen cell construction (thereby inhibiting swarming), and its production diminishes as the queen ages.

6.2.2.4 Forager pheromones.

It is Ethyl oleate compound that is released by older forager bees to slow the maturing of nurse bees. This primer pheromone acts as a distributed regulator to keep the ratio of nurse bees to forager bees in the balance that is most beneficial to the hive.

If the number of foraging bees is sufficient, it will inhibit the new nurse bees from quick maturing and foraging. But if the number of foraging bees is low, the effect of this pheromone is reduced, causing the nurse bees to mature faster and

start foraging. This plays a role in increasing the efficiency of the bee colony, so that the number of bees is managed correctly and the balance in the hive is maintained.

6.2.2.5 Nasanov pheromone.

Worker bees emit this pheromone, which helps in orientation of the hive and attracting new bees, helps to locate the hive, helps to gather bees in new locations during swarming, attracts bees to sources of water, pollen, nectar and helps to identify flight paths.

6.2.3 Drone

Drone Mandibular gland secrets this pheromone to attract other flying drones to suitable sites for mating with virgin queens.

6.2.4 Brood recognition pheromone.

Larva and pupae emit this pheromone that prevent worker bees to bear offspring in a colony. This inhibits ovarian development in worker bees and helps nurse bees distinguish worker larvae from drone larvae and pupae. This pheromone is a ten-component blend of fatty-acid esters.

6.2.5 Other pheromones.

6.2.5.1 Rectal gland pheromone: Produced in the Rectal Gland. Also found in drone bees, it helps in finding a potential mate.

6.2.5.2 Wax gland and comb pheromone: Found in wax produced in the Wax Gland. Mainly helps to attract new worker bees to build combs and to identify the primary egg-laying site for the queen bee.

Sample questions for practice.

1. What is the purpose of bee dance?
2. Explain the major dances performed by honey bees.
3. Describe the function of pheromone secreted by queen bee.

Session 33

Bee insurance and existing insurance policies in Nepal

1. Learning objectives

By the end of the session, the participants will be able to:

- Explain the existing bee insurance policy of Nepal
- Describe the need and importance of insurance in beekeeping
- Analyze the procedure of insurance
- Explain about the claim process of insurance

2. Sub-topics

- Honey bee insurance in Nepal
- Importance of bee insurance
- Existing bee insurance policy/product
- Coverage and exclusions of insurance policy
- Procedure of insurance.
- Claim process

3. Materials and methods

3.1 Training methods

- Lecture
- Brainstorming/experimentation
- Group discussion
- Practical exercise

3.2 Training materials

- Projector, power point slides, pictures
- Marker pen, brown paper, pen and masking tape, meta card

3.3 Time

Theory: 110 minutes
Practical: 60 minutes
Discussion: 10 minutes

3.4 Place: Training hall

4. Activities and exercises

4.1 Inform the participants about the lecture/practical exercises included in the training and obtain information about the level of knowledge of the participants on the subject.

4.2 Presentation

Give a short presentation on honey bee insurance in Nepal, importance of insurance, existing bee insurance policy, coverage of policy, procedure of insurance and claim process as outlined in the resource materials.

4.3 Practical exercises

After theoretical session, give individual participants mathematical problems to find out sum insured amount, insurance premium, commission to technicians, claimed amount etc. under different situations and circumstances. Discuss the procedure followed by each participants and tally with right answer. If some participants are still confused, repeat them the procedure until they have confidence to solve problems.

4.4 Discussion

After practical exercise discuss to find out whether they are clear and to discuss topics to clarify if they are not clear.

5. Detail schedule

SN	Subject matter	Description	Time	Materials
1	Honey bee insurance in Nepal	Ask participants to write what they know about honey bee insurance.	5 minutes	Marker, pen, meta card
2	Importance of bee insurance	Discuss with participants about importance of bee insurance.	10 minutes	Projector, PPT slides, photo, video
3	Existing honey bee insurance policy/product	Explain the existing honey bee insurance policy and its special provisions.	30 minutes	Projector, PPT slides
4	Coverage and exclusions of insurance	Elaborate the coverage and exclusions of insurance.	20 minutes	Projector, PPT slides, photo, video

SN	Subject matter	Description	Time	Materials
5	Procedure of insurance	Discuss with participants about the procedure of insurance.	25 minutes	Projector, PPT slides, photo, video
6	Claim process	Discuss in depth about the claim process if damage happened.	20 minutes	Projector, PPT slides, photo, video
6	Practical exercise	Give individual participants mathematical problems to find out sum insured amount, insurance premium, commission to technicians, claimed amount etc. under different situations and circumstances.	60 minutes	Mathematical problems, chart paper
7	Discussion		10 minutes	

6. Resource materials

6.1 The Importance of honey bee insurance in Nepal

Honey bee insurance plays a crucial role in safeguarding the livelihoods of Nepalese beekeepers, many of whom rely on apiculture as a primary or supplementary source of income. Given the sector's vulnerability to climate change, diseases, pests, and environmental hazards, insurance provides a critical safety net that helps beekeepers recover from losses and continue their operations. It also encourages the adoption of modern beekeeping practices and promotes commercial apiculture, contributing to rural income generation, biodiversity conservation, and agricultural productivity through pollination services. In this context, honey bee insurance supports not only individual farmers but also the broader goals of sustainable agriculture and economic resilience in Nepal. The bee farming has a vital role of economic aspect of bee keeper farmers and entrepreneur. The importance of honey bee insurance can be outlined as follows:

6.2 Existing Honey bee insurance policy/product

The Honey Bee Insurance policy has been in effect since 2013, following its approval by the Nepal Insurance Authority for implementation by non-life insurance companies across the country. This policy is structured on a cost-of-

production basis, providing coverage specifically for the hive, bee colony, and associated management costs. In the event of loss or damage to the insured honey bees and their accessories, caused by the perils outlined in the policy, the insurance company compensates the policyholder based on the nature and extent of the loss.

6.3 Coverage

This insurance policy covers the damage caused by following reasons:

- Loss or damage caused by fire or due to fire-related incidents.
- Wind-related damages:
  - Damage caused by strong winds or storms.
  - Damage caused by cyclones or hurricanes.
- Water-related and weather-induced damages:
  - Damage caused by heavy or unseasonal rainfall.
  - Damage caused by hail or snow.
  - Damage caused by floods or waterlogging.
  - Damage caused by drought
  - Damage caused by frost
  - Damage caused by cold waves.
- Land-related damages:
  - Damage caused by earthquakes
  - Damage caused by landslides or land slippage.
- Damage caused by lightning.
- Damage resulting from sudden or accidental external causes.
- Damage caused by wild animals and birds by eating, trampling, scratching, digging, pecking, or dislodging.
- Damage due to disease, pests, or pesticides:
  - Damage caused by diseases
  - Damage caused by insects and pests
  - Damage caused by pesticides.
- Damage to the hive during the transportation or shifting of bees to foraging areas due to strikes or shutdowns.

(Note: During transportation, only bees must be present in the transport vehicle.)

6.4 Accidental insurance

There is a provision of one-year accidental insurance for farmers with Rs. 200 premium. In case of death due to any accident other than suicide, a spinal injury resulting in permanent paralysis of the spinal cord, total loss of the use of one or both arms above the wrist, total loss of the use of one or both legs above the ankle, and complete loss of vision in both eyes.

6.5 Exclusions

- Any indirect damage resulting from beekeeping-related losses.
- If honey production does not occur
- If beekeeping is destroyed by order of the authorized authority.
- If beekeeping is damaged due to exposure to radioactive substances or contaminated waste.
- If damage occurs due to the use of nuclear, chemical, or biological mass destruction weapons.
- If damage occurs due to military rebellion, abduction of power, siege, war, invasion. foreign military action, or any similar warlike action, civil war, sedition, or similar situations.

6.6 Insurance policy and terms related to insurance

6.6.1 Submission of proposal form:

- Before purchasing the insurance policy, the insured must fully complete and submit the proposal form.
- When submitting the proposal form the insured must attach a technical inspection report from the relevant technician certifying whether the proposed bee colony is technically suitable or insurable.

6.6.2 Issuance of insurance policy:

- After receiving the proposal form and the technical inspection report, the insurer shall issue the insurance policy.
- The insurance for beekeeping may be based on the cost.

6.6.3 Re-examination, testing, and inspection

After the issuance of the insurance policy, the technician shall re-examine, test, and inspect the bee colony recommended for insurance at least once during the insurance period. The technician must provide a report of this inspection as per Schedule-4 to the insurer. The insurer must keep the inspection report attached with the insurance policy.

6.7 Duration of insurance policy: The duration of the insurance policy shall be one year.

6.8 Sum insured and insurance premium

Sum insured: I+II+III

I= Actual price of bee hive along with stand

II= Actual price of honeybee colony

III= Average Management cost per year

Insurance premium= 5% of sum insured

6.9 Claims process

6.9.1 Notification of damage:

- In case of damage to the insured bee colony under this insurance policy, the insured must inform the insurer within three days of the damage via telephone, SMS, written letter, email, fax, or any other means.
- After receiving the information, the damage assessor may conduct an inspection, and in such cases, the damaged location must be secured until the inspection is carried out.

6.9.2 Necessary documents for the claims process:

The insured must submit the following documents to the insurer for the claim's payment process:

- A fully completed claim form, for total damage, a copy of the original insurance policy, and for partial damage, a copy of the insurance policy.
- A site report (The report must have signatures from at least five people, and their names, surnames, addresses, and contact numbers should be clearly mentioned).
- A recommendation from the agricultural service technician or branch of the local government, or if such a service is unavailable, a recommendation from the ward office confirming the damage.
- An updated record as per Schedule-7 mentioned in this insurance policy.

6.9.3 Claim:

- The insured must submit the required documents as per Section 25 to the insurer to make an insurance claim.
- While making the payment for the beekeeping insurance claim, the insurer must consider the claim payment schedule based on Schedule-8.

6.9.4 Claim settlement:

- After the claim is made as per Section 26, the insurer must immediately initiate the claim settlement process for the bee colony insurance.
- Upon receiving the information or notice regarding the insurance claim, the insurer must assist the insured in completing the claim settlement process.
- After receiving the necessary documents as per subsection (1), the insurer must send a damage assessor within seven days of receiving the damage report from the insured (unless the insurer is conducting the damage assessment themselves).
- The damage assessor must attach at least five steady photographs taken from different angles and a video clip of at least one minute, along with the damage assessment report in accordance with Schedule-9, clearly showing the damage to the insured bee colony. If, for any reason, the damage assessor cannot take the photographs or video, the insured may provide at least five steady photos and a video clip of at least one minute showing the damage.
- The damage assessor must prepare and submit the damage assessment report, in physical or electronic form, to the insurer within fifteen days from the date of being assigned the assessment.
- If the damage assessor is found to have made an incorrect assessment or acted in violation of this policy, the insurer may assign a new assessor for re-evaluation with the approval of the authority.
- Even if the insurer conducts the damage assessment themselves, the damage assessment report must be attached in accordance with Schedule-9 within the period mentioned in subsection (5).
- Within thirty-five days of the damage assessor submitting the assessment report, the insurer must determine the liability and pay the claim to the insured. If the insured does not receive the claim amount, the insurer must provide written information with the reasons.
- When making the claim payment as per subsection (8), the insurer must pay only the amount equivalent to the actual damage or the sum insured, whichever is less, based on the actual damage that occurred at the time of the incident.
- The insurer shall deduct ten percent or ten thousand rupees, whichever is less, from the payable amount under the claim, and then proceed with the payment.

1.10 Miscellaneous

6.10.1 Meaning of terms used in the insurance policy:

The insurance policy, including the insurance proposal form, schedules, tables, and insurance premium payment receipts, must be understood as a single beekeeping insurance agreement or policy. These documents should not be read, understood, or interpreted separately or in isolation to determine the meaning of the policy.

6.10.2 Minimum number of hives:

For insurance purposes, beekeeping must be carried out in at least five hives.

6.10.3 Complaints:

The insured may file a complaint with the authority (Central and provincial offices of NIA) in the following circumstances:

- If the insurer does not register the claim request.
- If the insurer fails to provide the amount due for the claim
- If the insured believes that the amount paid by the insurer for the claim is insufficient.
- If the insurer pays the claim amount to a party other than the insured or policyholder
- If any other dispute arises related to the insurance claim.

Sample questions for practices

1. What are the importance of honey bee insurance?
2. What are the coverage and exclusions of bee insurance policy?
3. What is the claim process?

Session 34

Bees and pesticides

1. Learning objectives

By the end of the session participants will be able to:

- Identify bee poisoned by pesticides. from pesticides killing.
- Identify symptoms of bee poisoning
- Practice appropriate measures to minimize loss of bee colonies.
- Explain about the adverse effects of pesticides on beneficial insects and pollinators from pesticide application in crop fields.

2. Sub topics

- Introduction
- Bees coming in contact with pesticides
- Symptoms of pesticide poisoning
- Protecting bees from pesticide poisoning
- Insecticide toxicity to bees
- Beekeeping and integrated management

3. Methods and materials

3.1 Training methods

- Lecture
- Brainstorming/experimentation
- Group discussion
- Identifying symptoms of pesticide poisoning on bees
- Practicing selective measures to safeguard bees
- Identifying types of pesticides and their toxic effects to bees
- Beekeeping and integrated management
- Visits and observation of practices to minimize loss of bee colonies from pesticides

3.2 Training materials

- Projector, power point slides, pictures
- Marker pen, brown paper, pen and masking tape, meta card
- Collection of samples/videos of bees and pesticides applications
- Collection, observation and identification of bees poisoned by pesticides
- Identification of selective pesticides and their toxicity to predators and pollinators.
- Microscope/hand lens

3.3 Time

Theory: 50 minutes

Practical: 30 minutes

Discussion: 10 minutes

3.4 Place: Training hall, bee farm, laboratory

4. Activities and exercises

4.1 Inform the participants about the lecture/practical exercises included in the training and obtain information about the level of knowledge of the participants on the subject.

4.2 Presentation

Give short presentation on pesticides, situation of bees coming in contact with pesticides, pesticide toxicity to beneficial insects, symptoms of bee poisoning, practices to protect bees from pesticide poisoning, and integrated management as outlined in the resource materials.

4.3 Group division/practical exercises

Divide participants into 4 groups and complete the following tasks during the practical exercises.

1. Identify types of pesticides and their toxicity to bees.
2. Observe and identify bees poisoned with pesticides.
3. Visit and observe apiary areas and practices for managing bees from pesticide poisoning.

Take participants to bee farm in order to observe and identify some pesticides and bee samples to demonstrate pesticide effects on bees. Similarly, introduce them to identifying pesticide poisoning symptoms. Then provide them some

selective pesticides and ask to identify their level of poisoning to pollinators (bees), and beneficial insects. If available, use binocular / hand lens to observe the process more clearly.

4.4 Discussion

After returning from the bee farm, organize group presentation to present the results of their observations. Ask participants about pesticides, pesticide poisoning to bees, symptoms of poisoning and practicable measure to minimize loss of bee colonies, to find out whether they are clear and to discuss topics to clarify if they are not clear.

5. Detail schedule

SN	Subject matter	Description	Time	Materials
1	Introduction	Ask participants to write name of pesticides commonly used by farmers to spray in crop fields.	5 minutes	Marker, pen, meta card
2	Bees coming in contact with pesticides	Discuss with participants to list different situation of bees coming in contact with pesticides in their locality.	10 minutes	Projector, PPT slides, photo, video
3	Symptoms of poisoning	Discuss with participants to identify the symptoms of bee poisoning with pesticides.	15 minutes	Projector, PPT slides,
4	Protecting bees from pesticide killing/poisoning	Discuss with participants to follow common practices to minimize bee colony loss from pesticide application in crop fields.	10 minutes	Projector, PPT slides, photo, video
5	Pesticide toxicity and integrated management	Discuss with participants about toxicity levels of different pesticides to pollinators (bees) and beneficial insects.	10 minutes	Projector, PPT slides, photo, video

SN	Subject matter	Description	Time	Materials
6	Practical exercise	Organize participants in four groups and visit to apiary areas, crop fields to observe protective measures to save bees from pesticide poisoning, if possible with the help of binocular/hand lens.	30 minutes	Bees, bee flora, honey potential plants, conservation areas
7	Discussion		10 minutes	

6. Resource materials

6.1 Introduction

Pesticides are *substances that are used to control pests. Many types of pesticides like, insecticides, fungicides, herbicides are available in the market and their use is increasing every day. P*esticides application on field crops have many side effects, one of them is toxicity to honey bees due to contamination of nectar, pollen, and foliage, which leads to loss in production of honey, contamination of bee products, and reduction in the yield of cross-pollinated crops. Direct exposure occurs from pesticide application when bees are visiting flowers in crop fields during spraying and indirect exposure occurs from the spray drift or bee foraging in sprayed crops. Thus, pesticide application to crop plants eliminate the large number of pollinators. To safeguard bees, beekeepers should collaborate with pesticide users, ensuring proper timing of pesticide applications and using buffer zones to minimize their exposure. Location of bees, pesticide formulation, selection of pesticides, timing and method of application, dosage of pesticide, these are some of the points to be noticed to reduce the pesticide poisoning to bees.

6.2 Bees coming in contact with pesticide

Bees are exposed to various pesticides through different routes (Figure 1). For example, during the forging process, bees come in direct contact on the treated crop fields. Particles of pesticide formulations contain poison that adhere to feeding bees or the entire colony after spray drift. Pesticide residues runoff from the treated field crop to nearby areas and spread to forage plants that are not sprayed but are blooming close to the sprayed crops.

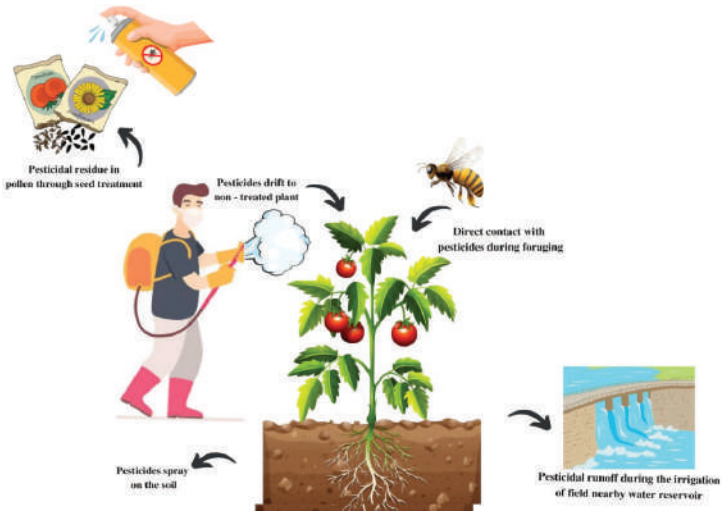


Figure 116: Routes of exposure to different pesticides in honeybees

- Pesticide sprays on crops while bees are foraging coming in direct contact with poison.
- Drift of toxic chemicals in apiary areas, and plant parts- flower, pollen, nectar.
- Bee feeding on contaminated food, water sources or collecting pollen and nectar.
- Use of highly toxic chemicals, broad spectrum insecticides, growth regulators, dust formulations, weather condition and age of bee colony.

6.3 Symptoms of pesticide poisoning

- Dead bees near the entrance of hive or colonies.
- Dead bees on the top of frames or bottom board.
- Lack of recognition of guard bees.
- Aggressiveness of worker bees.
- Worker bees vomiting nectary fluids.
- Fighting among bees in the colony.
- Paralyzed bees crawling and unable to fly.
- Sudden decline in food storage and brood rearing in hive.
- Dying bees showing their protruded tongue.
- Dead and deserted broods and depleted population in the colony.
- Poor recognition of pollen and nectar by bees.
- Finally, resulting in contamination of bee products.

6.4 Protecting bees from pesticide

Bee poisoning associated factors and protective means are as follows:

- **Selection of pesticide**: Selecting safer pesticides to protect crops and minimize effects on bees and pollinators such as use of less hazardous, selective and repellent (Bt, methyl Salicylate) insecticides.
- **Botanical pesticides**: The botanical insecticides are derived from plant sources like nicotine, quassin; veratrine; anabasine; rotenone; ryan; tephorosia; pyrethrins. These insecticide materials do not show large negative influence on bees and on pollinators.
- **Formulation of pesticide**: Different types of formulations such as Dust, EC, WP, SC, Gr are available in the market and among them granules are safer to bees. Also avoid formulations with attractants like Sevimol during crop bloom period, while, addition of adjuvant Sylgard 309 silicone surfactant helps to reduce bee mortality.
- **Time of spray**: Day time spraying harms to field foraging, bees, reduces pesticide effectiveness due to direct sunlight, person using apron become restless due to high temperature and poisoned while spraying. Spraying pesticides in evening time is safer to user and bees.
- **Apiary site**: Selecting apiary sites away from pesticide/chemical factories. Usually foraging bee colonies should be kept at least five km away from pesticide poison areas.
- **Feeding bees**: Providing a water: sugar (1:1) syrup to support bees inside the hive, as they may be unable to forage for nectar due to pesticide exposure.
- **Need based application**: Farmers blindly follow regular sprays, which is wastage of time, resource and precious loss of beneficial organisms, like bees. Need based use of pesticides saves time, cost and minimizes loss of bees.
- **Bee strains**: Domesticated bee species are highly susceptible to pesticides and therefore, breeding and selection for tolerant and high honey producing strains support beekeepers.
- **Integrated pest management (IPM)**: Beekeepers following IPM practices benefits from various aspects in beekeeping, crop pollination and pest management.
- **Link of beekeepers and farmers:** Informing the beekeepers in advance about the spray program. Growers can inform beekeepers to know where, when, and what type of pesticides they are using.

6.5 Beekeeping and integrated pest management

Exposure of honey bees to pesticides is a serious challenge. New pesticides with new formula, emerged out which are potentially hazardous to bees and other pollinators of plants. Presence of bee populations with greater abundance and rich diversity is necessary for guaranteed pollination of domesticated crops and wild plants. There exists strong association between pollinating plants and pollinators, of which bees are the best pollinators. Therefore, the loss of interactions between the bees and plants could have inescapable effects accelerating species extinctions and negative impact on ecosystem functions.

Farmers following need-based application of insecticides and integrated management (considering economic threshold) of crop pest and disease can reduce the pesticide load in the field, save natural beneficial organisms and safeguard both beekeeping and crop production. In this line, many bio-botanical products, which are least-polluting are efficient in insect pest and disease control. Integrated pest management take consideration of all those efforts with least relying on chemical pesticides promoting pollination of agricultural entomophilous crops by bees an important agro-technical measure that contributes to a natural, clean and without any additional investment growth in the production of seeds, fruit and vegetables.

6.6 Insecticide toxicity to bees

Insecticide toxicity is generally measured using acute contact toxicity values LD_{50} -the exposure level that causes 50% of the population exposed to die. The LD_{50} provides general measure of toxicity to individual of social insects like honeybees. Mixing of different pesticides may have synergistic effects, such as mixtures of pyrethroid insecticides and fungicides applied to honeybees in the laboratory have increased toxicity in the range of 10 to 100-fold (Figure 117).

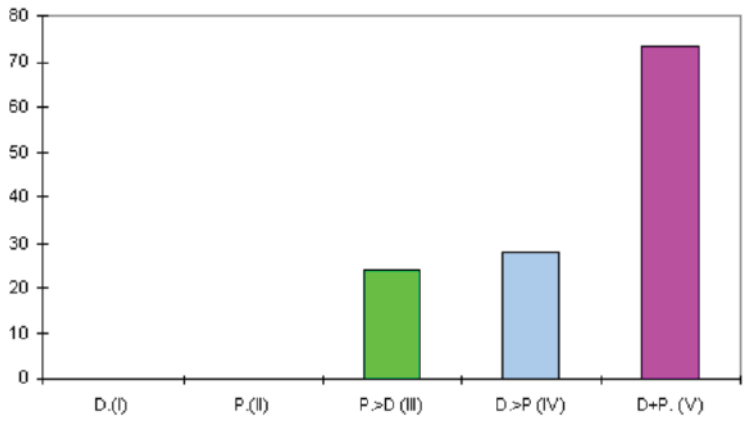


Figure 117: The synergistic effects of the combination insecticide-fungicide

if deltamethrin (D) and prochloraz (P) are sprayed separately (I and II) where they are sprayed one after another (III and IV) where they are used together (V). deltamethrin doses used 0.125 g/ha, prochloraz: 25 g/ha.

However, honeybees have also shown filter mechanism. For example, the amount of pesticide determined in nectar in rape field ranged from 0.1-30mg/kg and the one determined in centrifuged honey ranged from 2-18 micrograms/kg (1000 times less than in nectar). This phenomenon is due to the filter effect exerted by honey bees. Studies have shown that the degree of contamination of bee products is as follows: propolis> wax> pollen> honey. Toxicity thresholds of pesticides are generally fixed as highly, moderately, slightly, non-toxic.

1. **Highly toxic** (acute LD_{50} < 2 µg /honey bee)
2. **Moderately toxic** (acute LD_{50}: 2 - 10.99 µg/honey bee)
3. **Slightly toxic** (acute LD_{50}: 11 - 100µg/honey bee)
4. **Non-toxic** (acute LD_{50} > 100µg/bee) to adult honey bees

The adverse effects on beneficial insects (honeybee, lady beetle and lacewing) from application of pesticides in crop fields are presented in Table 1.

Table 24. Adverse effect on beneficial insects from use of pesticide in crop fields

Pesticides	Honeybee	Lady beetle	Lacewing
Abamactin	**	*	***
Acephate	***	***	***
Acetamiprid	**	**	**
Azadirachtin	*	*	*
Azinphos-methyl	***	***	***
Bifenazate	-	*	*
Bifenthrin	***	***	***
Buprofezin	*	-	*
Chlorpyrifos	***	***	***
Cryolite	-	-	-
Cyfluthrin	***	***	***
Cyhalothrin-gamma/lambda	***	***	***
Cyromazin	*	-	-
Diazinon	***	***	***
Dicofol	*	*	*

Dimethoate	***	***	***
Dinotefuran	***	***	***
Emamectin	**	*	**
Esfenvalerate	***	***	***
Fenpropathrin	***	***	***
Imidaclorprid	***	***	**
Malathion	***	***	***
Methamedophos	***	***	***
Methomyl	***	***	***
Methoxyphenozide	-	-	-
Naled	***	***	***
Oils	-	*	*
Oxamyl	***	***	***
Oxydemeton-methyl	***	***	***
Permethrin	***	***	***
Pymetrozine	-	-	-
Pyrethrins+Rotenone	**	**	**
Pyrethrins+PBO	**	**	**
Pyriproxifen	*	***	*
Soaps	-	**	***
Spinosad	**	**	**
Spiromesifen	-	**	**
Sulfur	*	*	*
Tebufenozide	-	-	-
Thiamethozam	***	***	*
Zeta-cypermethrin	***	***	***

= No, * = Slight, ** = Medium, *** = High

Sample questions for practice

1. Prepare a list of pesticides used by framers in crop fields in your locality, and identify their toxic category to beneficial insects
2. Enlist major symptoms of pesticide poisoning of bees.
3. What are the practicable measures to minimize pesticide poisoning of bees ?

Session 35

Policy backstopping in beekeeping sector

1. Learning objectives

By the end of the session, the participants will be able to:

- Explain the existing bee promotion policy, 2073 and **Nepal Good Beekeeping Practice Implementation Guideline- 2074 B. S.**
- Describe the other supportive legislative documents like act, regulations and policy of other sectors that have indirect support or influences over beekeeping.

2. Sub-topics

- Sharing the bee promotion policy, 2073
- Sharing the Nepal Good Beekeeping Practice Implementation Guideline-2074 B.S.
- Provision of other supportive legislative documents like act, regulations and policy of other sectors that have whether direct or indirect support or influences over beekeeping.

3. Methods and materials

3.1 Training methods

- Lecture/Presentation
- Brain storming
- Group discussion/Observation

3.2 Training materials

- Projector, power points, slides, pictures
- Marker, brown paper, pen, masking tape, meta card

3.3 Time

Theory: 150 minutes

Group Presentation: 20 minutes

Discussion: 10 minutes

Note: 2 sessions

3.4 Place: Training hall, Apiary

4. Activities and exercise

4.1 Inform participants about the existing policy instruments and inquire about their level of knowledge on the subject matter.

4.2 Presentation

Give a comprehensive presentation on direct and indirect Policy backstopping in beekeeping sector as outlined in the resource material.

4.3 Group division/group review and presentation

Divide the participants into 3 groups and complete the following tasks during the group discussion.

1. Strength and weakness of the existing bee promoting policy of Nepal.
2. Strength and weakness of the existing Good Beekeeping Practice of Nepal.
3. Strength and weakness of the other supportive legislative documents like act, regulations and policy of other sectors that have indirect support or influences over beekeeping.

Conduct a **group review and discussion** on one of the specified topics. As part of the group exercise, make them discuss, synthesize and present first in **small group presentation**, and then present it to the **larger group**. After each presentation, organize a **discussion session** in the larger group.

1.5 Discussion

After completing the theory session, use in depth discussion and question and answer to discover whether the participants can analyze the existing policy documents, understand the way in which tasks and activities are divided among them, and whether the participants are clear about the bee promotion policy and Good Beekeeping Practice. Any unclear or misunderstood issues can be further clarified during the review

5. Detail schedule

SN	Subject matter	Description	Time	Materials
1	Introduction	Participants will write down their existing knowledge about the provision of legal framework for beekeeping sector in Nepal.	10 minutes	Marker pen, meta cards

SN	Subject matter	Description	Time	Materials
2	Presentation on bee promotion policy 2073	Provide an explanation on Bee Promotion Policy 2073, need and objective of the same and other legal instruments for the promotion of bee sector.	50 minutes	Projector, PPT slides
3	Presentation on good beekeeping practice 2074	Explain about the importance and objectives of Good Beekeeping Practice 2074.	60 minutes	Projector, PPT slides
4	Other legislative documents supportive to this sector	Beside bee policy and GBB explain other relevant legislative documents.	30 minutes	Projector, PPT slides
4	Group discussion review and presentation	Divide participants into three groups. Each group will discuss, focusing on assigned topics during the review and group discussion. Groups will then prepare and deliver a presentation to the larger group.	20 minutes	Brown paper, marker, meta card
5	Discussion	Conduct a final review session based on group presentations.	10 minutes	

6. Resource materials

6.1 Beekeeping promotion policy 2073 B.S.

6.1.1 Goal and objectives of policy

Goal:

To develop beekeeping as a competitive and commercial profession, generate employment, substitute imports, and promote exports.

Policy objectives

1. Enhance foraging resources, strengthen and manage bee colonies, improve infrastructure, and ensure technical knowledge is accessible to all beekeepers. Also promote product diversification.

2. Increase production, productivity, reduce costs, and improve quality of bee products. Promote national and international markets and balance trade.
3. Conserve native and local bee species, increase colony numbers, and strengthen pollination services.
4. Mainstream traditional honey hunters and marginalized communities into modern beekeeping for poverty alleviation.

6.1.2 Bee promotion policies

Objective No. 1

- **Species Management**: under this policy there are five action policies.
- **Bee Forage Promotion and Management**: under this policy there are nine action policies.
- **Bee Migration Management**: under this policy there are four actions polices.
- **Bee Disease Management:** under this policy there are six actions polices.
- **Honey Hunting Management and habitat conservation:** under this policy there are four actions polices.
- **Honey Production and Market Management:** under this policy there are eight actions polices.
- **Promotion and Subsidies:** Under this policy there are seven actions polices.
- **Loan Management in Bee sector:** Under this policy there are three actions polices.
- **Insurance Policy Promotion:** Under this policy there are no more actions polices.
- **Tax Exemption Policy:** Under this policy there are no more actions polices.
- **Research Provision in Bee-keeping:** Under this policy there are four actions polices.
- **Human Resource Management:** Under this policy there are six actions polices.

Objective No. 2

- **Honey Quality Standard, Certification and Pesticide Residue Control**: Under this policy there are five actions polices.
- **Honey Marketing Management:** Under this policy there are six actions polices.

- **Standardization, Monitoring and Regulation:** Under this policy there are four actions polices.

Objective no. 3.

- **Bee-keeping for Pollination and Management**: Under this policy there are five actions polices.

Objective no. 4.

- **Mainstreaming of socially and Economically Deprived Groups:** Under this policy there are four actions polices.
- **Institutional Development:** under this policy there are six actions polices.

Note: For more clarification and detail, please refer to the Bee promotion policy-2073 from nepallawcommission.com

6.2 Lists of other legal instruments and policies supportive to bee promotion

6.2.1 Relevant national strategies

- Agriculture Development Strategy (2015 – 2035)
- Nepal Trade Integration Strategy 2080 BS (2023)
- National Standardization Strategy (2021-2023)

6.2.2 Relevant national policies

- Food Safety Policy 2019
- National Agriculture Policy (2004)
- Agriculture business Promotion Policy (2007)
- Trade Policy 2015 (Reviewed 2018)
- Industrial Policy (2010)
- Micro, Cottage and Small Industry Promotion Policy (2023)
- National Supply Policy 2069 (2012)

6.2.3 Relevant acts

- Food Safety and Quality Act 2024
- Accreditation Act 2079
- Consumer protection act 2018
- Environment protection act 2019
- Plant Protection Act 2007
- Pesticide Management Act 2019

- Nepal standard (NS certification) act 1980
- Standard measures and weight act 1968
- Safeguards, Anti-Dumping and Countervailing Act, 2019
- Right to Food and Food Sovereignty Act, 2075 (2018)

6.2.4 Relevant regulations

- Food Regulation 1970 (FYR: this is under revision in DFTQC since new act has been published; will update once new regulation is updated)
- Consumer Protection Regulations, 2019
- Environmental Protection Rules, 2020
- Export and Import rules, 1978
- Plant Protection Rules 2010
- Nepal Standard (NS certification) Rules, 1983
- Safeguards, Anti-Dumping and Countervailing Regulations, 2021
- Standard Measurement (Sealed Package) Rules, 2076 (part of Nepal's legal metrology framework)
- Right to Food and Food Sovereignty Regulations, 2023

6.2.5 Standards

- Mandatory Food Standard 2080
- Standard for maximum residue limit (MRL) for pesticides in food product) 2024
- Nepal Standard (by NBSM for NS certification mark)

6.2.6 Directives/Procedures

- Directives on Market Surveillance 2079
- Prime Minister Nepali Production and Consumption Enhancement Program Implementation Procedure, 2081
- GBP Implementation Directives -2017

6.2.7 Relevant government's project and program

- Prime Minister's Agriculture Modernization Project (PMAMP) 2016 (20 years project)
- Prime Minister Nepali Production and Consumption Enhancement Program (2022-23)

6.3 Nepal good beekeeping practice implementation guideline- 2074 B.S.

6.3.1 Preamble:

Nowadays, the importance of food safety is increasing worldwide. This has two main objectives:

- To protect consumers from food-borne illnesses, and
- To ensure that food products are safe for consumption and acceptable in international trade.

According to the World Trade Organization (WTO) and food trade regulations, livestock-based products and honey must be safe and of high quality. In recent years, the international market for Nepalese honey has been growing steadily. To promote exports, ensuring its cleanliness and quality has become essential. At the same time, honey importers are now buying products only after confirming their cleanliness and quality, and after understanding the production and processing procedures. Good beekeeping practices are necessary for activities such as: bee rearing, hive management, disease and pest control, harvesting, processing, and complete handling procedures of honey. For this, a complete package of good practices is required-from production to consumption. The use of Good Beekeeping Practices (GBP) enables the production of clean, safe, and high-quality honey. With proper management, honey produced following these practices can help Nepal gain recognition in international markets and boost export potential. According to the government's **Beekeeping Policy 2073 B.S.** "The Good Beekeeping Practice (GBP) will be promoted for quality production and development of the honey sector."

6.3.2 GBP guideline structure

- Definition of GBP
- Objectives of the GBP Manual
- Ownership
- Governance Structure
- Standards Framework
- Implementation Process
- Monitoring and Evaluation

6.3.3 Core modules of GBP standards

Aligned with Nepal GAP (2017), the GBP includes five standard modules:

- Food Safety
- Environmental Management

- Worker Health, Safety & Welfare
- Product Quality
- General Requirements

6.3.4 Types of compliance criteria

Each module includes essential criteria and indicators that must be complied with. Within each module, the indicators are categorized into the following three levels based on their significance:

- **Critical:**

  These are the most essential indicators related to food safety and product quality that must be strictly adhered to without exception. Failure to comply with critical indicators will result in immediate disqualification from certification. Such indicators are non-negotiable and must be fully met.

- **Major:**

  These are important indicators related to food safety and product quality. At least 90% compliance with these indicators is required for certification.

- **Minor:**

  These are recommended indicators which, although not critical, contribute to better practice. At least 50% compliance with minor indicators is required.

6.3.5 Food safety module:

The cleanliness of food products must be based on national and international standards. This principle also applies to drinking water. Among the key elements affecting food cleanliness and quality, Good Agricultural Practices (GAP) are the most important. The tools used to ensure food safety are categorized within this module. This module aims to implement good agricultural practices to minimize the presence and impact of harmful substances, and to ensure the production, processing, and packaging of clean and safe food products.

The main features of this module are as follows:

A) Good agricultural practices related to beekeeping

- Crop history and land use where bees forage
- Seed and plant material management (relevant to bee exposure)
- Use of GM crops and its effect on bee health

- Compost and manure input (potential contaminants)
- Irrigation (affecting flowering and nectar availability)
- Use of agricultural chemicals (pesticides impacting bees)

B) Good beekeeping practices (GBP)

- Legal procedures
- Suitable environment for beekeeping
- Selection and development of beekeeping sites
- Selection of bee species
- Management of the knowledge and skills of the beekeeper
- Social management of bee colonies
- Some special management practices
- Management of flowering crops and other food sources for bees
- Management of harvest and storage of bee products
- Processing of bee products
- Packaging and labeling of bee products
- Management of bee disease and pest control
- Conservation of native bee species
- Migration-based beekeeping management
- Care and management of the queen bee

C) Good honey processing practices

- Obtaining legal authorization
- Collection of fresh honey
- Packaging and transport of raw honey
- Storage of raw honey at the processing center
- Honey processing techniques
- Quality control of honey

D) Establishment of a honey processing center

- Site selection
- Construction of the processing center
- Tools, equipment, and utensils
- Laboratory and related facilities management
- Worker and staff management
- Honey storage and transportation

- Honey traceability and return system
- Training system
- Documentation and record-keeping

E) Good hygiene practice (GHP):

In primary production (environmental health, honey health, hygienic production, transportation, storage, and packaging), GHP includes cleanliness, care, and personal hygiene.

Key areas of focus include:

- Processing center: site design and facilities
- Control of operational activities
- Cleanliness of processing equipment
- Personal hygiene
- Packaging
- Consumer awareness and product information
- Training
- Good Production Practices
- Hazard Analysis and Critical Control Point (HACCP)

F) Other good practices

- Bee insurance
- Code of conduct for entrepreneurs
- Code of conduct for honey collectors and sellers
- Honey pricing determination and regulation
- **Fair trade** and Nepali beekeepers
- Relationship with international organizations
- Certification
- Review

G) Residue monitoring plan (RMP)

6.3.6 Environment management module:

To manage and minimize the harmful impacts of beekeeping, honey production, and honey processing on the environment, it is essential to adopt and implement good practices. Special attention must be paid to the proper implementation of these practices. While addressing such practices, it is necessary to consider environmental policies, beekeeping promotion policies, and related regulations.

The main features of this module are as follows:

- Soil and land management of the location selected for beekeeping
- Management of environmental impacts due to bee relocation
- Management of forage/flowering plants related to bee foraging
- Basis of land type and agricultural field
- Management of compost and fertilizers
- Water management
- Pesticide management
- Energy saving
- Reduction of air and noise pollution in the environment
- Waste management
- Biodiversity
- Training / capacity building
- Documentation and certification
- Review of good practices

6.3.7 Worker's health, safety, and welfare module

Main features of this module are as follows:

- Management of chemical substances
- Workplace conditions
- Personal hygiene
- Worker welfare arrangements
- Orientation and training
- Documentation and recordkeeping
- Review of good practices

6.3.8 Product quality module:

This module focuses on ensuring the production of high-quality honey by using selected equipment and proper handling practices. It emphasizes the implementation of good beekeeping practices according to the manual. The module outlines important considerations during practical application.

Among the various honey types produced through beekeeping, the focus here is on Nepali honey in Nepal. Therefore, the discussion centers on this type. The quality of honey is assessed based on external characteristics (color, texture, clarity) and internal components (sugar content, moisture, HMF, vitamins, etc.).

Beekeepers and honey processors are encouraged to use this information to ensure quality control. If good beekeeping practices are effectively implemented, it helps maintain quality during production and processing. However, if not followed properly, quality control becomes difficult and ineffective.

Main features of this module are as follows:

- Quality module
- Forage plant diversity related to bee grazing
- Compost and crop nutrient content
- Water
- Agrochemical substances used for crop protection
- Antibiotic medicines
- Management of honey harvested after the main flowering season
- Honey traceability and recall management
- Orientation and training
- Review of good practices

6.3.9 General requirement module:

This module includes general quality standards and requirements that are applicable across all modules of good beekeeping practices. It outlines common and essential administrative requirements that are necessary for effective and integrated implementation.

Main features of this module are as follows:

- Legal provisions
- Emergency requirements
- Addressing special complaints
- Health details
- Documentation and internal inspection
- Calibration of measuring instruments

6.3.10 Some other important aspect covered in GBP

- Current Beekeeping Trends
- Local Practices and Distribution
- Role of Women in Beekeeping
- Women's Empowerment
- Challenges in Beekeeping Constraints
- Honey Harvesting Techniques

- Honey Harvesting Conditions
- Post-Harvest Handling
- Other Hive Products and Production Practices
- Honey Quality Standards
- Parameters Affecting Honey Quality
- Institutional Stakeholders in Beekeeping

This manual has been developed through collaboration between key stakeholders in Nepal's beekeeping sector:

- Government institutions: Ministry of Agriculture, Department of Livestock Services (DLS), Department of Food Technology and Quality Control (DFTQC), and other thematic divisions.
- Academic institutions: Tribhuvan University, Agriculture and Forestry University, and related colleges.
- NGOs/INGOs: working in agriculture, environment, forest, and biodiversity
- Farmer groups and cooperatives.
- Private sector actors and bee product entrepreneurs.
- National and local laboratories involved in product testing.

Legal framework for GBP implementation

- The Good Beekeeping Practice (GBP) implementation will follow a structured **legal and institutional framework**:
    - Lead agency: Department of Livestock Services
    - Support agencies: DFTQC, MoALD, bee research labs, academia, standards authority
    - Policy alignment with agriculture development strategy, biodiversity strategy, and forest strategy

Stakeholders must coordinate within this framework for successful GBP execution.

Regulatory coordination

- Multiple ministries and departments are involved in GBP, including:
    - Ministry of Agriculture and Livestock Development
    - Department of Food Technology and Quality Control
    - Beekeeping research and training centers
    - International standards bodies (Codex)
    - National laboratories and quality assurance agencies

This collaborative model ensures accountability and consistency in honey quality control and sector growth.

Monitoring and evaluation

- Various indicators and milestones have been defined to **track implementation**.
- Performance will be reviewed annually to assess progress and adjust.
- Evaluation will include both government-led monitoring and independent reviews.
- Indicators include compliance with quality parameters, traceability, certification rates, and adoption of sustainable practices.

Note: For more clarification and detail, please refer to the Good Beekeeping Practice Implementation Guideline- 2074 B.S.

Sample questions for practice

1. What are major objectives bee promotion policy 2073?
2. What are modules included in GBP, 2074?
3. What are the other legislative documents relevant for beekeeping sector?

Session 36

Training need assessment

1. Learning objectives

By the end of the session, participants will be able to:

- Define training need assessment
- Explain different methods of training needs assessment

2. Sub-topics

- Concept and definitions of training need assessment
- Level of training need assessment
- Methods of training need assessment

3. Methods and materials

3.1 Training methods

- Interactive lecture
- Group discussions
- Brainstorming
- Group work/practical exercise

3.2 Training materials

- Projector, power points, pictures.
- Marker, brown paper, pen, masking tape, meta card

3.3 Time

Theory: 40 minutes

Practical: 40 minutes

Discussion: 10 minutes

3.4 Place: Training hall

4. Activities and exercises

4.1 Brief the participants on the lecture and practical activities planned for the session and assess their existing knowledge on the topic.

4.2 Presentation

Give a short presentation on the concept of TNA, level of TNA and different methods of TNA,

4.3 Group division/practical exercises

Divide the participants into three groups and assign the following task:

- **Group A (Questionnaire design)-task:** Develop a set of sample questions to identify training needs within a selected organization (e.g., agricultural extension service, or government department).
- **Group B (Interview schedule development)-task:** Design an interview schedule for conducting one-on-one interviews to assess the training needs of agricultural extension agents.
- **Group C (Focus group discussion planning)-task:** Develop a plan or short scenario showing how a focus group discussion could be used to assess training needs among field extension agents or farmers.

4.4 Group presentations and discussions

Each group presents findings to the larger groups, summarizing the key points of their assigned task. This is followed by peer and trainer feedback and discussion.

5. Detail schedule

SN	Subject matter	Description	Time	Material
1	Introduction to TNA	Elaborate on the concept of TNA, define it, and explain its relevance in organizations and agricultural extension work.	10 minutes	Projector, PPT slides, whiteboard
2	Level of TNA	Explain the different levels of TNA: organizational level, task level, and individual level.	10 minutes	Projector, PPT slides
3	Methods of TNA	Explain different methods of TNA, when to use them.	20 minutes	Projector, PPT slides

SN	Subject matter	Description	Time	Material
4	Group exercise	Divide the participants into three groups and assign the following task: Group A (Questionnaire Design)-Task: Develop a set of sample questions to identify training needs within a selected organization (e.g., agricultural extension service, or government department); Group B (Interview schedule development)-task: Design an interview schedule for conducting one-on-one interviews to assess the training needs of agricultural extension agents; Group C (Focus group discussion planning)-task: Develop a plan or short scenario showing how a focus group discussion could be used to assess training needs among field extension agents or farmers.	30 minutes	Flip charts/ brown paper, markers
5	Group presentation & discussion	Each group presents findings; peer and trainer feedback and discussion.	15 minutes	Flip charts, markers
6	Summary and Q&A	Summarize key learning points, clarify doubts.	5 minutes	

6. Resource materials

6.1 Concept and definition

Training needs assessment (TNA) is defined as the systematic identification of gaps in knowledge, skills, and attitudes within a specific target group, which could be an individual or an organization. In other words, TNA determines whether a training need exists and, if so, what specific training is required to

address that need. An accurate needs assessment enables the development of training courses or programs based on the real needs of the target group. TNA is a fundamental step in the training cycle, especially during the design phase. Once training needs are identified, appropriate training programs can be designed and implemented to address those gaps. These training programs can take various forms, such as mentoring, coaching, on-the-job training, or classroom-based training.

6.2 Levels of training need assessment

TNA can be conducted at three levels: organizational level, task level, and individual level.

6.2.1 Organizational level

\This is a macro-level analysis conducted for the entire organization. The main purpose of determining training needs at the organizational level is to identify what is required to improve the organization's overall performance. This analysis examines the training needs of different sections, units, or departments and helps identify general weaknesses within the organization, ultimately guiding the design of need-based training programs.

6.2.2 Job/task level

\This level focuses on the specific competencies or tasks required to perform a particular job effectively. It identifies the knowledge, skills, and attitudes needed for a specific job, ensuring that employees have the necessary capabilities to succeed in their roles.

6.2.3 Individual level

This level aims to identify gaps in the specific knowledge, skills, or attitudes of individual employees/members. It helps determine who requires training and in which areas or subjects to enhance their performance.

6.3 Methods of training need assessment

Training needs assessment can be conducted using a variety of methods, depending on the available resources, time, situation, and context. These methods include observations, questionnaires, interviews, focus group discussions, competency assessments, performance evaluations, critical incident techniques, SWOT analysis and so on. No single method of need assessment is universally best; the choice of method depends on the specific situation and available resources. However, applying more than one method can enhance the reliability of the data.

6.3.1 Observations

Observations allow for the assessment of knowledge, attitudes, skills, and behavior in real-life situations. Direct observations provide valuable insights into participants' or employees' performance, helping to identify the knowledge, skills, etc. they possess, as well as any gaps. These gaps can then inform training needs. However, it is labor-intensive and time consuming.

6.3.2 Questionnaires

A pre-structured questionnaire or checklist can also be used to identify training needs. It consists of a series of questions designed to gather both quantitative and qualitative data, helping to identify training gaps and areas for improvement. It is often used for statistical analysis of the respondents. Questionnaires can be sent via email; however, they may have a low response rate.

6.3.3 Interviews

Personal interviews can be conducted with employees, farmers, participants, or other stakeholders to gain in-depth insights into individual training needs and challenges. This can be done using an interview schedule that contains a predefined set of questions. The interview schedule may include both closed and open-ended questions. Interviews can be conducted in-person, through video conferencing or over the phone. This method of training need assessment allows for detailed responses and helps build rapport. However, it is time-consuming, and interviewees may feel inhibited. Therefore, it is essential to create a comfortable environment that encourages interviewees to share their opinions freely and honestly.

6.3.4 Focus group discussion

Focus group discussion is a qualitative data collection method that involves group interviews with a small number of participants facilitated by a trained moderator. This is useful for gathering diverse views and identifying common issues related to training needs, expectations and challenges. This method is more cost effective than personal interviews because information can be captured from more employees, farmers, or stakeholders in a relatively short period of time. Group dynamics and interactions also help foster participant engagement. However, it is not suitable for large groups and dominant participants may influence responses.

6.3.5 Performance data analysis

Performance data analysis is also considered one of the valuable methods for training need assessment of employees. It includes reviewing existing performance records such as employees' performance evaluations, customer feedback, and productivity reports that help to identify the performance gap and areas needing improvement.

Sample questions for practice

1. Describe the concept of TNA.
2. What are the levels of training need assessment?
3. What are the methods of training need assessment?

Session 37

Training methods

1. Learning objectives

By the end of the session, the participants will be able to:

- Explain the different training methods.
- Explain how to select the effective training methods.
- Apply proper training technique in their work condition.

2. Sub-topics

- Training and training methods
- **Technique for selecting training methods**
- **Three things to remember when choosing a training technique**

3. Materials and methods

3.1 Training methods

- Lecture
- Brainstorming
- Group discussion
- Observation
- Role play

3.2 Training materials

- Projector, power points, pictures.
- Marker, brown paper, pen, masking tape, meta card

3.3 Time

Theory: 50 minutes

Practical: 30 minutes

Discussion: 10 minutes

3.4 Place: Training hall

4. Activities and exercises

4.1 Inform the participants about the lecture/practical exercises included in the training and obtain information about the level of knowledge of the participants on the subject.

4.2 Presentation

Give short presentation on the training methods, techniques for selecting training method, as outlined in the resource materials and the things to remember when choosing training technique.

4.3 Group division/practical exercises

Divide the participants into 2 groups and assign them a topic. Then ask them to prepare a session using different training methods. Analyze critically how effectively they use these methods.

4.4 Discussion

After the session organize discussion to analyze the level of participants understanding. Ask them whether they are clear about different training methods, when to use these methods and things to remember while choosing training method.

5.Detail schedule

SN	Subject matter	Description	Time	Materials
1	Introduction	Ask participants to write key information on training and training methods.	5 minutes	Marker, pen, meta card
2	Training methods	Explain different training methods, when to use them and things to consider while delivering the session.	30 minutes	Projector, PPT slides, photo, video
3	Technique for Selecting Training Methods	Discuss about the technique for selecting training methods.	10 minutes	Projector, PPT slides, photo, video
4	Things to Remember When Choosing a Training Technique	Discuss about the things to remember when choosing a training technique.	5 minutes	Projector, PPT slides, photo, video

SN	Subject matter	Description	Time	Materials
5	Practical Exercise	Divide the participants into 2 groups and assign them a topic. Then ask them to prepare a session using different training methods. Analyze critically how effectively they use these methods.	30 minutes	
6	Discussion		10 minutes	

6. Resource materials

6.1 Training

Training is the process of learning which is essential for helping participants to get the organizational goal. Training is a systematic activity performed to modify the skills, attitudes and the behavior of participants.

6.2 Training methods

Training methods are the means to help participants acquire capabilities of teaching and learning, Changing the way of working. It also helps to bringing effective changes in the mindset of learners.

In principle, there are many methods or technique that trainers can exploit to conduct training. A list of training methods are as follows:

- Lecture method
- Demonstration method
- Group discussion
- Field/study visit
- Learning through games
- Project work
- Case study
- Role play
- Debate
- Symposium
- Panel discussion
- Brainstorming

Among the above methods, some are explained below:

6.2.1. Lecture method

This is a traditional method and is widely used. It only delivers knowledge and is suitable for a large number of participants. However, it is not effective for skill development. To make the lecture effective, the following points should be considered:



Figure 118: Lecture Method

- **Introduction:** Start by introducing the topic and ask questions to understand how much the participants already know.
- **Information sharing:** Share or present the relevant content.
- **Conclusion:** Summarize the content shared at the end and ask questions or assign writing tasks to evaluate understanding.

6.2.1.1 Things to consider while delivering a lecture

- Use simple and short sentences.
- Speak clearly, but don't shout.
- Avoid using difficult words.
- Ensure everyone can hear.
- Adjust volume as necessary.
- Speak consistently—not too fast or too slow.

6.2.1.2 Trainer's nature and presentation

A trainer's behavior is directly related to the learning environment, so a trainer should be careful:

- **Appearance:** Dress neatly and appropriately.
- **Positioning:** Stand in a place where everyone can see; avoid sitting at the desk.
- **Behavior:** Avoid repetitive words, don't chew anything, and don't play with pens or other objects.

6.2.2 Demonstration method

This traditional method involves showing how to do something, which helps learners retain information better. It combines both lecture and demonstration, allowing for both knowledge and skill development.

When to use

- To teach skills.
- When participants have low educational background.
- To show correct usage or practice.
- To grab attention.
- To involve participants more.
- When the number of participants is relatively small.

6.2.3. Brainstorming

This is a technique used to generate ideas on a given topic. It helps identify problems, solutions, and needs. It is effective when participants are fewer in number and promotes participation, trust, and positivity.

When to use

- To give everyone a chance to speak.
- To find out what participants already know at the beginning of a session.
- Alongside lectures.
- To gather many ideas in a short time.
- To solve specific problems.
- When the objective is not to teach a skill.

6.2.4. Group discussion

This involves interactive conversation among participants and also includes sharing of experiences to solve problems. The group tries to develop knowledge, ideas, and perspectives.

When to use

- When the number of participants is small.
- When participants have knowledge and experience but are inactive.
- To influence attitudes.
- When the topic is familiar.
- For creating plans with feedback.

6.2.5 Role play

Although it seems fun, it is a learning method, not a game. It provides participants the opportunity to express their ideas, is more motivational and activity-based.

When to use

- To change participants' behavior or attitude.
- In learning-by-doing situations.
- To make the learning environment engaging.
- When ample time is available.
- When participants have subject-related experience.
- When the number of participants is up to 5.

6.2.6. Case study

This involves giving a group a detailed description or report of a real-life problem, which they study to derive conclusions.

When to use

- To provide real-life work insights.
- To facilitate learning based on actual data.
- When the trainer is well-informed about the group.

6.3 Technique for selecting training methods

There are many training methods, but choosing the right one scientifically and wisely helps achieve the learning objectives effectively. Thus, selection should be based on the following:

6.3.1 Based on the objective of the session

- If the objective is knowledge transfer
    - Lecture
    - Group Discussion
    - Brainstorming
    - Field Trip
    - Group or individual exercises
- If the objective is skill development
    - Skill demonstration
    - Role play
    - Practice sessions
    - Case study

- If the objective is to change attitudes
    - Role play
    - Group discussion
    - Demonstration
    - Individual exercises
- If the objective is problem-solving
    - Case study
    - Brainstorming
    - Discussion
    - Practice

6.3.2 Based on the characteristics of the participants should consider

- Age
- Gender
- Educational background
- Social background
- Experience

6.3.3 Based on the training conditions

- If participants are many – use Lecture Method
- Time constraints – not all methods can be used in limited time
- Physical facilities or resources – classroom, practice area, lighting, etc.

6.3.4 Based on the trainer's experience use of training methods also depend upon trainer's experience

6.4 Three things to remember when choosing a training technique:

- I hear and I forget.
- I see and I remember.
- I do and I understand.

Sample questions for practice

1. What are the different training methods?
2. What are things to remember while choosing training method?
3. When should we use case study as a training method?

Session 38

Training facilitation skills

1. Learning objectives

By the end of the session, the participants will be able to:

- List the key components of facilitation.
- Explain how to interact with the participants.
- Apply APPLE technique of questioning.

1. Sub-topics

- Facilitation and Facilitator
- Key Facilitation Components
- Creating a Learning Environment

3. Materials and methods

3.1Training methods

- Lecture
- Brainstorming
- Group discussion
- Observation

3.2 Training materials

- Projector, power points, pictures
- Marker, brown paper, pen, masking tape, meta card

3.3 Time

Theory: 40 minutes

Practical: 40 minutes

Discussion: 10 minutes

3.4 Place: Training hall

4. Activities and exercises

4.1 Inform the participants about the lecture/practical exercises included in the training and obtain information about the level of knowledge of the participants on the subject.

4.2 Presentation

Give short presentation on the facilitation and facilitator, key Facilitation Components and creating a Learning Environment as outlined in the resource materials.

4.3 Group division/practical exercises

Divide the participants into 4 groups and select a group leader. Assign them different topics and give some time to prepare on assigned topic. Then organize facilitation of each group and give feedback.

4.4 Discussion

After the session organize discussion to analyze the level of participants understanding. Ask them whether they are clear about facilitation, its components, learning environment.

5. Detail schedule

SN	Subject matter	Description	Time	Materials
1	Introduction	Ask participants to write key information on facilitation and facilitator.	5 minutes	Marker, pen, meta card
2	Facilitation and facilitator	Discuss about facilitation and facilitator.	10 minutes	Projector, PPT slides, photo, video
3	Key facilitation components	Explain about key facilitation components.	10 minutes	Projector, PPT slides, photo, video
4	Creating a learning environment	Discuss about creating a learning environment.	15 minutes	Projector, PPT slides, photo, video

SN	Subject matter	Description	Time	Materials
5	Practical exercise	Divide the participants into 4 groups and select a group leader. Assign them different topics and give some time to prepare on assigned topic. Then organize facilitation of each group and give feedback.	40 minutes	
6	Discussion		10 minutes	

6. Resource materials

6.1 Introduction

"I never teach my pupils. I only attempt to provide the conditions in which they can learn." — Albert Einstein

6.1.1 Facilitation

Facilitation involves managing group dynamics, building interaction, and utilizing communication and support tools to help participants engage and learn together effectively.

6.1.2 Facilitator

A facilitator is someone who creates an environment that encourages participation, active engagement, learning, and self-expression. A facilitator is a person who makes it easier for others to participate by preparing the environment, resources, and guidance necessary for effective learning and dialogue. A facilitator ensures that everyone involved in the learning process has the opportunity to contribute and express themselves.

6.2 Key Facilitation components

- Presentation
- Motivation
- Interaction
- Observation

- Group Management
- Evaluation and Feedback

6.2.1 Presentation

During a presentation

- Use relevant examples or stories.
- Reflect on your own presentation: What did you say and why?
- Interact with participants and ensure inclusiveness.
- Adjust based on participants' responses and questions.

In Effective presentations:

- Use subject knowledge and examples.
- Use participants' language as much as possible (local, national, technical, etc.).
- Choose suitable environments and be clear with delivery.
- Allow time for questions and answers.
- Use different forms of media and materials to keep engagement.
- Deliver the message clearly and relate it to real-world examples.

6.2.2 Motivation

- Stimulate curiosity and interest.
- Clarify the purpose and relevance of the topic.
- Encourage active participation.
- Facilitate constructive discussion and reflection.
- Create a comfortable learning atmosphere.

6.2.3 Interaction

- Connect participants' experiences and perspectives to the topic.
- Provide opportunities for group engagement.
- Respect diverse opinions and encourage dialogue.
- Link shared experiences to key learning points.

6.2.4 Observation

- Observe participants' body language, engagement, and emotional responses.
- Identify participants who are not engaged and support them.
- Adjust the session if participants seem lost or disengaged.

- Provide special attention to individuals who seem confused or need help.

6.2.5 Group management

- Ensure equal opportunity and involvement of participants.
- Form groups strategically.
- Consider diversity in the group.
- Acknowledge group dynamics and leadership roles.
- Facilitate both structured and spontaneous discussions.

Effective group work does not happen automatically therefore,

- Provide clear instructions and goals.
- Assign group roles or tasks when necessary.
- Monitor group progress and help when needed.
- Evaluate the overall group experience and give feedback.
- Encourage mutual learning among all group members.

6.2.6 Evaluation and feedback

- Gather feedback from participants.
- Use feedback to make improvements.
- Make evaluations meaningful, not just formal.
- Plan for both immediate and long-term evaluations.
- Include both individual and group-based feedback methods.

6.3 Creating a learning environment

To create the learning environment facilitator should consider the following things

1.1.1 Use questioning techniques – APPLE:

A = Ask the questions
P = Pause a few seconds
P = Pick a participant to respond
L = Listen to the response
E = Evaluate the response

1.1.2 Proper use of body language

- Posture
- Gestures

- Personal appearance
- Eye contact
- Facial expression
- Movement

1.1.3 Use TRAINER acronym

T = Time Bound

R = Realistic

A = Active

I = Ideal, Inspiring, and Informative

N = Need-based

E = Energetic and Enthusiastic

R = Responsive

Sample questions for practice

1. What are the key facilitation components?
2. What are the key features of effective presentation?
3. What is APPLE technique for creating learning environment?

Session 39

Practicum assessment

1. Learning objectives

By the end of the session, participants will be able to:

- Prepare a PowerPoint for their assigned topics.
- Deliver the session on assigned topics**.**

2. Sub-topics

- Individual and group assignment
- Presentation

3. Methods and materials

3.1 Training methods

- Individual or group presentation
- Discussion

3.2 Training materials

- Projector, power point slides, pictures
- Marker pen, brown paper, pen and masking tape, meta card

3.3 Time

- Presentation: 200 minutes (10 minutes for each participants)
- Feedback: 60 minutes (3 minutes for each participants)
- Discussion: 10 minutes

3.4 Place: Training hall

4. Activities and exercises

In this session assign each participant with different topics related to beekeeping sector and organize individual presentation. Evaluate each presentation according to different presentation skills. (use Table 25)

Table 25: Criteria for Presentation Evaluation

Presentation Title:	
Name:	

Presentation Skills	Poor (Score: 2)	Fair (Score: 4)	Good (Score: 6)	Very good (Score: 8)	Excellent (Score: 10)
1. Maintain eye contact					
2. Spoke audibly and clearly					
3. Relates the presentation to speaking					
4. Give the clear indication of the presentation's main idea					
5. Give an ample and detailed evidence to support the presentation points					
6. Uses visual or other aid effectively					
7. Summarizes the key points					
8. Provides the memorable conclusion					
9. Provokes thought in the audience					
10. Submits the quality written, audio, or visual work in conjunction with the presentation					
Total Scores:					
Comments and Suggestions for Improvement:					

Evaluator
Signature:
Name:
Post:
Organization:
Address:
Date:

Session 40

Production, processing, storage and use of honey and other bee products

1. Learning objectives

By the end of the session, the participants will be able to:

- Explain the importance and benefits of the bee products.
- Describe the production, processing, storage and use of bee products.

2. Sub-topics

- Introduction, importance
- production, processing, storage and use of honey
- production, processing, storage and use of other bee products

3. Methods and materials

1.1 Training methods

- Lecture
- Brainstorming
- Group discussion/Interaction

1.2 Training materials

- Projector, power points, slides, pictures.
- Marker, brown paper, pen, masking tape, meta card
- different sample of honey
- different sample of other bee products

1.3 Time

Theory: 80 minutes
Practical: 00 minutes
Discussion: 10 minutes

1.4 Place: Training hall

4. Activities and exercise

3.1 Inform participants about the topics covered in the training and inquire about their level of knowledge on the subject matter.

3.2 Presentation

Give short presentation on the introduction, importance production, processing, storage and use of honey. Likewise, give a presentation on production, processing, storage and use of other bee products as outlined in the resource materials.

4.3 Discussion

After the session, organize discussion to obtain information on whether the participants are clear about honey along with other bee products and how to facilitate others about bee products and to further review any unclear topics.

4. Detail schedule

SN	Subject matter	Description	Time	Materials
1	Introduction and importance of bee products	Make participants to write down what they know about the bee products.	10 minutes	Marker pen, meta card
2	Production, processing and storage of honey	Discuss about honey and its production, processing and storage	20 minutes	Projector, power point slides, pictures, videos
3	Production, processing and storage of other bee products	Provide information about other bee products and its production, processing and storage	30 minutes	Projector, power point slides, pictures, videos
4	Use of bee products	Explain about Bee products	20 minutes	Projector, power point slides, pictures, videos
5	Discussion		10 minutes	

6. Resource materials

6.1 Introduction

The beekeeping business in Nepal is mostly driven by the understanding that it is only for honey production as general public said. But there are other bee products (royal jelly, propolis, beeswax, bee pollen, honeydew honey, bee hive air, etc) which are more important economically and nutritionally than honey. Currently, these other bee products are also commercially produced and marketed. The production, processing, and storage of these bee products are described in detail below.

1.2 Honey production, storage and use

Honey is a sweet, aromatic, viscous semi-liquid substance, a modified form of nectar, collected and stored by various species of bees from the flowers of crops, fruit trees, and plants found in nature. Honey contains sugar/sucrose, glucose, fructose, maltose, saccharose and other carbohydrates, minerals, vitamins, enzymes and water. Honey production is the process of extracting honey stored by bees without harming the bees.

Based on sources, honey production situation in Nepal can be classified into two categories:

1) Honey from domesticated bees (*A. cerana* and *A. mellifera*) and
2) Honey from wild bees (Melipona spp, Trigona spp, Apis florea, Apis dorsata, Apis laboriosa).

For commercial honey production, some important management aspects to be considered as given below:

- Requeening: Replace quality queen every year.
- Make colonies strong: At least 2 months before the start of bee foraging.
- Remove the old black comb and replace them with new comb foundation
- Use queen-excluder.
- Select suitable forage, identify forage capacity and appropriate environment and relocate beehives.
- Extract/harvest honey only from honey chamber after 90% of cells are sealed.

6.2.1 Honey extracting method

Honey is harvested only from honey chambers when ample bee forage available in the nature.

- Honey is extracting when more than 90% honey comb is sealed.
- Collect the necessary materials (smoker, knife, soft brush, net, honey pot, honey jar, etc.) for honey extraction.
- Use smoker while removing outer and inner cover of beehives.
- Remove the frames from the honey chamber and remove the bees with a soft brush, place them in a bucket, and cover with a clean cloth.
- Use net in open field to avoid entrance of bees while extracting honey.
- Extract honey using honey extractor.
- Use clean container for honey collection and filter it through a clean steel mesh, and store in a room with appropriate temperature and low humidity.

6.2.2 Honey processing

Honey processing refers to the process of removing wax, pollen or other foreign matter from honey during extraction without compromising the quality of the honey, as well as reducing the amount of excess moisture in the honey to maintain its consistency.



Figure 119: Honey heating tank

The bees collect nectar from the flowers and store it in their honeycombs after bringing it back to the hive. The nectar in the honey sac is processed by the bees by swallowing and regurgitating it, mixing various substances released from the bees' bodies (excretions) into the nectar, reducing the amount of water, and then storing it in a honeycomb. Thus, the honey produced by the bees process themselves and maintain its quality.

Things to be kept in mind while processing honey

- The processing area should be dry, clean, and low in humidity.
- The processing room should be closed so that bees cannot enter.
- The utensils and equipment used in honey processing should be made of stainless steel, glass, or food-grade plastic, and these items should always be kept clean and dry.
- The method of processing is adopted for liquid honey, crystal honey (frozen honey), cream honey or comb honey production.
- Honey should not be heated directly and at temperatures above 55°C degrees Celsius.

6.2.3 Traditional Honey Processing Method

a) Straining: First strain the honey using two layers of muslin cloth or a double steel sieve (with a mesh size of 1 mm on the upper side and 0.5 mm on the lower side). Honey is kept in a container for about 48 hours and then, different layers are seen in the container. Extract honey only from middle layer and store for a long time or package in bottles for sale.

b) Heating: High and direct heating of honey deteriorates the quality of the honey. A study by John Skinner of the University of Tennessee, as shown in **Table 26** is given below.

Table 26: Heating temperature of honey and the effects of heat

SN	Honey heating temperature	Effects of heat
1	When heated to 37°C (95° F),	About 200 elements in honey are degraded.
2	When heated at 40°C for more than 48 hours	The very important invertase enzymes in honey are destroyed
3	When heated to 50°C (100° F) for more than 48 hours	The important sugar in honey will change its form.
4	When heated to 60°C for more than 2 hours	The elements in honey quickly deteriorate and break down.
5	When heated to 71°C(110° F) for more than 2 hours	The elements in honey will quickly be destroyed and the important sugar will be transformed (denatured).

Source: *John Skinner, University of Tennessee, USA*

Heat the honey indirectly below 55°Celsius, strain the honey through a cloth and steel mesh. After the honey has been strained, store it in an airtight container.

6.2.4 Honey storage method

- Favorable storing environment: dry, clean, and closed room with a humidity of less than 20% and a temperature of 20^{o}C degrees Celsius.
- Use air tight containers (glass, food-grade plastic, or stainless-steel).
- Water content in the stored honey should be less than 20%.
- Production date and storage period should be mentioned.

6.2.5 Use of honey

Honey is considered a superior food because it contains more than 200 different types of rare and extremely important and useful nutrients, vitamins, and mineral salts for the human body.

6.2.5.1 Benefits of honey

- It helps in curing digestive system and stomach related diseases and also increases digestion. It helps stomach problems in humans: Preventing ulcers and intestinal diseases.
- The flavonoids and antioxidants found in honey protect humans from cancer and heart diseases.
- Honey containing enzymes, the hydrogen peroxide (a natural oxidant) helps to destroy bacteria and fungi.
- Helps in curing dry cough, sore throat, tonsil problems. Increases eyesight, reduces obesity, reduces urinary tract problems, asthma, diarrhea, etc.
- Honey helps to balance the amount of sugar in a human's blood.
- Honey can be used to heal cuts and burns.
- Helps to increases memory, strength, sperm, immune system, and libido.
- Helps reduce liver, nerve, and blood-related diseases.
- Helps to cure menstrual cramps in women.
- Helps in the physical and mental development of children and adults.
- Honey makes the skin and hair look radiant and shiny.
- Using honey helps in preventing skin wrinkles.

6.2.6 Things to be followed by beekeepers/honey producers

Beekeepers or honey traders must meet minimum honey quality standards to market their honey in the national and international markets. In addition, paying attention to the following points will help to maintain the quality of honey, increase honey production, and improve the public health of consumers through the consumption of honey:

- Emphasize on production according to market demand.
- Make sure for proper utilization of natural resources and development of foraging areas.
- Fallow the procedure of organic honey production and its certification and brand development.
- Be careful in using utensils (do not use metals such as copper, iron, brass).
- Extract only sealed honey from the super chamber.
- Give special precautions in processing, packaging, and storage of honey.

- Emphasis on the use of organic pesticides or plant-based pesticides.
- Be careful when using chemical pesticides (do not use pesticides when the flowers are in bloom).

6.3 Pollen production, storage and use



Figure 120: Bee pollen

Pollen is a protein-rich essential food for raising bee broods. This pollen is produced in the male parts of the flower, the stamens. This pollen is collected by worker bees, usually in the morning. A bee carries 10-19 mg of pollen. The bee collects pollen grains with the help of its mouth, legs, and body hairs, and mixes the loose pollen grains with saliva and nectar, kneads them, and then collects them in the pollen basket on its hind legs, where it stores them inside the hive. Out of total forager bees, about 15-30 percent of bees in the colony collect pollen. A beehive requires an average of 45-65 kg of pollen annually. Pollen contains digestible carbohydrates (7-18%), proteins (7.5-35%), reducing

sugars/fructose-glucose (15-50%), fats (1.5-2.3%), minerals (2.8-10.6%), flavonoids, vitamins, enzymes, hormones, etc. Therefore, it is also a very important food item for human health.

6.3.1 Pollen production

- use pollen traps (made from plastic, wood, or bamboo) near the entrance of beehive in season (abandon pollen flow).
- Use traps only in the strong colonies at morning to day times for pollen collection
- Pollen falls into the trap and is collected, dried and stored.
- Do not use a trap on the same hive continuously for collecting pollen
- Collect pollen daily and cool or dry immediately to protect its quality. If the pollen gets wet, it will quickly become moldy and rot.
- A colony with 20,000 bees can collect 57 kg of pollen in a year.
- Can collect 10-20 kg of pollen annually from a healthy and strong colony.

6.3.2 Storage of pollen

- Store the collected fresh pollen in the shade or indoors or in an oven and lower its temperature below 10%. However, pollen should not be dried directly in the sun.

- Use 20-watt bulb for drying pollen and temperature should be below 45°Celsius.
- Clean the pollen by removing other objects from it after drying it.
- Make packaging in an airtight plastic bag or food-grade container and store in a cool, dry place.
- Store in room temperature at 55% humidity for many months.
- Avoid from direct sunlight and maintain room temperature below 45°Celsius.
- Store in a refrigerator at a temperature of 5°C for up to 1 year without losing quality or store in a refrigerator at a temperature of -15°C for many years.



Figure 121: Pollen Trap

6.3.3 Use of pollen

- Use as a protein substitute.
- Eat directly by sprinkling on salads and yogurt.
- Use pollen instead of sugar in coffee.
- Use pollen as a liver detoxifier.
- Pollen helps to stimulate appetite, treat mouth ulcers, joint pain, bladder problems, nose bleeds, menstrual problems in women, diarrhea, and helps to look younger.
- Use pollen as apitherapy.

1.4 Royal jelly production, storage, and use

Royal jelly is a liquid secreted from the hypopharyngeal glands on the heads of worker bees aged 6–12 days. This nutritional powerhouse is creamy white in appearance and has a slightly sour taste. Its chemical composition consists of water (57–70%), protein (17–45%), sugar (18–52%), lipids (3.5–19%), and minerals (2–3%).

6.4.1 Royal jelly production method

The following steps should be followed to produce royal jelly:

- Prepare a grafting frame to make queen cups for royal jelly production.
- Graft the young (1-day-old) larvae from healthy and strong colonies to the grafting frame.

- Place the grafting frame in a colony with a large number of young worker bees.
- Prepare a queen less colony at least 48 hours before to insert the grafting frame.
- Place the grafting frame in the queen less beehive with a large number of young worker bees.
- Remove the grafting frame after 72 hours of being placed in the hive.
- Prepare for extracting royal jelly and remove the larvae from the grafting frame and collect the royal jelly.
- A strong hive can produce 0.25 - 0.5 kg of royal jelly per year.

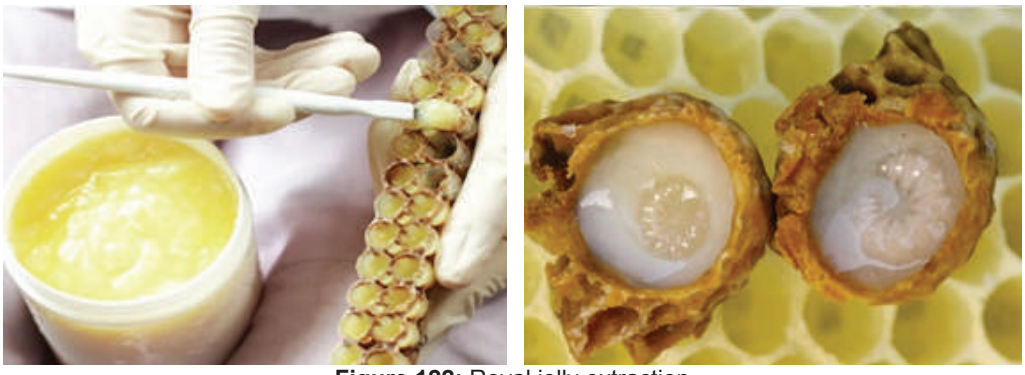


Figure 122: Royal jelly extraction

6.4.2 Royal jelly storage

The collected royal food is prepared and stored either as is or in a modified form by mixing it with dry powder or other food items. These royal food products should be stored as follows:

- Royal jelly products can be stored in the refrigerator (at a temperature of -17°C) for up to 2 years. However, royal jelly products should not be stored in the refrigerator for more than 1 year after being packaged and removed from the refrigerator.
- Products made by mixing frozen royal jelly and royal jelly can be stored at normal room temperature for several years.

6.4.3 Use of royal jelly

- It helps to improve memory, which is deteriorating due to old age.
- It can balance the sugar and insulin levels in the blood of diabetic patients.
- It helps reduce the amount of cholesterol in the body and increase the chance of fertility in women.

- It helps in reducing body fat and preventing skin wrinkles.
- It is also used in the treatment of asthma, bone fractures, skin diseases, intestinal ulcers, liver and kidney diseases.
- If cancer patients regularly consume processed honey mixed with royal jelly twice a day for 1 month, fatigue will be reduced.
- It is used in the preparation of women's cosmetic products.

1.5 Propolis production, storage and use

This is a semi-solid sticky substance that bees collect from tree bark and leaves, grind into a paste, and bring to their hive. Propolis contains more than 300 elements including wax, volatile oils, resins, vitamins, minerals, as well as flavonoids, phenylpropanoids, terpenes, stilbenes, lignins, coumarins, and other elements.

6.5.1 Propolis production method

Bees collect propolis from many plants found in nature. The main plants from which bees collect propolis include sisau/beech, birch, oak, conifers, spices, plums, etc.

6.5.2 Propolis collection

- Place the propolis trap on the top bar of the brood chamber or honey chamber.
- Make more hole and cracks in the hives to collect more propolis per hive.
- Remove propolis traps after 1 year of application and scrape off traps and collect it.
- Fallow the propolis processing method and make packaging and send for sale.
- Time: September-October

6.5.3 Use of propolis

- Clean and pure propolis heals cuts and wounds, and cures gum problems.
- Propolis paste/cream can be used internally and externally to treat wounds.
- Propolis solution cures problems like gum disease, cough, sore throat, and gastric ulcers.
- The use of propolis products has shown good results in treating cancers of the mouth, stomach, prostate, lung, etc

1.6 Wax production, storage and use

Wax is a substance secreted by the four pairs of wax glands located in the fourth to seventh segments of the abdomen of worker bees aged 12 to 18 days.

6.6.1 Wax production method

- Collect old comb and wild bee comb.
- Soat it overnight in a plastic container
- Remove the dirt materials from the wax.
- Boil the wax in low heat and squech the boiled wax by using jute bag with the help of two wooden stick.
- Put the screened wax in a clean plastic container.
- Wax is ready to use for different propose as you like.



Figure 123: Bee Wax

Generally, wax production is much less than honey production. The ratio of honey to wax production in modern beehives and traditional beehives is 75:1 and 10:1, respectively.

6.6.2 Uses of wax

- Beauty (cosmetic) uses: Currently, 40% of the world trade in beeswax (unheated, pure, and propolis-free) is used in the beauty (cosmetic) industry.
- Use in Pharmaceutical Production 30% of the world's trade turnover is found to be used by the pharmaceutical industry for the production of medicines.
- Wax used in candle making (20% of world trade) is used by the candle industry.
- Other uses of wax (including wax and wax substitutes) 10% of world trade transactions involve the use of wax for other purposes.
  - ✓ For example; Painting creation area, use in gold, silver, copper jewelry, polishing cars, furniture, shoes, other leather items.
  - ✓ In the agricultural sector, to produce saplings by grafting plants, to increase the shelf life of fresh fruit.
  - ✓ In the field of science, wax is used as an insulator in the computer industry and other electronic products, to increase the strength and durability of sewing threads, and to dye fabrics.

The use of wax in beekeeping is mainly as a comb foundation for beekeeping. Applying wax to an empty hive attracts bees to settle there.

1.7 Bee venom production, storage and use

Bee venom is a clear, colorless, bitter, and watery liquid that smells like ripe bananas and is obtained from mature worker bees. Bee venom contains many components, including histamine, pheromones, enzymes, peptides, acids, and reducing sugars. Melittin, found in peptides, is the main component of bee venom. When a bee stings or comes into contact with bee venom, it causes a burning and uncomfortable feeling.

6.7.1 Bee venom production method

- The worker bee reaches 18 days of age, the venom gland located at the end of its abdomen begins to become active. This venom gland contains a venom sac and begins to produce bee venom. Bees use venom to defend their nests against their enemies.
- A bee stores about 0.5 mg of venom in its lifetime, and 0.1 mg of venom is released from a single sting. Bee venom is collected in two forms: dried powder and liquid.



Figure 124: Bee venom collector

6.7.2 Bee venom collection

- Surgical method of bee venom collection:-is collected by surgically removing the bee's venom sac and squeezing it out.
- Using an electric shock device/Bee venom collector: Place the bee venom collector near the entrance of beehives.
- Switch on the device to flow the electric current in the wire of device
- Bee start to sting and dropping venom onto a glass plate, then remove the glass plate containing in the device.
- Scribe the deposited venom by using scriber and collect venom carefully.
- It takes more than 2 hours to collect 1 gram of bee venom from 20 hives. That is, 1 gram of dry bee venom can be collected from 1 million bee stings. This device should be kept for 15 minutes at intervals of 3 days and this process should be repeated after 2-3 weeks.

6.7.3 Storage of bee venom

- Store in a dark bottle in the refrigerator at freezing temperature, in a dark room out of direct sunlight.

- Dried bee venom can be stored in a refrigerator for a few months, but it should not be stored in the refrigerator for more than a few weeks.
- Liquid bee venom should be kept in a dark container, tightly sealed, and stored in the refrigerator at freezing temperatures.



Figure 125: Bee venom

6.7.4 Use of bee venom

Information about the use of bee venom is given below.

- Use to treat rheumatism and drug-related diseases.
- Use for people who are allergic to bee venom to reduce their itching or use its ointment.
- Use for bee sting treatment prevents skin from peeling.
- Use in cancer treatment for human due to its element e.g. Melittin.

1.8 Apilarnil production, storage and use

This is the juice extracted from the 7-day-old drone larvae before entering the pupal stage and is also called male royal jelly. Apilarnil is prepared by mixing royal jelly, pollen, wax, propolis residue, honey, water, and drone larvae in the hive. It has a pH of 6.2, water 67%, protein 16.8%, amino acids 1.28%, carbohydrates 3.2%, lipids 6%, ash 1.8%, and others 5.8%.



Figure 126: Apilarnil

6.8.1 Apilarnil production method

For the production of apilarnil, drones production is necessary and it depends on the following factors:

- Bee behavior
- Number of brood and worker bees
- Availability of food

- Antecedents of swarming
- Replacement of old queen bees
- Environmental conditions (temperature and humidity)

Apilarnil can be produced from male brood born from this queen bee and worker bee. For male brood production

- Use the drone production techniques.
- Provide necessary bee supplementary food.
- After hatches, the 7-day-old drones' larvae and all the contents of the larval cells should be squeezed out for preparing apilarnil.

6.8.2 Storage of apilarnil

- Store apilarnil at a temperature of -20° to -5°Celsius for long times.
- Store for a long time by mixing 1-part apilarnil with 10 parts honey.

6.8.3 Use of apilarnil

- Helps to eliminate the sexual problems (fast ejaculation) in men .
- Helps to eliminate weakness in men.
- Helps to improve the kidney problems of human.
- Helps to reduce fatigue and stress.
- Helps athletes to maintain their performance.
- Helps to cure the respiratory problems seen in children.
- Provides fertility to human couples.

The dosage is 3 grams per day mixed with honey and consumed for 1 month.

1.9 Bee bread production, storage and use

Beebread is a mixture of honey, flower nectar, and bee saliva, which is considered the most nutritious food for bees. It contains 55% carbohydrates, 35% proteins, 3% minerals and vitamins, 2% acids, and 5% others.

Therefore, during the season of abundant food flow, the bee-prepared beebread can be produced and used as needed.



Figure:127: Bee Bread

6.9.1 Use of bee bread

- Consume as a source of protein supply.
- Improve the digestive power of those who have weak digestion.
- Helps to improve the liver patients and liver starts working well.
- Reduces bad cholesterol.
- Reduces urinary tract and prostate problems.
- Dosage 1 tablespoon or 3 grams daily.

1.10 Honeydew honey production, storage and use

Honeydew is a sticky, sweet liquid that is produced by sucking insects like aphids, scale insects etc. from plants. Generally, bees collect nectar found in nature and make honey, but in summers when food is scarce, bees also collect honeydew and make honey from it. Since honeydew evaporates quickly and dries out, bees collect it in the morning and evening and mix it with flower nectar to make honey. Honeydew honey contains 16.35% water, 8.85% sucrose, 57.85% reducing sugar, 8.85% maltose, 0.745% ash, other acids, enzymes, and a pH of 4.4.

6.10.1 Honeydew honey storage and use

Adopt methods for storing and using nectar/honey from flowers.

1.11 Bee hive air production and use

Bees extract, essential oils and flavonoids from honey, royal jelly, wax, and propolis in the hive, and the flow of these elements also mixes with the air produced in the hive.

Currently, natural medicine is using the air obtained from bee hives to treat many diseases and allergy sufferers. A small apiary is built and bees are kept there for the production and use of bee air. As shown in the picture, the equipment for taking air from the beehive is installed and arranged in a separate room.



Figure 128: Bee hive air

6.11.1 How to get fresh air from a beehive

This air is recommended for use because it has the ability to heal and cleanse wounds in the human body. Using this air for a maximum of half an hour a day for 10 days will be beneficial. Studies have shown that its use can treat the following problems.

- Respiratory diseases: Asthma and bronchitis
- Respiratory problems: Chronic arterial disease
- Patients with chronic arterial disease
- Patients with reduced ability to fight disease
- Patients with migraine headaches
- Patients with depression

Sample questions for practice

1. Enlist the bee products and describe their importance.
2. Describe the production techniques of royal jelly.
3. Describe the method of pollen collection in practice.

Session 41

Marketing of honey bee products

1. Learning objectives

By the end of the session, the participants will be able to:

- Describe of production and consumption of honey, use of honey, and honey bee market and marketing
- Explain about the necessity of honey bee marketing
- Describe about the price and consumer surplus, honey consumption trend
- Describe about the importance of nutrition profile of honey bee products
- Discuss about the importance of branding and labelling
- Tell the types of honey and products from apiary business
- Calculate farm gate and market price

2. Sub-topics

- Production and consumption of honey
- Honey bee market and marketing
- Use and necessity of honey in human life
- Farm-gate and market price and consumer surplus
- Honey consumption trend
- Importance of nutrition profile of honey bee products
- Importance of branding and labelling
- Types of honey and products from apiary business

3. Methods and materials

1.1 Training methods

- Lecture
- Brainstorming
- Group discussion

- Experience sharing
- Practical exercise
- Visit to honey products outlets and inputs suppliers

1.2 Training materials

- Projector, power points, slides, pictures.
- Marker, brown paper, pen, masking tape, meta card
- Different honey products (domestic and imports)

1.3 Time

Theory: 60 minutes

Outlet Visit: 20 minutes

Discussion: 10 minutes

3.4 Place: Training hall

3. Activities and exercise

3.1 Inform participants about the topics covered in the training and inquire about their level of knowledge on the subject matter.

3.2 Presentation

Give a short presentation on the honey bee market and marketing, labelling and branding of products, honey bee products, nutrition profiling of different products, competitiveness of our Nepali brands, comparison between domestic and imported products, farm gate and retail price, marketing cost as outlined in the resource materials.

3.3 Outlet visit/practical exercise

Take participants to nearby honey bee outlets like Bigmart/Bhatbhateni/Honey Bee Association and explain about the labelling, packing, MRP price, wild honey without label and price, domestic honey and imported or Dabur honey and compare among these products regarding marketing, branding, nutrition profile, MRP and market trend.

3.4 Discussion

After returning from outlet visit, organize group presentation to discuss on the result of marketing Cost and price of different honey products, consumer preferences. Use in depth discussion and question and answer to discover whether the participants can understand the importance of nutrition profile,

labelling and branding in marketing of honey and whether the participants are clear about marketing of honey bee products.

4. Detail schedule

SN	Subject matter	Description	Time	Materials
1	Introduction and importance of market and marketing of honey products	Ask participants to write down what they know about the market and marketing of Honey products.	5 minutes	Marker pen, meta card, power point
2	Production and Consumption of honey	Discuss about the production and consumption trend of honey in Nepal.	10 minutes	Projector, power point slides, pictures, videos
3	Use of honey and necessity	Use and necessity of honey in Nepal.	15 minutes	Projector, power point slides, pictures, videos
4	Types of honey products	Introduce the different honey products.	10 minutes	Projector, power point slides, pictures, videos
5	Farm gate and retail price of honey and consumer surplus	Brief description of farm gate and retail price, profit, and consumer surplus.	20 minutes	Projector, power point slides, pictures, videos.
6	Branding and labelling, importance of nutrition profile	Why our products are not competitive compare to imported ones in Honey business, nutrition profiling, labelling and branding of honey.	20 minutes	Outlet visit, sample/ picture show comparison domestic vs imported
7	Discussion		10 minutes.	

6. Resource materials

6.1 Introduction

The agricultural market is a complex system where farmers produce crops and livestock, and these products are then moved through a variety of channels to reach consumers.

6.2 Production trend of honey

Marketing adds cost to the product, but, at the same time, it adds utilities to the product (form, place, time, possession- ownership).

Table 27: Bee keeping and honey production status

Year	Bee hives (No.)	Production (mt.)
2010/11	140,850	1,365
2011/12	156,000	1,500
2012/13	169,000	1,625
2013/14	170,000	1,650
2014/15	225,000	3,000
2015/16	232,000	3,500
2016/17	240,000	3,950
2017/18	242,000	3,980
2018/19	242,500	3,990
2019/20	248,037	3,997
2020/ 21	249,680	4,062
2021/ 22	248,995	5,168
2022/23	245,010	4,308

Table 28: Import of honey, 2023/34

04090010	Raw natural honey (unprocessed)	kg	500703	120268
04090090	Other natural honey	kg	118277	30074
	Total	**mt**	**618.98**	

From these table, the production of honey is increasing trend. In 2021/22, the highest production from honey bee was 5,168 mt per year. In the same way, the import of honey is also in increasing trend due to increment in number of hotels

for the promotion of tourism. Beside this, the awareness about the consumption of honey is increasing due to aware about the health.

Recommended honey consumption: 10gm/day

Vegetable: 60-128kg/year (ICMR, 1995)

Due to increased awareness/education: Consumption of vegetables/fruits/ honey/meat/milk increased.

6.3 Market analysis

- Market analysis is determining the characteristics unique to your particular market and analyzing this information, which will help you make decisions for your business.
- By conducting a market analysis, able to gather valuable data that will help you get to know your customers, determine appropriate pricing, and figure out your competitors' vulnerabilities.

6.4 Market function

A) Exchange functions

- Buying
- Selling

B) Physical functions

- Storage
- Transportation
- Processing

C) Facilitating functions

- Standardization
- Financing
- Risk bearing

6.5 Drivers of growth in honey marketing

- Technology change
- Specialization
- Urbanization
- Transportation and communication
- Warehouse and cold storage
- Income
- Global village

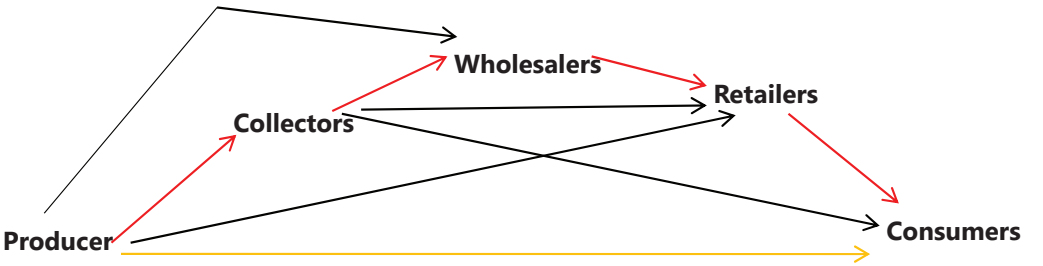
6.6 Honey market

6.6.1 Market expansion for honey: Imported honey amount is increasing year after year

increased of fruits production means increasing honey bee farming and honey production

6.6.2 Market chain

Producers – Collectors – Wholesalers – Retailers - Consumers



Long market chain means low value to farmers and high charge to consumers and profit margin captured by middleman.

Long market chain means increased cost of marketing, loss and high rate charged to consumers.

6.6.3 Market information channel

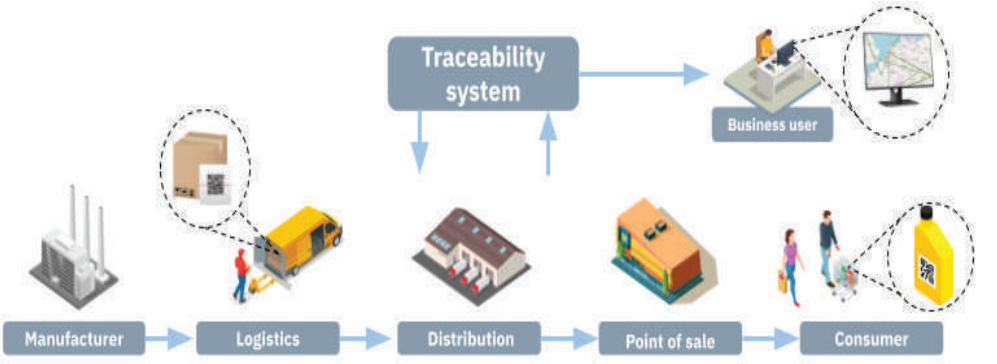


Figure 129: Market Channel

6.6.4 Types of market

A. **Physical market:** Domestic, regional and international, hat bazaar, collection center, cooperative marketing, money lenders and traders, wholesale market

B. **E- Marketing:** Online marketing, home delivery.

6.7 Branding and labelling

Nutrition Profiling: The most important for marketing of honey bee is the nutrition profiling of honey based on its types like mustard-based honey or chiuri based honey. Branding and labelling of honey can be done according to the type of honey.

6.7.1 Type of honey based on honey bee species

- Honey from *A. cerana* (Hill honey)
- Honey from *A. dorsata* (Wild honey)
- Honey from *A. mellifera* (Terai honey)

6.7.2 Type of honey based on the plant resources to prepare honey

- Mustard based honey
- Rudhilo based honey
- Buckwheat based honey
- Rhododendron based honey
- Eucalyptus based honey
- Chiuri based honey
- Apple based honey
- Orange based honey
- Mixed honey
- Wild (forest) based honey
- Dabur honey

Consumers are less aware about the nutrition profile regarding plant material or species-based honey and less valued compare to Dabur honey. So, branding with nutrition labeling based on species or plant materials used to make honey by honey bee and price variation. Wild honey costing Rs 4000/lt due to high power or its plant-based resources and species with high quality compare to other seasonal based crops like mustard, chiuri.

Now, IT friendly market and market are the boon to producers and consumers too but challenges in IT used in market are:

- New technology
- Lack of information in objective settings
- High cost and low consumption
- Trustworthy and quality concern

- Issues of skilled human resources
- Lack of training to the human resources
- Expensive
- Sensitivity of information
- Lack of resources
- Less secure
- Geographical issues
- IT based Infrastructure lacking and costly
- Lack of decision-making culture based on data and information

6.9 Price determination process

- Market determine the price of any commodity in the open market.
- In economics, Demand and supply determine the price of any commodity

6.9.1 Factors affecting the supply

- Inputs price
- Technology
- Future products and price
- Production quantity

6.9.2 Factors affecting the demand

- Income
- Prices of substitutes
- Prices of complements
- Advertising
- Population
- Consumer expectations

To determine the farm gate price of honey, cost items for honey production (variable and fixed) are summed and profit with local transportation will be added.

For determination of market price, processing, packaging, labelling and storage charge with transportation from local vendor to destiny district markets will be added on farm gate price.

Summary

In Nepal, the market for honey is not well-established yet as Dabur Nepal honey but Dabar honey had the well-established market for honey in Nepal. The forest with flowering plants like chiuri, masala provided the forage for honey bee and agricultural seasonal plants like buckwheat, mustard provide the juice for collection and processing by honey bee to honey with high quality and standard. Normally, honey produced at village and supply to city for marketing with loose or old plastic bottles with 500 to 1000 ml/gm. The nutrition profile of different types of honey (species or flowering crop varieties) is not labelled on the cover of honey pot which is less attractive to consumers compared to Dabur honey. Due to lack of labelling and well packed, the price of Nepali honey gets lower price and less popular to consumers though high quality. We should encourage the private suppliers/traders for nutrition profiling with attractive labelling and packaging for competitiveness in the market and also gets high price like quality and standard.

Sample question for practice

1. What is the scenario of honey import in Nepal?
2. What are different types of honey brand found in Nepal?
3. What is the price determination process of honey in Nepal?

Session 42

National and international honey quality and standards

1. Learning objectives

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

- Understand the fundamental concepts and importance of honey quality and safety standards.
- Differentiate between mandatory and voluntary standards, particularly in the Nepali context.
- Describe the Codex Alimentarius honey quality parameters and safety requirements.
- Explain the procedures for honey certification and the significance of each step.
- Analyze the differences and similarities among national (Nepal, India) and international (Codex) standards.
- Apply knowledge to ensure compliance with regulatory frameworks in honey production and trade.

2. Sub-topics

- Introduction to honey quality and standards
- Mandatory vs. Voluntary food standards (Nepal Focus)
- Importance of honey quality and safety
- Codex Alimentarius honey standards
- Honey certification and compliance procedures
- Comparative overview of national and international standards (Nepal, India, Codex)

3. Methods and materials

3.1 Training methods

- Lecture / Presentation
- Brainstorming

3.2 Training materials

- Projector, power point slides, visuals/charts
- Marker pens, brown paper, pens, masking tape, meta cards

3.3 Time

Theoretical: 80 minutes

Discussion: 10 minutes

3.4 Place: Training Hall

4. Activities and exercises

4.1 Inform participants about the topics covered in the training and inquire about their level of knowledge on the subject matter.

4.2 Presentation

Present the following key topics using presentation slides and reference materials:

4.3 Discussion

Organize a fun quiz or question-answer session where one group asks questions to another based on the session topics. Use the responses to evaluate the level of learning and clarify any misunderstandings.

5. Detail schedule

Sub-topics

Sub-topic	Summary
1. Introduction to honey quality	Overview of what defines honey quality and the role of standards in ensuring safety and trade credibility.
2. Mandatory vs. voluntary standards	Explains legal vs. optional standards in Nepal, including DFTQC's role and how businesses use voluntary standards for added value.
3. Importance of honey safety	Highlights why maintaining hygiene, nutritional value, trade access, and sustainability is critical.
4. Codex standards	Covers Codex parameters like moisture, sugar composition, additives, and hygiene practices.
5. Certification process	Outlines the step-by-step certification process including HACCP, ISO, and audits.

Sub-topic	Summary
6. National & international comparisons	Compares Nepal, India, and Codex honey quality frameworks.

Session breakdowns

Detailed session plan with sub-topics

SN	Subject matter	Description	Time	Materials
1	Introduction to honey quality and standards	Make participants to write down what they know about the Honey standard then discuss about honey quality and mandatory standards.	10 minutes	Marker Pen, Meta card
2	Nepali context of food standards (DFTQC)	Explain the role of DFTQC in regulating honey- Key technical regulations and compliance requirements- How businesses engage with DFTQC- Examples of mandatory standards for honey in Nepal.	15 minutes	Projector, Power point slides, Pictures, Videos.
3	Significance of honey safety (Health, trade, environment)	Discuss the public health protection through honey safety- Preservation of nutritional quality- Trade facilitation through standard compliance- Economic losses due to contamination- Role in sustainable food systems (SDG alignment).	10 minutes	Projector, Power point slides, Pictures, Videos.
4	Codex honey quality parameters (Moisture, sugar, etc.)	Give overview of Codex Standard for Honey (CXS 12-1981)- Composition requirements (moisture, sugars, sucrose)- Purity and absence of foreign materials- Water-insoluble solids, free acidity, HMF, diastase activity.	15 minutes	Projector, Power point slides, Pictures, Videos.

SN	Subject matter	Description	Time	Materials
5	Codex safety requirements (Hygiene, contaminants, additives)	Elaborate heavy metals and pesticide residue limits- Codex hygiene practices (CXC 1-1969)- Additives prohibition in honey- Key safety measures: sanitation, personal hygiene, traceability.	5 minutes	Projector, Power point slides, Pictures, Videos.
6	Steps in honey certification (HACCP, ISO, inspection)	Explain the purpose and importance of certification- Key stages: application, documentation, audit, testing- Overview of HACCP and ISO 22000 standards- Certification challenges (cost, technical gaps).	10 minutes	Projector, Power point slides, Pictures, Videos.
7	Comparison of Nepal, India, and Codex standards	Discuss about the overview of national and international standards- Differences in legal status and implementation- Parameter comparison (moisture, sugar, etc.)- Relevance to domestic and export markets.	15 minutes	Projector, Power point slides, Pictures, Videos.
8	Discussion		10 minutes	

6. Resource materials

6.1 Basic concept of honey quality and standards

Honey quality and standards are crucial in ensuring the safety, purity, and authenticity of honey products, protecting both consumers and producers. These standards serve as a foundation for quality assurance, fair trade, and market transparency.

Internationally, Codex Alimentarius standards play a key role in defining the physical and chemical properties of honey, including moisture content, sugar

composition, and absence of contaminants. By adhering to these benchmarks, honey producers help maintain consumer trust and support cross-border trade. Moreover, regular updates to honey standards ensure that they remain consistent with emerging scientific research, technological advancements, and evolving food safety concerns. As a result, harmonized honey standards contribute to a competitive, safe, and sustainable apiculture industry globally and in countries like Nepal.

6.2 Mandatory and voluntary food standards

Mandatory and voluntary food standards are regulatory tools used to ensure food safety, quality, and consumer protection. Mandatory food standards are legally enforceable requirements set by government authorities. These include specifications related to food safety, labeling, permissible additives, hygiene, and nutritional content, and must be followed by all food producers, processors, and sellers. Non-compliance can lead to legal penalties or product recalls.

Voluntary food standards are not legally binding but serve as guidelines or best practices, often developed by industry groups, certification bodies, or international organizations. These standards may cover aspects such as organic certification, fair trade, or premium quality labeling, and are usually adopted by businesses to gain market advantage or consumer trust. The main difference lies in enforcement: while mandatory standards are compulsory and legally monitored, voluntary standards are optional and depend on the organization's commitment to higher quality or ethical practices.

In Nepal, the Department of Food Technology and Quality Control (DFTQC) establishes technical regulations related to food safety, and the standards issued under these regulations are mandatory and legally enforceable. In contrast, other technical standards developed by industries, trade associations, or independent certifying bodies are considered voluntary, serving as guidelines that businesses may choose to adopt to demonstrate higher quality or ethical practices beyond the minimum legal requirements.

6.3 Importance of quality and safety in honey and honey products

Food safety is fundamental to health, trade, and sustainability. The Codex Alimentarius provides a framework for global best practices, emphasizing prevention over corrective action. The following are the main objectives to maintain hygiene and safety in honey and honey products.

- **Protecting public health**

  Honey quality and safety prevent foodborne illnesses caused by pathogens, chemical contaminants, or physical hazards. Proper handling reduces health risks for consumers.

- **Ensuring nutritional quality**

  Safe honey retains its nutritional value, preventing degradation due to contamination or spoilage. Hygiene practices preserve vitamins, minerals, and other essential nutrients.

- **Facilitating trade & market access**

  Compliance with international standards (e.g., Codex) builds trust in global markets. Certified hygiene practices reduce trade barriers and recalls, benefiting producers and exporters.

- **Preventing economic losses**

  Foodborne diseases and spoilage lead to financial losses for businesses (recalls, lawsuits) and healthcare systems. Hygiene minimizes waste and ensures economic sustainability.

- **Legal & regulatory compliance**

  Adherence to hygiene standards (e.g., HACCP, GMP) is mandatory in most countries. Noncompliance risks penalties, reputational damage, and loss of consumer confidence.

- **Consumer trust & brand reputation**

  Consumers prioritize safe honey. Transparent hygiene practices enhance brand loyalty and competitiveness in the market.

- **Sustainable food systems**

  Safe honey reduces resource waste (e.g., spoiled produce) and supports the UN Sustainable Development Goals (SDG 2, 3, 12).

Key safety measures according to Codex guidelines are as follows

- Personal Hygiene: Training for handlers to prevent contamination.
- Sanitation: Clean facilities, equipment, and pest control.
- Temperature Control: Proper storage.
- Traceability: Recordkeeping for recalls and accountability.

6.4 Codex standard for honey

The Codex Standard for Honey establishes globally recognized benchmarks for the quality and safety of honey intended for direct human consumption and industrial use. The standard outlines clear definitions, compositional requirements, and guidelines to ensure honey is safe, unadulterated, and of acceptable quality.

6.4.1 Quality requirements

1. **Composition and purity**

   Honey must be free from any added substances, including food additives or other non-honey ingredients. It should not have foreign flavors, odors, or signs of fermentation. Minimal processing is allowed, provided it does not alter the natural composition or diminish quality.

2. **Key quality parameters**
   - Moisture Content: Generally, not more than 20%; Heather honey allowed up to 23%.
   - Sugar Composition: Fructose + Glucose ≥ 60 g/100g (≥ 45 g/100g for honeydew blends).
   - Sucrose: Ranges from 5 to 15 g/100g depending on floral origin.
   - Water-Insoluble Solids: ≤ 0.1 g/100g for most honey; ≤ 0.5 g/100g for pressed honey.

3. **Annex quality parameters (voluntary for trade partners)**
   - Free Acidity: ≤ 50 meq/kg.
   - Diastase Activity: ≥ 8 Schade units (≥ 3 for low enzyme varieties).
   - Hydroxymethylfurfural (HMF): ≤ 40 mg/kg; ≤ 80 mg/kg in tropical honeys.
   - Electrical Conductivity: Differentiates floral vs honeydew sources.

6.4.2 Safety requirements

4. **Contaminants**
   - Heavy Metals: Must not exceed Codex-defined limits to avoid health risks.
   - Pesticide and Veterinary Drug Residues: Must comply with Codex Maximum Residue Limits (MRLs).

5. **Hygiene**

   Production and handling must align with the *General Principles of Food Hygiene (CXC 1-1969)* and other relevant Codex hygiene codes. Microbiological criteria must be met as per CXG 21-1997.

6. **Food additives**

No additives are permitted in honey, reinforcing its natural purity.

6.4.3 Sampling and analysis

7. The standard outlines validated methods (e.g., AOAC and MAFF methods) for testing moisture, sugar content, water-insoluble solids, diastase activity, and HMF levels to ensure compliance with compositional and safety parameters.

6.5 Honey and honey products certification

The key principles and steps for private sector honey and honey products certification to ensure safety, quality, and compliance with international standards. Private sector certification ensures safety of the products and quality but requires adherence to rigorous processes and standards

1. Purpose of certification

- Certification verifies that honey and honey products meet regulatory, safety, and quality standards, enhancing consumer trust and market access.

2. Certification process

- Application: Producers submit details about products, processes, and compliance measures.
- Documentation review: Certification bodies assess compliance with standards (e.g., Codex Alimentarius, ISO, HACCP).
- Inspection/Audit: Onsite checks of facilities, hygiene, and production practices.
- Testing: Laboratory analysis for contaminants, additives, or nutritional claims.
- Certification Decision: Approval or corrective actions if gaps exist.

3. Key Standards

- Hazard analysis (HACCP): Mandatory for risk management.
- ISO 22000: Covers food safety management systems.

4. Challenges

- Costs, complexity, and varying standards across regions can hinder small producers.
- Requires ongoing compliance monitoring and recordkeeping.

6.6 National and international standard for honey

The following information relates to technical standards for honey, including Nepal's mandatory requirements, Indian honey standards, and the Codex

Alimentarius standards for honey, which are considered voluntary international guidelines.

Table 29: Honey quality standards of China, India, Nepal and the Codex Alimentarius Commission

Quality Parameters	Standard Limits						Codex standards	
	China	India			Nepal		General	Other
		Special	A grade	B grade	Pure Nectar honey	Other honey		
Specific Gravity @27 C		Min.1.4	Min 1.4	Min 1.35				
Moisture Content	Max. 18%	Max. 20%	Max. 22%	Max. 25%	Max. 23%	Max. 23%	Max. 20%	Max. 23% (heather honey).
Sucrose content (g/100g)	Min. 5	Max. 5	Max. 5	Max. 5	Max. 5	Max. 10	Max. 5	Max. 10 (honeydew, blends of honeydew and blossom, Robinia, citrus, alfalfa, acacia, red gum, sweet clover, leatherwood) Max. 15 (Lavendula and borage)
Reducing sugars (g/100g)	Min. 70	Min. 65	Min. 65	Min. 65	Min. 65	Min. 60		
Fructose/ glucose ratio	Min. 1-1.15	Min. 1	Min. 0.95	Min. 0.95	Min. 0.95	Min. 0.95		
Sum of fructose and glucose (g/100g)							Min. 60	Min. 45 (honeydew, blends of honeydew and blossom)

Quality Parameters	Standard Limits						Codex standards	
	China	India			Nepal		General	Other
		Special	A grade	B grade	Pure Nectar honey	Other honey		
Ash or mineral content (g/100g)		Max. 0.5	Max. 0.5	Max. 0.5	Max. 0.5	Max. 0.5	Max. 0.6	Max. 1 (honeydew or blends of honeydew and blossom)
Aniline chloride test positive or negative		Negative	Negative	Negative				
Acidity as formic acid		Max. 0.20%	Max. 0.20%	Max. 0.20%	Max. 0.20%	Max. 0.20%		
Water insoluble content (g/100g)					Max. 0.5	Max.0.5	Max. 0.1	Max. 0.5 (pressed honey)
MHF content (mg/kg)		Max. 50	Max. 50	Max. 50	Max. 40	Max. 40	Max. 40	Max. 80 (honey of declared origin from countries or regions with tropical ambient temperature.

Source: ICIMOD, 2012

Sample question for practice

1. What is the importance of Quality and Safety in Honey and Honey Products?
2. What is the honey certification process in Nepal?
3. What is the national standard of honey?

Session 43

Apitherapy
(Natural medicine from honeybees)

1. Learning objectives

By the end of the session, the participants will be able to:

- Explain the need of bee products in health and medicine.
- Describe the use of hive products in apitherapy.
- Learn, practice and earn from the use of beehive products.

2. Sub-topics

- Introduction and importance
- Bee products in therapy
- Apitherapy in practice
- Apitherapy guidelines
- Safety precautions

3. Materials and methods

3.1 Training methods

- Lecture
- Brainstorming/experimentation
- Group discussion
- Identification of bee hive products
- Application of bee hive products in apitherapy
- Visits and observation of apitherapy practices

3.2 Training materials

- Projector, power point slides, pictures
- Marker pen, brown paper, pen and masking tape, meta card
- Bee colony and hive products
- Protective wears, bee smoker, hive tools

3.3 Time

Theory: 50 minutes

Practical: 30 minutes

Discussion: 10 minutes

3.4 Place: Training hall, bee farm, laboratory

4. Activities and exercises

4.1 Inform the participants about the lecture/practical exercises included in the training and obtain information about the level of knowledge of the participants on the subject.

4.2 Deliver lecture on the subject

Give a short presentation on the introduction and importance, bee hive products as apitherapy, apitherapy practices, apitherapy guidelines, and safety precaution as outlined in the resource materials.

4.3 Group division/practical exercises

Divide participants into 4 groups and complete the following tasks during the practical exercises

1. Bee hive products identification (honey, pollen, propolis, royal jelly, venom) and worker bee handling for sting practice.
2. Each group preparing and practicing at least safe use of one of the hive products (honey, pollen, propolis, royal jelly, venom) in supervision of health worker.
3. Listing and following guideline standards for performing apitherapy on other animals.
4. Visit apitherapy treatment center and observe treating patients.

Take participants to the bee farm/apitherapy treatment center for observation and practice. Introduce them to bee hive products and their uses in health and medicine and safely handling treating patients

4.4 Discussion

After returning from the bee farm/apitherapy practice center, organize group presentation to present the results of their observations. Ask participants about importance and practice of apitherapy, guidelines, and safety precautions to find out whether they are clear and to discuss topics to clarify if they are not clear.

5. Detail schedule

SN	Topic	Description	Time	Materials
1	Introduction and importance	Ask participants to write importance of apitherapy.	5 minutes	Marker, pen, meta card, treatment materials
2	Types of hive products in apitherapy	Discuss with participants on various types of bee hive products in apitherapy.	10 minutes	Projector, PPT slides, photo, video sample products
3	Apitherapy in practice	Discuss with participants on general practice of apitherapy.	15 minutes	Projector, PPT slides, sample products
4	Apitherapy guidelines	Discuss with participants on the standard guidelines of apitherapy.	10 minutes	Projector, PPT slides, photo, video
5	Safety precaution	Discuss with participants on safety measures and precaution while practicing apitherapy.	10 minutes	Projector, PPT slides, photo, video
6	Practical exercise	Organize participants in four groups and visit to bee farm/ apitherapy practice center to observe apitherapy treatment of patients (human beings, animals), if possible with the help of binocular/hand lens.	30 minutes	Bees, bee flora, honey potential plants, conservation areas
7	Discussion		10 minutes	

6. Resource materials

6.1 Introduction

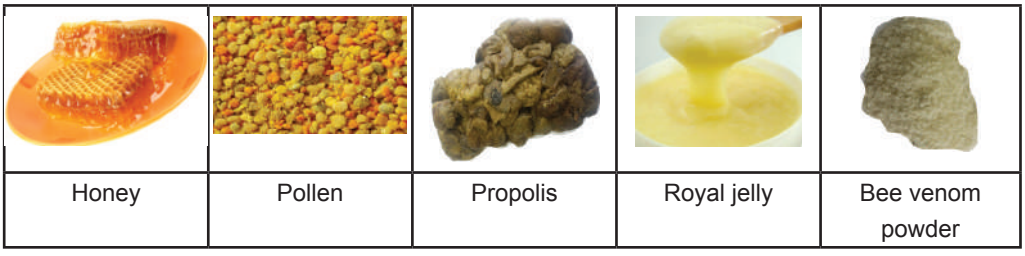
Apitherapy is '*The art and science of treatment and holistic healing through the honeybee and hive products for the benefit of mankind and animal kingdom'*. Alternatively, it is also known as *Apitherapy*, *Bee treatment*, *Bee Therapy*, *Bee Treatment*, *Bee Venom Therapy* and *Honey Bee Venom Therapy*. In practice, for example, the uses of honey as a treatment has history over thousands of years. The treatment is based on the use of bees and beehive products (honey,

pollen, wax, royal jelly, propolis and bee venom) in preventing/treating various diseases, and increasing the resistance against various diseases. Hence, honeybees and their products have great potential for use in health and medical care, which also increases economic values of beekeeping. Recently, bee sound therapy is gaining popularity in many countries, which is spreading to different parts of the world. At the current level of medical science and technology, health care relates to the insurance and medical care systems in society, as well as continues self-health care in local traditional culture.

6.2 Bee products in therapy

Apitherapy includes the use of bee products (honey, pollen, propolis, royal jelly venom, etc.) with systemic actions- anti-inflammatory, anti-fungal, anti-bacterial, anti-viral, and anti-pyretic, stimulating vascular permeability (Figure 130).

As people are realizing that modern medicine is not the soul remedy for infections today, they are looking back for the alternative approaches with least possible side effects like apitherapy.



Honey	Pollen	Propolis	Royal jelly	Bee venom powder

Figure 130: Bee products in apitherapy

6.2.1 Honey

Honey has many uses in human health and medicine. The antitumor activity of honey has been explained by its anti-bacterial, anti-inflammatory, immune modulating, anti-oxidant and probiotic effects. Honey is a potent inhibitor of the causing agent of peptic ulcers and gastritis, caused by *Helicobacter pylori*. The positive effect of honey on nutrition function is also due to its probiotic effect. Honey has also been used in livestock for wound healing.

6.2.2 Pollen

The bioactive substances present in pollens provide varieties of therapeutic benefits to human. Its medicinal properties are stimulating, antiseptic, slight aphrodisiac, diuretic and laxative, sedative. It regulates growth function with menstrual and myocardial effects. It also supports venous and arterial circulation, and act on liver and prostate decongestant. It adds in cardiovascular functions

and fighting diabetes. It is believed to strengthen the organic ability of the body to overcome the effects of stress and greatly improve one's health, and prevent senescence. The use of pollen on poultry has also been practiced for gut microflora colonization, growth promoter, improvement of growth performance and immune status, improvement in weight gain and food conversion rate, positive effect on daily gain, feed conversion, and microbiological composition of intestine.

6.2.3 Propolis

Propolis has active compound like polyphenols and flavonoids which show therapeutic potential in the pharmaceutical and food processing industries. It has a range of biological activities on human, such as immunomodulatory, anti-bacterial, fungicidal, anti-inflammatory, healing, analgesic/ aesthetic, and anti-carcinogenic effects. It can be used for a wide range of purposes as anti-inflammatory and hypotensive agent, immune system stimulant, and bacteriostatic and bactericidal agent, among many other uses. .

6.2.4 Royal jelly

Royal jelly has anti-hypertenisive, hypotensive, vasodilatative effects. Other biological effects include anti-oxidative and radiation-protective and hepatoprotective (liver-protecting, hyperglycaemic, preventing insulin resistance, stimulating bone formation and promoting bone healing, preventing osteoporosis in promoting building of collagen in cell cultures and suppressing the development of atopic dermatitis-like skin lesions on human. It has bio-stimulating activity due to induced increase of respiration and oxidative phosphorylation particularly in the liver as well as oxygen uptake in the brain. It works to decrease inflammation and increase wound healing due to the presence of an antibacterial peptide called royalisin. Its major protein activates keratinocytes, which is involved in wound healing.

6.2.5 Bee venom

It is the use of live bee stings (injecting venom) to treat various diseases on human beings such as arthritis, rheumatoid arthritis, multiple sclerosis, lupus, sciatica, low back pain, and tennis elbow etc. The main component of bee venom responsible for pain in vertebrates is the toxin melittin; histamine and other biogenic amines may also contribute to pain and itching, while the sting stimulates the immune system to relieve the inflammation caused by the bee venom. Animals are venom treated for various ailments such as reproductive performance on rabbit, healing effects on dog suffering from *Malassezia*-related otitis externa, growth promoter on chicken, and promotion of antibody production and PRRS viral clearance.

6.3 Apitherapy in practice

The use of the sting organs of bees to carry out needling to treat diseases is called bee acupuncture. In it, the sting pulled out from live bees is used to carry out scattered needling on the affected area or the cutaneous region related to the relevant diseases or where there is pain. Usually the stingers of 3-5 bees are used to perform scattered needling on an area. The number of *A. mellifera* bees used vary 10 - 25, while that of *A. cerana indica* may be more. It is performed once in every two days with 10-15 bee needling. The second period begins 5-7 days after the first treatment. Its current use is limited to certain countries, such as China, Korea, Romania, Bulgaria and Russia. However, recently, some patients tested the lyophilized bee venom from company (Simic's Apitronic Service) seemed extremely useful and practical than traditional needling, i.e. using the syringe and choosing the depth of the injection, allowing new therapeutic possibilities.

6.4 Apitherapy guidelines

There over 7000 practitioners in the world; they follow traditional practices in apitherapy. In the present context, the practitioners and recipients must follow the guidelines with necessary precautions.

i. It should be practiced only with the professional guidance or close supervision of a qualified health professional.
ii. The diagnostic should be a 'holistic' one: classical (allopathic) but also energetic (as in Acupuncture), structural (Ayurveda), informational (Homeopathy) etc.
iii. An allergy test is necessary before administering any of the bee-products, but in particular before administering bee venom, which should be conducted by a qualified health practitioner in a medical clinic equipped with proper materials and lifesaving emergency procedures.
iv. The principle receiver of the therapy should be prepared to initiate life-style and dietary changes, and to be an active participant in the healing process to maximize the benefits of bee hive-products.
v. The treatment is based on the general state of health of the principle receiver (health condition and the route of delivery of bee-product(s).
vi. The time of treatments should be in harmony with different (bio) rhythms; these rhythms vary with the patient, the disease, the season, the hour of the day etc.
vii. Apitherapy is not a 'panacea' and should be applied in harmony with other natural healing methods like Phytotherapy, Aromatherapy, Acupuncture, Organic diet, Ayurveda, etc.

viii. Is should not be as experiment on patient, but as safe methods with high-quality products.

ix. It is very important to improve the blood flow through other methods like Massage, Acupressure, Gymnastics, *Taiji Quan, Qigong, Hatha* Yoga etc.

x. Good sleep and relaxation enhance the effect of bee products, and a good environment (clean, ordered, non-polluted) with a 'positive-thinking' is also beneficial.

xi. It is necessary to educate patients before, during and after treatments such as each patient must become, in time, his own apitherapist.

xii. It is always good that an apitherapist is a beekeeper and knows the bee colony's life in detail.

xiii. Good exchange of information with other specialists from other 'Apitherapy related countries', with the use of Internet can help in finding the best medical strategy for each person.

xiv. Before starting apitherapy, one must 'clean' the body with different 'detoxifying' methods: special diets, fasting, colon cleansing if necessary.

xv. The duration of an apitherapy treatment is proportional with the severity of the treated health condition, the proper execution, the knowledge of the therapy provider- positive attitude, willingness and participation of the principle receiver.

xvi. Finally, after an unspecified period of time of symptom relief, re-initiating and repeating the apitherapy treatment may be needed to maintain an improved health status that previously did not respond to conventional therapies.

6.5 Safety precautions

Any treatment with venom should start with a test of allergy. In the United States, 3% of the population is allergic to bee venom. For testing allergy, the convenient way is to have a bee sting on the wrist, then sting is removed. In the following minutes the person stung is observed to explain the different reactions to the venom and the Epinephrine Kit test for people involved in the therapy.

It is important to state that products from the honeybee hive are contaminated with chemicals (acaricides used by beekeepers to control bee mite) and other pesticides (used by farmers in agriculture) including other environmental pollutants. The bee products from such unsuitable apiaries and the incorrect application procedures are substandard, ineffective or even dangerous. Such pollutants eliminate the microelements and enzymes essential for apitherapeutic efficacy.

Beekeepers wishing to collect and sale products for human health and animals must adhere to a charter of good beekeeping practices. Venom's composition also varies slightly with the bee's age and with the bee's genetics, possibly also with the bee's feeding source. It is always advisable to utilize products derived from natural sources, such as pollution free plants. Though apitherapy has great potential for application in human and animal medicine, but officially, it can only be used as a complementary method of treatment.

All bee products have more or less beneficial effects on all patients. While, the fresh, 'organic' bee products show better effects than the 'industrial' processed ones, which due to overheating, excessive filtration and refining elicit detrimental effects. Dose of each bee product have to be established with accuracy based on age, weight, general/local condition of patient, time of application etc. Further, different methods of administration are better than only traditional one.

The literature on bee venom are available. The American Apitherapy Society (AAS) has a database containing over 600 titles of publications in English from the last 30 years, of which nearly 500 were published in the last 5 years. This shows increasing interest among scientists in very recent years. To come to safe conclusion, research and testing must continue to develop effective measures and safer practical means of apitherapy.

Sample questions for Practice

1. Write down importance of different types of apitherapy products.
2. Enlist important applications of various types of bee hive products.
3. What are the basic guidelines and safety precautions to follow while treating a patient?

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Officer Level

Apiculture Development Center, Godawari, Lalitpur

Government of Nepal
Ministry of Agriculture and Livestock Development
Department of Agriculture
Center for Industrial Entomology Development

Apiculture Development Center

Godawari, Lalitpur
Phone: 01-5174138

Email : info@apidc.gov.np, bgodawari@gmail.com
Website: www.apidc.gov.np

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