

**BEE FLORA STATUS AND MIGRATORY CHALLENGES FOR *Apis mellifera* L.
BEEKEEPING: A STUDY FROM CHITWAN DISTRICT OF NEPAL**

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ABSTRACT

Beekeeping is widely recognized as a valuable farming practice that enhances, conserves, generates and improves, respectively, agricultural productivity, biodiversity, employment opportunities and rural livelihoods. Knowledge about the bee flora is very crucial for the beekeepers as bee products largely depend on the availability of bee flora. This study was carried out to identify the major bee flora based on the beekeeper's knowledge and problems in bee foraging and migratory beekeeping. Sixty beekeepers were selected randomly and a survey was conducted in Kalika Municipality using semi-structured questionnaire. The data were analyzed for descriptive statistics and ranking index methods in Microsoft Excel. The beekeepers suggested the flora like rapeseed, mustard, buckwheat, maize, paddy, sunflower, sesame and coriander as major annual bee flora whereas the flora like butter tree (chiuri), litchi, eucalyptus, black plum (jamun), *Pogostemon* (rudilo), *Castanopsis* (padke), sisoo, curry tree, bottle brush, sal, *Bombax* (simal) and citrus were listed as major perennial bee flora for honey bees. Almost all beekeepers used sugar syrup as supplementary feeding during floral scarcity period (June-August). Moreover, majority of respondents harvested honey five to seven times per year, while 65% beekeepers practiced inter-district colony migration for different seasonal floral resources. Beekeepers faced the pesticide poisoning as serious problem followed by climate change in the bee foraging. Similarly, the beekeepers in the migratory beekeeping encountered conflicts with local communities and, also, faced managerial burden a challenge. Overall, conserving bee flora, creating pesticide awareness, and formation of local committee for the migratory bee colony management were found needs, in the long run, for the promotion of beekeeping sector.

Keywords: *Apis mellifera*, beekeeping, bee flora, supplementary feed, colony migration

INTRODUCTION

Beekeeping is a cultural heritage in the Nepalese community, and it has been practiced since ancient time (Joshi, 2008). In Nepal, a scientific beekeeping was initiated with an introduction of some modern practices to rear indigenous honey bee, *Apis cerana* (Devkota, 2020), and accelerated commercializing beekeeping in the country with an introduction of the western honey bee, *Apis mellifera*, in 1994 (Devkota 2020; Pokhrel, 2009). *A. mellifera* is the most widely managed commercial bee species worldwide, primarily for honey (Koshiyama et al., 2011; Workneh et al., 2008), and have strong adaptability to migratory beekeeping practices (Rao et al., 2020). Nepal is rich in floral diversity, favorable climatic condition, and abundant natural forage that support

beekeeping, with the potential of harvesting 20 thousand metric tons of honey annually (Gyawali, 2025; BDC, 2024).

Honey is the major product of beekeeping whereas beekeepers also harvested valuable bee products including beeswax, pollen, royal jelly, and propolis (Amgai, 2026; Hung et al., 2018). The success of beekeeping depends not only on honey bee species, management and hive structures, but also on the abundance and availability of bee flora (Pokhrel, 2009). Bee flora is a primary requisite for beekeeping, as it provides nectar, pollen and propolis needed to fulfill the daily needs of honey bees (Adhikari & Ranabhat, 2011; Pande & Gi 2018; Partap, 1987). The migratory beekeeping practice is very common in *A. mellifera* where the bee boxes are shifted from one place to another depending on the availability of bee flora (Das et al., 2023; BDC, 2024). Knowledge on the bee flora is very crucial for beekeepers to achieve optimum production of bee products (Adhikari & Ranabhat, 2011). However, forest areas which were previously used in bee foraging sites have become degraded, resulting lack of forage to bees (BDC, 2024).

Beyond honey production, bee pollination plays a significant role in agriculture enhancing yield and quality of seeds and fruits (Joshi, 1999). Globally, around one third of the total food production depends on bee pollination, contributing USD \$235-577 billion annually to crop production (Devkota et al., 2021; Potts et al., 2016). Now, honey bee populations are declining due to the poor colony management, colony migration, absconding, pest and diseases infestations, inadequate bee research program and inaccurate information regarding bee floral resources (Aryal et al., 2015; Manandhar & Khanal, 2021). Bee flora with longer flowering periods and flowering during dearth periods are very important for honey production. Therefore, this study aims to document beekeepers' recognized major bee flora in the Kalika Municipality of Chitwan district, and to identify major problems associated with *A. mellifera* bee foraging and its migratory beekeeping practice.

MATERIALS AND METHODS

The study was conducted in Kalika Municipality, which is the hub of *A. mellifera* beekeeping for the honey production in Chitwan district (BDC, 2024). Sixty beekeepers were randomly selected from the official list available in Beekeeping Development Center, Chitwan (BDC, 2024), and survey was carried out in year 2025. The primary data were collected from beekeeper's household survey using semi-structured questionnaire. Similarly, focus group discussion (FGD) and key informant interview (KII) were conducted to get information related to problems in bee foraging and problems encountered during colony migration. The secondary data were collected from various journal articles, research papers, and proceedings in internet.

Data analysis

The collected data were coded, tabulated, and analyzed using the descriptive statistics developed in Microsoft Excel. The problems of respondents were ranked with the use of index value. Beekeepers' faced problems were ranked using five-point scaling technique comparing as most serious, serious, moderate, a little bit, least serious problem using scores of 1, 0.8, 0.6, 0.4, and 0.2, respectively (Pandey et al., 2020). The index value was computed using the following formula;

$$I_v = \sum (S_i F_i / n)$$

Where,

I_v = Index value, $\sum$ = Summation, S_i = Scale value of i^{th} problem, F_i = Frequency of i^{th} response, n = Total numbers of respondents. The problem was ranked based on the index value like higher index value represents higher problem.

RESULTS

Socio-demographic characteristics of the respondents

Among the respondent's 88.33% were males, indicating that beekeeping activities were predominantly managed by male with comparatively low participation of female, showed that there needed for empowering female in this enterprises. The ethnicity was categorized into three categories such as Brahmin/Chhetri, Janajati and other (Chepang/Tharu). The majority of the respondents (68.33%) belonged to Brahmin/Chhetri followed by Janajati (Table 1). Similarly, beekeeping was the main source of income for 63.33% of the respondents, followed by 23.33% (agriculture with livestock along with beekeeping). All of respondents in the domain of study were found literate (Table 1).

Table 1. Socio-demographic characteristics of respondents in the study area

Variables	Frequency	Percentage
Gender of beekeepers		
Male	53	88.33
Female	7	11.67
Ethnicity of beekeepers		
Brahmin/Chhetri	41	68.33
Janajati	15	25.00
Other	4	6.67
Source of income of beekeepers		
Beekeeping	38	63.33
Agriculture with Livestock	14	23.33
Business	5	8.34
Services	3	5.00
Education status of beekeepers		
Primary	18	30.00
Secondary	24	40.00
Higher Secondary	9	15.00
Bachelor and above	9	15.00

Beekeeping experience and number of beehives

The largest proportion of beekeepers (46.66%) in the study area had 10-15 years of experience in beekeeping followed by the respondents who had less than 10 years of experience. As number of beehives was one of the determining factors for the honey production, majority of respondents (61.67%) had beehives more than 75, indicated that beekeeping remained largely commercial in nature followed by beekeepers with 25-75 beehives in the study area (Table 2).

Table 2. Numbers of beehives and experience in beekeeping in the study site

Variables	Frequency	Percentage
Experience in beekeeping		
Less than 10 years	22	36.67
10-15 years	28	46.66
More than 15 years	10	16.67
Numbers of hives		
Small scale (<25 hives)	8	13.33
Medium scale (25-75 hives)	15	25.00
Large scale (>75 hives)	37	61.67

Plants for bee flora

Successful beekeeping depended largely on the availability of abundant forage resources. The respondents identified a range of annual and perennials plants as important bee flora. The bee flora had been categorized into two types, namely annual bee flora and perennial bee flora (BDC, 2024). Ten annual and twenty eight perennial bee flora were identified by beekeepers as important bee flora for bee foraging which were listed in Tables 3 and 4.

Table 3. Major annual bee flora recognized by beekeepers in the study area

SN	Nepali name	Common name	Scientific name	Blooming time	Source of pollen and nectar*
1.	Tori	Rapeseed	<i>Brassica campestris</i> var <i>toria</i>	Oct/Nov-Jan/Feb	N1P1
2.	Sarson	Field mustard	<i>Brassica campestris</i> var <i>sarson</i>	Oct/Nov-Jan/Feb	N1P1
3.	Phapar	Buckwheat	<i>Fagopyrum esculentum</i>	Jan-Feb	N1P1
4.	Suryamukhi	Sunflower	<i>Helianthus annuus</i>	March-July	N1P1
5.	Til	Sesame	<i>Sesamum indicum</i>	Feb-March	N1P1
6.	Dhaniya	Coriander	<i>Coriandrum sativum</i>	Feb-June	N1P1
7.	Makai	Maize	<i>Zea mays</i>	April/May-Jun/Jul	P1
8.	Dhan	Paddy	<i>Oryza sativa</i>	April-May and Sep-Oct	P2

contd...

SN	Nepali name	Common name	Scientific name	Blooming time	Source of pollen and nectar*
9.	Farsi	Pumpkin	<i>Cucurbita moschata</i>	March-May	P1
10.	Jukini	Squash	<i>Cucurbita pepo</i>	March-May	P2

* N1= High nectar, N2 = Low nectar, P1= High pollen and P2 = Low pollen

Table 4. Major perennial bee flora recognized by beekeepers in the study area

SN	Nepali name	Common name	Scientific name	Blooming time	Source of pollen and nectar*
1.	Chiuri	Butter tree	<i>Diploknema butyracea</i>	Nov-Feb	N1P2
2.	Litchi	Litchi	<i>Litchi chinensis</i>	March-April	N1P1
3.	Rudilo	Bengal Pogostemon	<i>Pogostemon benghalensi</i>	Jan-June	N1P1
4.	Masala	Eucalyptus	<i>Eucalyptus camaldulensis</i>	June-July	N1P2
5.	Jamun	Black plum	<i>Syzygium cumini</i>	March-April	N1P2
6.	Sisoo	Shisham	<i>Dalbergia sisoo</i>	March-April	N1
7.	Padke	Indian chestnut	<i>Castanopsis indica</i>	June-July	N1P1
8.	Kadipata	Curry tree	<i>Murraya koenigii</i>	April-June	N1P1
9.	Simal	Simal	<i>Bombax ceiba</i>	March-April	N1P1
10.	Kalki phul	Bottle brush	<i>Callistemon</i> sp.	April-May	N1P1
11.	Sal	Sal	<i>Shorea robusta</i>	March-April	N2P2
12.	Kagti	Lemon	<i>Citrus aurantifolia</i>	Feb- April	N1P1
13.	Aasare phul	Crepe Myrtle	<i>Lagerstroemia indica</i>	May-Aust	N2P2
14.	Asuro	Malabar nut	<i>Justicia adhatoda</i>	March-April	N1P1
15.	Saj	Indian laurel	<i>Terminalia elliptica</i>	April-May	N1P1
16.	Amba	Guava	<i>Psidium guajava</i>	March-April	N2P2
17.	Karam	Yellow teak	<i>Adina cordifolia</i>	May-July	N1P1
18.	Amala	Indian gooseberry	<i>Emblica officinalis</i>	April-May	N2P1
19.	Kera	Banana	<i>Musa paradisiaca</i>	March-Oct.	N2P2
20.	Tanki	Orchid tree	<i>Bauhinia purpurea</i>	Sep.-Oct.	N1P1
21.	Khair	Black catechu	<i>Acacia catechu</i>	March-May	N2P2
22.	Rudraksha	Rudraksha tree	<i>Elaeocarpus ganitrus</i>	March-May	N1P2
23.	Bhagate	Pomelo	<i>Citrus grandis</i>	Feb-March	N1P1
24.	Cuphea	Candy corn plant	<i>Cuphea micropetala</i>	March-Oct.	N1P2
25.	Lajjabati	Touch-me-not	<i>Mimosa pudica</i>	June-July	P1
26.	Banmara	Siam weed	<i>Eupatorium odoratum</i>	April-August	N2P1
27.	Gandhe jhar	Goatweed	<i>Ageratum conyzoides</i>	May-June	N2P2
28.	Shitalchini	Drumstick tree	<i>Moringa oleifera</i>	Feb-March	N1P1

* N1= High nectar, N2= Low nectar, P1= High pollen and P2= Low pollen

Supplementary feeding practices in beekeeping

When natural forage is not available, bee colony do not increase and consequently no honey production. Supplementary feeding must be provided to support bee colonies in this situation. All of the beekeepers reported using sugar syrup as a main supplementary feed for bee colonies during drought periods (June-August), indicating that sugar syrup was the most common and basic feeding practices among beekeepers followed by use of sugar syrup with candy, and combination of all three supplementary feeds (sugar syrup+candy+pollen) as illustrated in Fig. 1.

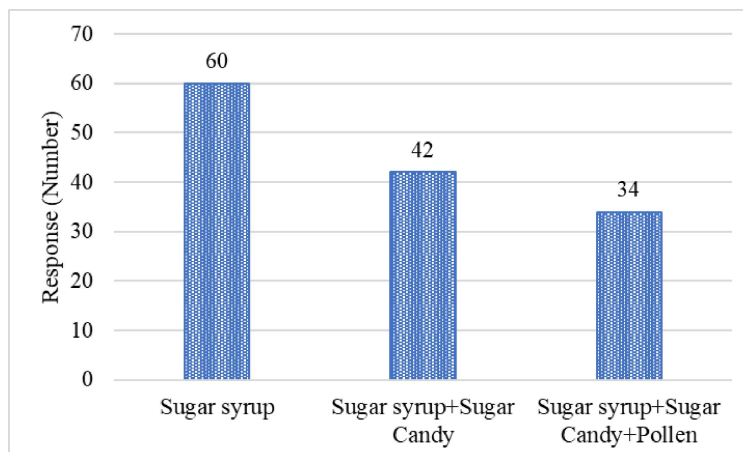


Fig. 1. Different types of supplementary feeds used by beekeepers.

Honey harvesting frequency and colony migration

The frequency of honey harvesting was varied among the beekeepers. The study revealed average honey harvesting frequency, 5.2 times, from *A. mellifera* beekeeping in the study area, where more than half of the beekeepers (53.33%) harvested honey five to seven times per year followed by 28.33% beekeepers in a tune of less than five times honey harvestings. Only 18.34% of the beekeepers reported honey harvesting more than seven times per year (Table 5). Similarly, colony migration referred to the movement of bee colonies from one location to another for forage. The study revealed that the majority of beekeepers practiced migratory beekeeping to maximize the honey production, and utilized the seasonal floral resources. Around 65% of the beekeepers migrated their colonies outside in different districts indicated that inter district migration remained a common management strategy adopted by beekeepers to enhance honey yield and colony productivity. Around 25% beekeepers practiced migration within the same district, particularly in different areas of the western Chitwan followed by 10% beekeepers, with possession of fewer number of bee hives, did not practice migration but kept their bee colonies in the same location (Table 5).

Table 5. Honey harvesting frequency and colony migration status in the study area

Honey harvesting	Harvesting frequency	Beekeepers (%)	Major honey types
Less than five times	17	28.33	Mustard honey, butter tree honey, Rudilo honey, masala honey, Buckwheat honey, litchi honey, jamun honey, sisoo honey, padke honey
Five to seven times	32	53.33	
More than seven times	11	18.34	
Bee colony migration		Place	
Migration within districts	15	25	Areas of western Chitwan
Migration out of districts	39	65	Areas of Lumbini and Madesh Provinces
No migration	6	10	Remained origin place

Perception of beekeepers towards bee pasture situation

Beekeeper's perception about bee pasture situation in the study area is presented in Fig. 2. Most of the beekeepers (50%) asserted that the bee flora of their locality was insufficient for their honey bees followed by 40% of beekeepers who said bee flora sufficient for few months only. Only 10% of beekeepers, holding lesser number of honey bee colonies, perceived that bee flora remained sufficient to their honey bees.

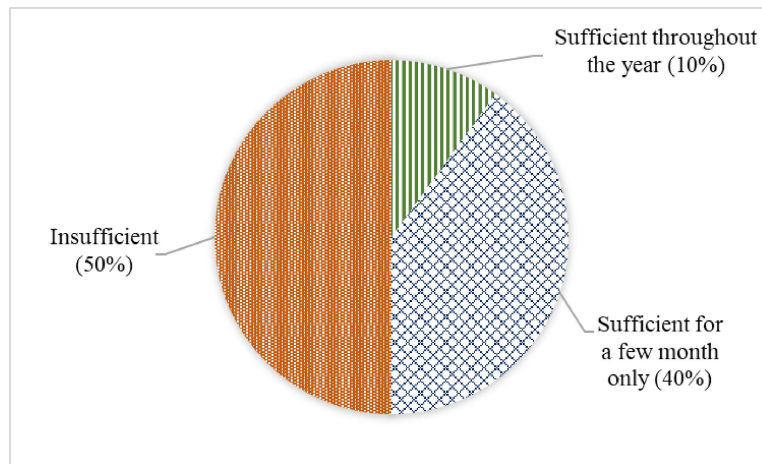


Fig. 2. Perception of beekeepers towards bee pasture situation in the study area

Problems in bee foraging

The pesticide poisoning ($I_v = 0.72$) ranking, Rank I, was perceived as the most serious problem faced by beekeepers (Table 6). Rank I pesticide poisoning suggested that the use of agro-chemical pesticides in agricultural crops represent a major threat to honey bee colonies. The climate change ($I_v = 0.68$) i.e. change in climate patterns, irregular rainfall and temperature was ranked second major constraint (Rank II) followed by unaware about the value of pollination services provided by honey

bees in Rank III. Similarly, unknown about the carrying capacity of bee flora, deforestation and forest fire were also considered as problems, respectively, Rank -IV, -V and -VI in the bee foraging (Table 6).

Table 6. Ranking of the problems in bee foraging

Production problems	Index value (I _v)	Rank
Pesticide poisoning	0.72	I
Climate change	0.68	II
Unaware about the value of pollination services provided by honey bee	0.67	III
Unknown about the carrying capacity of bee flora	0.61	IV
Deforestation	0.50	V
Forest fire	0.45	VI

Problems encountered in migratory beekeeping

Among problems encountered in the migratory beekeeping, internal conflict with the local people (I_v = 0.69) was Rank I problem indicating that disputes with local communities regarding the placement of bee colonies, and land use were major challenges faced by the migratory beekeepers (Table 7). Managerial burden to beekeepers (additional cost during migration, labor management, transportation management, etc.) was, Rank II, second major problem followed by animals' attacks to beehives, Rank III. Similarly, lack of efficient manpower (Rank IV) and stolen of bee colonies (Rank V) in the migrated area were other ranked problems for beekeepers (Table 7).

Table 7. Ranking of problems encountered in migratory beekeeping

Migration problems	Index value (I _v)	Rank
Internal conflict with local people	0.69	I
Managerial burden to beekeepers	0.57	II
Animals attack to beehives	0.53	III
Lack of efficient manpower	0.48	IV
Stolen of bee colonies	0.39	V

DISCUSSION

The study documented a diverse range of annual and perennial bee flora species with different flowering periods. Mramba (2025) emphasized the importance of year round availability of bee forage for honey production and colony development. However, the perception of many beekeepers that bee flora was insufficient or available only for a few months indicates seasonal limitations in forage availability. Nurie (2020) reported that honey bee colonies may abscond during periods of forage dearth in case of unavailability of adequate food resources. Thus, conservation and management of bee flora are very important for maintaining colony strength and productivity.

The use of supplementary feeding during drought periods, particularly sugar syrup is very common in study area, indicating the importance of managing colonies during periods of inadequate natural forage. KC et al. (2021) reported 80 percent beekeepers fed their colonies with sugar syrup during rainy and summer season. The mean honey harvesting frequency was 5.2 times per year, which was comparable with 3-7 harvests (mean 4.8) reported by Pokhrel (2009) for *Apis mellifera* in the Terai during winter and spring. The high proportion of beekeepers practicing colony migration, indicating the importance of seasonal floral resources for honey production. Movement of colonies to different districts enables beekeepers to utilize available floral resources at different times of the year. Rijal & Thapa (2024) and BDC (2024) reported colony movement to different areas for accessing seasonal bee forage include Chitwan, Dang, Pyuthan, Rolpa, Rukum, Salyan, Bardiya, Nawalparasi, Rupandehi, Arghakhachi, Kapilbastu, Sarlahi, Mahattori, Rautahat. However, migratory beekeeping requires additional transportation, labour, site management and colony protection (Sharma et al., 2014).

Among the constraint to bee foraging, pesticide poisoning received the highest index value followed by climate change and lack of awareness about pollination services. This finding is consistent with Panta et al. (2024) and Khanal et al. (2025) who mentioned that haphazard use of pesticides was a major challenge faced by beekeepers. Similarly, lack of data on bee floral identification was reported by Aryal et al. (2015). Climate change may further affect flowering periods and forage availability; İzol & Turhan (2024) observed climate change altered the flowering period of bee flora species resulting low yields of bee products, while Kortsch et al. (2024) highlighted indiscriminate use of pesticides and erratic rainfall also decreased floral resources for bee foraging and had negative effects in beekeeping. Migratory beekeepers also faced several management and social constraints. Internal conflict with local people was the most prominent problem followed by managerial burden, animal attacks, and lack of efficient manpower and theft of colonies. Panta et al. (2024) also reported that payments to landowners, community forests and locally formed bodies could impose additional costs to migratory beekeepers. Therefore, improved coordination among beekeepers, local communities, landowners and local authorities is important for facilitating safe and sustainable colony migration.

CONCLUSIONS

Beekeeping is commercialized enterprises in Chitwan district of Nepal. Despite its commercialization, beekeepers are facing problems on managing the year round bee foraging. So, the colony migration is very crucial in search of good bee forage. As the bee flora is of annual and perennial, the management of perennial bee flora is more sustainable for beekeeping. The perennial bee flora like butter tree, litchi, Eucalyptus, bottle brush, rudilo, sal, sisoo, jamun, citrus and padke are very important for honey bees as recognized by beekeepers. Alongside, pesticides poisoning, climate change, internal conflict with local people, managerial burden to beekeepers and animal attack are the major challenges during bee foraging and colony migration. These factors hinder and complicate the effective management of migratory beekeeping practices. So, conserving the existing bee flora, understanding their flowering periods, strengthening beekeeper's knowledge on bee floral resource management, implementing supportive colony migration strategies and promoting

afforestation activities is essential for the promotion of sustainable beekeeping enterprises in the country.

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