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An Overview of Bee Keeping in Rupandehi District, Nepal over Seven Years

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ABSTRACT

Beekeeping is a high-value income-generating agricultural activity in Nepal. However, there is a lack of intensive information related to beekeeping. We conducted a comparative study among the beekeepers in 2014 and 2021 to assess the status of bee keeping in a gap of seven years in Rupandehi district. Result revealed a slight increase in honey production averaging 21.35 and 25.45 kg/ year/hive in 2014 and 2021, respectively. The average number of beehives per beekeeper increased from 39 in 2014 to 42 in 2021. We report that primary bottlenecks to beekeeping are lack of foraging area, pesticide poisoning, pests, diseases, and lack of government subsidiary. The lack of foraging area was mainly attributed to rapid population growth and unplanned urbanization. The problem of pesticide intoxication was found to worsen during 7 years in the study area. Governmental incentives to beekeepers, and stricter rules on pesticide application could encourage beekeepers to get involved in bee keeping. Rigorous documentation on beekeeping can help realize the potential of honey production, and to come up with efficient mitigation measures towards problems associated in beekeeping.

Keywords: Beehives, foraging, frequency of harvesting, honey, pesticides

INTRODUCTION

Beekeeping contributes less than 1% of National GDP, but it is one of the most profitable occupation in Nepal (Devkota, 2020). Besides, beekeeping is a key factor to sustainable agriculture and helps uplift the production rate of agricultural outputs through pollination (Kaluza et al., 2018). Beekeeping is promoted globally as a flourishing instance of an alternative livelihood project (FAO, 2011). Beekeeping is traditionally associated with Nepalese agriculture and animal husbandry in a subsistence scale. In Nepal, bee keeping holds a great prospect of

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income generation and is being promoted for marginalized farmers (Schouten, 2020). Beekeeping as an enterprise is accepted and adopted at a growing rate in Nepal in recent years which is the lucrative source of income (Adhikari, 2018). The data available on statistical information on Nepalese Agriculture suggests that there is an increase in number of beehives from 225,000 to 242,000 and honey production from 3,000 MT to 3,990 MT in the period of 2014/2015 to 2018/19 (MoALD, 2020). Eighty percent of the total pollination is carried out by insects and bees are responsible for 80% of the insect pollination (Thapa, 2006). *Apis mellifera* L. is highly valued in the ecosystem as it contributes for the pollination services in the extensive agricultural and food crops thereby holding the position being a single species serving as the most frequent pollinator and possessing the positive association with the crops globally (Cane et al., 2006; Garibaldi et al., 2013). Beside *Apis mellifera*, an exotic species of honey bee, four native species of honey bees are found in Nepal, namely: *Apis laboriosa, Apis dorsata, Apis florea,* and *Apis cerana*. Bee keeping of *Apis cerana* started to practice in 1960 and *Apis mellifera* in 1990 after it was introduced from Europe in Nepal (Thapa et al., 2018). Besides nutritional importance, the bee products such as honey, propolis, bee venom, royal jelly are known to have nutraceutical benefits. In Nepal, most of the honey produced are multifloral and some unifloral honey is also in existence. Starting up the business with low financial inputs and resources, one can get fast return within a year has tempted the people towards beekeeping.

Natural enemy of the bee, climate change, bee diseases, lack of foraging land, pesticide poisoning and insufficient financial reserves are the major factors that has left behind bee keeping in jeopardy (Aryal et al., 2015; Bhattarai et al., 2020). The expected gain has not been received by the beekeepers because of existing challenges including logistic and financial constraints. Despite possessing tremendous benefits, the systematic study and documentation of the findings is modest, which is a major setback for further understanding the prospects and bottlenecks of beekeeping. There is still paucity of bee keeping development in the context of Nepal. There is a need of farsighted vision and explicit policy for better management and development of sector of bee keeping in Nepal. Currently, beekeeping studies are fewer in comparison to cereal and other cash crops in Nepal. There is no extensive record of research activities in beekeeping in Rupandehi district, which is one of the potential district for bee keeping. Our study emphasizes on understanding the status of bee keeping, assess its challenges and strengths, provide succinct summary of beekeeping equipment used by beekeepers and to highlight the change in production and management practices

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in beekeeping over 7 years in Rupandehi district. The current study attempts to point out the existing setback for the successful beekeeping enterprise.

MATERIALS AND METHODS

Study Area

The survey was conducted in Rupandehi district of Terai region as it is one of the potential districts for beekeeping at Western Nepal. We conducted a survey in 2014 and a follow up survey after seven years in 2021 with the farmers associated with *A. mellifera* for bee keeping. A. mellifera is the most commonly reared bee in Nepal among beekeepers (Aryal & Dhakal, 2020). The survey sites of beekeepers in 2014 were Butwal Sub-Metropolitan municipality (former Sau-Farsatikar), Sainamaina municipality (former Saljhundi), Kanchan rural municipality (former Gajedi), Devadaha municipality, Siyari rural municipality (former Mainahiya VDC), Siyari (former Chiliya VDC), Siddharthanagar Municipality and Tillottama Municipality (former Shankarnagar VDC) of Rupandehi. These sites were chosen based on the higher number of beekeepers in the area. In 2021, the survey sites were extended to 13 local level units viz. Butwal Sub metropolitian city, Devdaha Municipality, Lumbini Municipality, Sanskritik Municipality, Sainamaina Municipality, Siddharthanagar Municipality, Tilottama Municipality, Gaidahawa Rural Municipality, Kanchan Rural Municipality, Marchawari Rural Municipality, Mayadevi Rural Municipality, Omsatiya Rural Municipality, Siyari Rural Municipality and Suddodhan Rural Municipality due to increased number of bee keepers in these areas. The Map of Nepal showing Rupandehi district and its all local level bodies is shown in figure 1(A) and 1(B).

Study population and sample size

A total of 34 and 89 bee keepers were randomly selected in 2014 and 2021 respectively. As there were less bee keepers in 2014, the sample size was 34 where it was increased to sample size of 89 in 2021 due to increase in number of bee keepers. We categorized beekeeping into three classes as

a. **Small scale** (Hobby beekeepers)- less or equal to 10 hives,
b. **Medium scale** (taking it as side business)- 11 to 50 hives,
c. **Large scale** (Beekeepers taking it as main business)- more than 50 hives**.**

Data collection

In order to obtain primary data, interviews were conducted with bee keepers and with key informants. Key informants were chosen based on information from Agriculture Knowledge Centre (Former District Agriculture Development Office)

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and Federation of Nepal Beekeepers. Face to face interviews were conducted with respondents at their home with the questionnaires which were pre-tested to 10% of respondents. In the same way, key informants were interviewed. The information obtained from the interview were cross checked during the focus group discussion (FGD). Progressive farmers, Agriculture Knowledge Centre officials, NGO staffs and cooperative officials who were chiefly engaged in bee sector were chosen as key informant person. All respondents consented to the interview.

Data analysis

Collected data were tabulated using MS-Excel Ver. 2016. Graphical representation of the data was done using MS Excel and maps were created using Arc GIS v 10.8

RESULTS AND DISCUSSIONS

Socio-demographic characteristics

The details on socio demographic character of respondents in 2014 and 2021 is shown in table 1.

Table 1. Socio-demographic characteristics of beekeepers in Rupandehi district, Nepal in 2014 and 2021

Description/ Year	2014 (N= 34)	2021 (N= 89)
Age of respondents		
18-30	11.76%	12.36%
31-43	32.35%	20.22%
44-56	47.06%	33.71%
57-69	8.82%	33.71%
Gender		
Male	94.12%	77.53%
Female	5.88%	22.47%
Marital status		
Married	97.05%	95.50%
Unmarried	2.95%	4.5%
Educational status		
Illiterate	5.88%	8.99%
Basic Level Education	52.94%	50.56%
Secondary level education	32.35%	19.1%
University	8.82%	21.35%

'N' refers to total number of respondents

In 2014, out of 34 respondents, only 8.82% (n=3) of the respondents belonging to the age group of 57- 69 years were involved in beekeeping. However, in 2021, out of 89 respondents, 33.71% (n= 30) of age group 57-69 years actively engaged in beekeeping in 2021. A decline in the involvement of people of age group (44 -

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56 years) in beekeeping from 47.06% in 2014 to 33.71 in 2021 was observed. Only 4 respondents out of 34 in 2014 and 11 out of 89, in 2021 were in the age group of 18- 30. Our results suggest that the young age group is not actively engaged in beekeeping. Majority of the respondents were male (n=32) in 2014 and (n=69) in 2021. Only in two out of 34 households, female were found to be actively engaged in bee keeping in 2014 and 20 out of 89 in 2021. This suggests an increase in the role of women in beekeeping in the span of seven years. Almost all beekeepers were found to be married i.e. 33 (97.05%) in 2014 and 85 (95.50%) in 2021. People who acquired basic level education were frequently recorded in both study years i.e. 52.94 % in 2014 and 50.56% in 2021. However, there seemed considerable involvement of the people with University education in the recent study (21.35%) while it was recorded only 8.82% involved in 2014 in Rupandehi district of Nepal. Two respondents in 2014 and eight respondents in 2021 had no former education.

Number of hives

There were 39 beehives per household on average in 2014 and 42 beehives per household on average in 2021, suggesting an increase in the number of bee hives. This increase in the beehives can be attributed to the increased attraction towards beekeeping. The average number of bee hives in 2021 in Rupandehi district was similar to the average number of bee hives in Chitwan (Bhattarai et al., 2020). Shrestha (2017) reported 34.54 hives per household in Bardiya which is slightly less than reported in our study in both years.

In 2014, 23.5% (n=8) of the participating farmers were found to be hobby beekeepers and reared bees for their recreational purpose in subsistence level with ≤ 10 bee hive. However, in 2021, the number of bee hives increased considerably to 41.57% (n=37). Likewise, the majority of the respondents, 64.7 % (n=22), were categorized as medium scale beekeepers, with 11 to 50 beehives reported in 2014 and 32.58% (n=29) in 2021. There was a decreasing trend among medium scale beekeepers from 2014 to 2021. In 2014, 11.8% (n=4) of the farmers were producing honey in large scale, taking it as a main business in commercial level which increased to 25.84% (n=23) in 2021, suggesting the increased interest in beekeeping in a commercial scale.

Honey production

Average honey production was 25.45 kg/ year per hive in 2021, an increase from 21.35 kg/year/hive reported in 2014 (figure 3). The average annual honey production in 2021 per hive from *A. mellifera* in the study area was similar to 24.064 kg per hive in

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Chitwan (Bhandari & Kattel, 2020), and 23.5 kg honey per hive per year in Dang as reported by Budhathoki-Chhetri et al (2021). The honey production in our study area was slightly less than in Bardiya where 34.6 Kg/hive was reported by Shrestha (2017), 36 kg/ hive/year in Chitwan district as reported by Dhakal et al. (2017) and 40.71 kg/hive/year in Karaj state, Iran (Vaziritabar & Esmaeilzade, 2016). These results signify more production than that of our study area. We found that Honey and bee wax were the major bee product and by product, respectively.

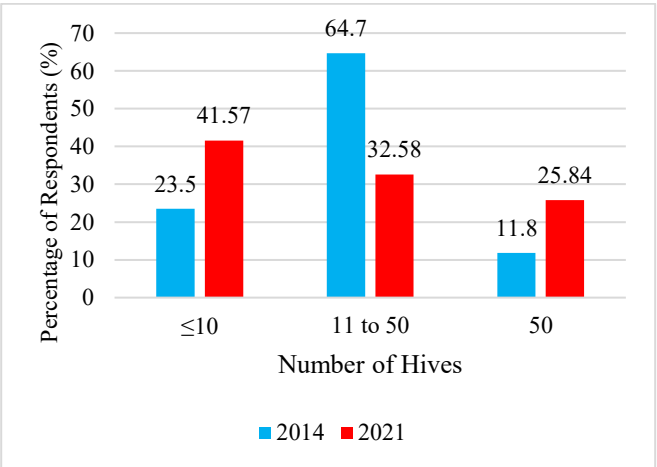

Figure 1. Beekeepers expressed as percentage of total respondents with their hive number in Rupandehi district in 2014 and 2021

Frequency of honey harvesting

Management practices coupled with number of bee hives, foraging of bee, species of honey bee, climatic conditions are the factors that influence the production of honey from honey bee and so the harvest times (Bhusal & Thapa, 2005; Budhathoki-Chhetri et al., 2021). The frequency of honey harvesting by the beekeepers in 2014 and 2021 is shown in table 2. It was found that middle scale beekeepers harvest the honey 4-6 times in a year but with proper foraging honey could be harvested up to 8 times a year. Similarly, most of the small scale or hobby keepers harvested 2-3 times a year. Our study conducted in 2014 showed that 17.65% (n=6) beekeepers harvested the honey less than 4 times a year, 55.88% (n=40) harvested 4-6 times a year and 26.47% harvested 7-8 times. Moreover, harvest of the honey for less than 4 times was done by 52.8% (n=47), 4-6 times by 44.94% (n=40) and 7-8 times by 2.25% (n=2) beekeepers

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in 2021. Lack of foraging area and increased insecticide application in agricultural field can be the reason for decrease in harvest time in 2021 compared to 2014.

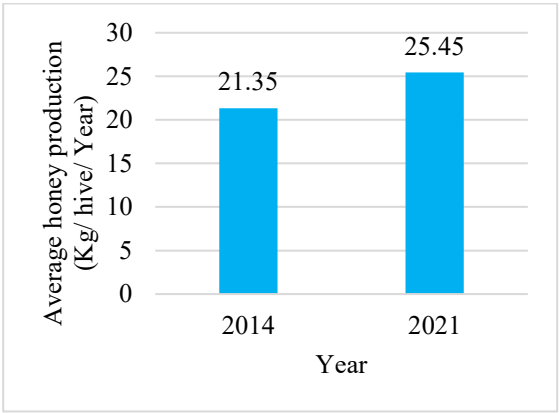

Figure 2. Average honey production (Kg/hive/year) in 2014 and 2021 at Rupandehi district, Nepal

Equipments used for bee keeping

Most of the bee keepers had essential equipments needed for the smooth beekeeping practices. Of the surveyed farmers, majority of the farmers were equipped with necessary tools in the study carried in both years ie. 2014 and 2021 (table 3). It was found that 100% of the surveyed farmers had knives and honey collecting buckets in both study years. Second most available equipment that respondents owned was brush (94.11%), followed by bee gloves (79.41%) and smoker and bee viel (64.70%). Few farmers (32.35%) had honey extracter in 2014.

But according to the some respondents, the use of smoker was concerning, as farmers associated it with the mortality of the bees. We reported that the use of bee gloves was not common among beekeepers in both years, even when the beekeepers own it. Farmers surveyed in both years percieved that working with bare hands during hive management and harvesting was more 'bee-friendly'. 88.76% of the respondents had brush and bee gloves (88.76%) followed by bee veil (87.64%) and smoker being 84.26% in 2021. We report 62.92% farmers had honey extractor, which depicts that in comparison to other equipment, bee keepers had few honey extractors in 2021.

The brush was used for cleaning the hive and bee veil during the peak harvesting period. Only few respondents had honey extractor in the study carried in both years.

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The commerical beekeepers, taking beekeeping as a main profession had honey extracting device and used it when required. Small scale farmers borrow it from the large scale farmers and cooperative during honey extracting period. It was found that some of the medium scale farmers had their own honey extractor and some of them bought it jointly or from cooperative and used it as per need during harvesting seasons. After extracting honey, the by product wax was recycled to make the frame foundation for next generation bees.

Table 2. Honey Harvesting times by the bee keepers in 2014 and 2021 at Rupandehi district, Nepal.

No. of Harvest per year	2014	2021
<4	17.65%	52.8%
4 to 6	55.88%	44.95%
7 to 8	26.47%	2.25%

The major production problem in Ethiopia was high cost and lack of availability of modern equipment and accessories (Abebe et al., 2016), and it represents the dire necessity of availability of equipment and accessory at low cost. However in our case, most of them had basic equipment. In both years, farmers had concerns with government for not subsidizing bee equipment.

Honey buyers

In 2014, it was reported that the 44.11% (n=15) of the respondents sold the produced honey to local people and did not involve a middleman when selling to the wholesaler. But majority of the respondent 55.89% (n=19) were reported to sell their products to local people cum wholesaler (Table 4). Likewise, in 2021, we found similar findings in terms of sale of the honey to the wholesaler (table 4). Only a single respondent was reported to sell the honey directly to the wholesaler (Table 4). However, there was an increase in honey sales to the local people (77.52%). There was a marked reduction in honey sales to local people and wholesaler (Table 4). The selling was preferred to the local people only because the production was not high and honey demand was high in the local community. Local people visited the beekeepers themselves to buy honey reducing transportation costs to the farmers. Similar result was reported by Shrestha (2017) in Bardiya, Nepal. We found that the beekeeper in Rupandehi district were not involved in long marketing channel of their products and no involvement of middlemen was reported.

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Table 3. Respondents with their equipments in 2014 and 2021 at Rupandehi district, Nepal

Equipment	2014 (N= 34)		2021 (N= 89)	
	Yes	No	Yes	No
Smoker	64.70% (22)	35.30% (12)	84.26% (75)	15.74% (14)
Bee veil	64.70% (22)	35.39% (12)	87.64% (78)	11.24% (11)
Brush	94.11% (32)	5.89% (2)	88.76% (79)	11.24% (10)
Bee gloves	79.41% (27)	20.59% (7)	88.76% (79)	11.24% (10)
Knife	100% (34)	0% (0)	100% (89)	0% (0)
Honey collecting bucket	100% (34)	0% (0)	100% (89)	0% (0)
Honey extractor	32.35% (11)	67.65% (23)	62.92% (56)	37.08% (33)

*Figures in parenthesis denote the corresponding number

Table 4. Honey buyers in Rupandehi district, Nepal in 2014 and 2021

Honey buyers	2014	2021
Local	44.11%	77.52%
Wholeseller	0	1.13%
Local+ Wholeseller	55.89%	21.35%

Foraging

Foraging is a peculiar characteristic of honeybees which refers to the association between honey bee colony and the surrounding environment whereby honey bees extract pollen, nectar and resin from the plants. Foraging has tremendous benefits behind it as it encourages not only for the plant pollination but also useful for colony (Abou-Shaara, 2014). Foraging was found to have a remarkable increase in the number of bees and honey production, thereby increasing the harvest per year. It is deemed that the foraging activity of honeybees starts in the morning time and ends in the evening time.

Our study conducted in 2014 revealed that 24 (67.65%) farmers practiced foraging in honeybee but there was a reduction in practice of foraging of honeybee (60.67%) in 2021 (figure 4). The main reason for this reduction in foraging practice was found to be a reduction in foraging land. Reduction in foraging land was due to clearing of *Dalbergia sissoo* Roxb tree from the Churiya range which seriously damaged the habitat of the important bee flora [Rudilo, (*Pogostemon glaber* Benth)] which was an important source of nectar. In both studies, large scale farmers and medium scale farmers were observed to transport their bee hives

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for foraging purposes during off season. Most of the farmers were observed to take their beehives to Dang, Chitwan, Kapilvastu and Mahottari for foraging. The beehives were kept in the jungles which were rich in foraging trees (*Dalbergia sissoo* Roxb.*, Pogostemon benghalensis* (Burm. f.) Kuntze, *Rhododendron ferrugineum* L.*, Diploknema butyracea* (Roxb.) H.J.Lam, *Fagopyrum esculentum* Moench, *Litchi chinensis* Sonn., etc.) and mustard was found to be the main cash crop during the foraging season. During foraging, transportation was the main problem which often caused mechanical injuries to bee frames, increasing stress in bee, and thereby reducing the production significantly. There was a higher honey production in migratory system of beekeeping in comparison with non-migratory system. Thus, respondents realize foraging is a crucial practice for commercial honey production. Feeding material has direct and positive role to affect the honey production (Devkota et al., 2016; Shrestha, 2017). Knowledge on bee flora along with its flowering time and behaviour is vital for the bee keepers (Rijal et al., 2018). Proper and sufficient knowledge is fundamental requirement before starting of bee keeping (Bista & Shivakoti, 2001; Adhikari & Ranabhat, 2011).

Involvement of the respondents in Bee keeping training

Various trainings were made available to the farmers by various Non-Governmental Organizations (NGO's), Agriculture Knowledge Centre, Federation of Nepal Beekeepers to provide routine trainings related to apiary and bee keeping to the farmers to increase their positive attitude, knowledge, practice and behavior towards apiculture. Among the surveyed farmers in 2014, 76.48% (n=26) had trainings in apiculture but 23.52% (n=8) had not received any form of trainings (Figure 5). This result is consistent with findings of Bhandari (2020) in Pyuthan district where majority of the farmers were trained. There was change in involvement of the farmer in training of bee keeping in 2021 and we reported only 65.16% (n=58) of the farmers were benefitted by training while 34.84% (n=31) farmers were deprived of any forms of training (Figure 5). Those who did not receive any form of training conducted the bee keeping on their personal experiences and guidance from farmers nearby. Paudel (2003) suggested that local institution should be involved in providing training on latest and affordable technology of bee keeping for the farmers.

Constraints

Pest problem faced by beekeepers of Rupandehi district, Nepal in 2014 and 2021 is shown in table 5. Of the beekeepers surveyed, we report all the beekeepers found

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hornets (Vernacular name: *Aringal*) as major insect threatening their enterprise in both 2014 and 2021. The problem was followed by mites, ants, bird, wax moth, lizard, rats and squirrel in 2014 and by ants, bird, lizard, mites, wax moth, squirrel and rats in 2021. The problem of ants was minimized by stacking the foundation on the bowl containing water or oil.

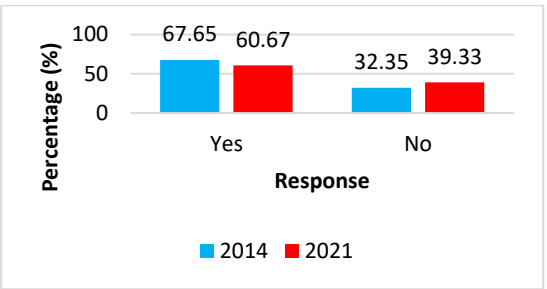

Figure 3. Involvement of beekepers of Rupandehi district, Nepal in foraging in 2014 and 2021

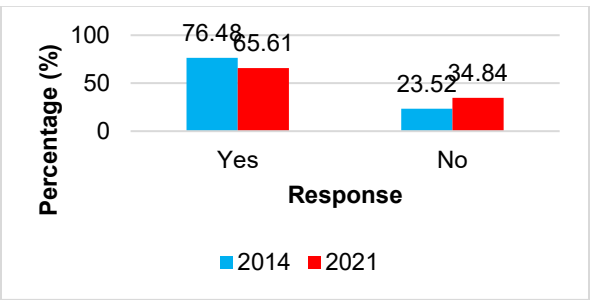

Figure 4. Beekeepers of Rupandehi district, Nepal involved in bee keeping training in 2014 and 2021

The problem of mites seemed to decrease, and the issue of ants was increased in 2021 considerably compared to 2014. We came to know that mites were a minor problem for small beekeepers, and it was a serious bottleneck for both medium and large beekeepers. Similarly, in contrast to the findings obtained from 2014, the problem of rat and squirrel experienced by beekeepers decreased from 32.29% to 3.37% and 26.24% to 7.86% respectively in 2021. This shows that the problem of rodents in bee keeping is not a major problem in bee keeping in present days, but it was one of the major factors of hindrance of successful beekeeping in 2014. In contrast to our study,

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the major pest was ant followed by lizards, and wasps in Gorkha district (Pudasaini, 2018).

Table 5. Pest problem faced by Bee keepers of Rupandehi district, Nepal in 2014 and 2021

2014				**2021**			
Pests	**%**	**N=34**	**Rank**	**Pests**	**%**	**N=89**	**Rank**
Hornet	100	34	1st	Hornet	100	89	1st
Mites	55.88	19	2nd	Ant	77.52	69	2nd
Ants	50	17	3rd	Bird	65.16	58	3rd
Bird	47.05	16	4th	Lizard	53.93	48	4th
Wax moth	44.11	15	5th	Mite	44.94	40	5th
Lizard	38.23	13	6th	Wax Moth	21.34	19	6th
Rats	32.29	11	7th	Squirrel	7.86	7	7th
Squirrel	26.24	9	8th	Rats	3.37	3	8th

Beekeepers shared that insufficient foraging land was hurdle for beekeeping and the existing foraging land was also being constricted. The problem of transportation was reported in case they took bees for foraging. The concerned authority is not able to give sufficient support to the beekeepers in terms of training the farmers, developing the efficient marketing channel and distribution of bee equipment. Farmers admitted that the application of pesticide in agricultural land had directly affected the number of bee population in a colony and also decreased honey production. Similar constraints in bee keeping was reported by Bhandari & Kattel (2020). The treatment of bee disease is not handy because farmers are not aware about the symptoms and cure of bee diseases in both years which is similar as reported by Bhandari & Kattel (2020). The constraints during production were similar to findings of Bhattarai et al. (2020). High cost and limited availability of modern equipment and accessories as major constraint was reported by Shrestha (2017) in Bardiya district. Majority of the respondents in our study area were acquainted with the knowledge of role of honey bees in pollination and similar finding was also reported in Gorkha district (Pudasaini, 2018)

CONCLUSION

Rupandehi district is one of the potential districts for rearing *Apis mellifera*. The average honey production was increased to 25.45 kg/ hive/ year from 21.35 kg/ hive/ year in span of seven years. The problem relating to foraging is also

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concerning, and indiscriminate use of the pesticide in agricultural crops. Concerned government authorities, Non- governmental organizations and farmers themselves should focus on the improved management practice to reduce the production problem. Government sector should work on the production problems faced by farmers like decrease in the bee forage area, insufficient certification, lab tests, insecticide poisoning, providing incentives etc. to motivate the farmers to have beekeeping as the primary occupation. It can play a great role in the upliftment of the economy of the people of Rupandehi as well as can aid to the nation's economy.

SUGGESTIONS FROM BEEKEEPERS

Farmers suggest that frequent seminars and training should be conducted to facilitate the farmers to operate managerial activities efficiently. Concerned authorities should give due attention to expanding the land meant for foraging. Farmers have also pleaded for the development of efficient transportation systems to take bees for foraging. Bee keeping should be strengthened by the introduction of new technology by ensuring the insurance facilities to the beekeepers. Further, a diagnostic laboratory for detection of disease and treatment of honey bee is of great necessity in our study area as per bee keepers.

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