

## RESEARCH ARTICLE

## PRODUCTION AND MANAGEMENT OF HONEY BEE IN DANG DISTRICT OF NEPAL

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## ABSTRACT

This paper studied the production and management of honey bee in dang district. 35 respondent rearing commercially honey bee of Tulsipur and Ghorahi sub-metropolitan city and Banglachuli rural municipality were selected by using Purposive sampling techniques out of 141 commercial bee growers (Registered AKC, PMAMP). Structure questionnaire were designed to sample opinion of respondents. Data were collected using M-water surveyor mobile Application by using pretesting questionnaire and analyzed using MS-Excel, Statistical Package of Social Science. Results obtained that 72% respondents commercially rearing *Apis mellifera* and 11% rearing *Apis cerana*. Farmers having 22-117 numbers of hives found maximum (77%). Maximum number of hives rearing found was 500 by commercial bee keepers. Average hive number and Average productivity found were 98 and 31.2kg per hive per year (*Apis mellifera*). 89% respondent were found increasing their enterprise and good source of income was found as the main reason to increase their enterprise whereas 11% respondent were decreasing their enterprise and Shortage of forage was found as the main reason to decrease their enterprise. Hive cleaning practice was adopted by majority of the farmer (40%) to protect the hive from rainy and summer season whereas feeding with sugar syrup was adopted by most of the farmer (80%) during rainy and summer season. Hive covering with jute sacs and straw was found most adopted practice (69%) to protect the bee colonies during winter season. Commercial bee keepers having more number of bee hives and migrate their beehives for foraging in different places outside the valley were found 4 and more times honey harvesting whereas two times harvesting was found by beekeepers rearing *Apis cerana*. Most of the farmer used to sell honey from farm gate (94%) however the most selling was done to the whole sellers due to lack of storing and processing equipment.

## KEYWORDS

Production, Management, Dearth Management, Predators

### 1. INTRODUCTION

Apiculture is one of the most important cultural heritage human being and their farming since ancient times. The indigenous species of *Apis* present in Nepal are *Apis cerana*, *Apis mellifera*, *A. florea*, *A. dorsata*, *A. laboriosa* (Shrestha and Shrestha, 2000). Traditional beekeeping with *A. cerana* is the most common in the rural area of Nepal (Allen, 1995). The Commercial beekeeping started with the introduction of exotic Honeybee *Apis mellifera* in 1970s (ICIMOD, 2012). Being a non-land Based enterprise with multipurpose output, demand of this farming has been increasing tremendously in Nepal (Bista and Shivakoti, 2001). Honey bee products such as Honey, Bee wax; Propolis etc. are good source of income of rural communities, food, medicine and nutritious value and cultural value. Larva of honey bees are used to consume as a good nutritive food, while bees themselves plays important role as pollinators for agriculture crop production and also help to maintain natural ecosystems. Because of the advent of framed hives made it is easy in management and thus beekeeping is becoming more professional these days (ICIMOD, 2012). Helps family income by providing self-employment opportunity (Kumar, 2000) The bee products are used extensively in industrial manufacturing, medicine, food processing and natural healing.

According to a study there are more than 60 identifiable components in the bee venom which acts anti-inflammatory, antimicrobials and antioxidants (Fratellone et al., 2015). Similarly, beepollen also improves functions of brain, heart liver, and prostate. Honey and wax are used as a

cosmetic purpose for skin moisturizer, softener and to heal the skin tissue, and used for the treatment of hair also. Most of the honey produced in Nepal is Multi floral that includes Chiuri, Rudilo, Guava, Mustard, buckwheat etc. The honey in the hill region from *A. cerana* whereas in Terai region from *A. mellifera*. But in some circumstances depending upon the location and climate suitability both *A. cerana* and *A. mellifera* are being reared by the same farmer. The government and the non-government agencies have put a lot of effort into promoting this bee species in order to increase honey production (Taylor, 2014). Government of Nepal has been declared zones and super zones of honey bee under the PMMP project to promote and motivate the beekeepers for beekeeping to uplift the economic status of the marginalized and disadvantaged women in the rural people.

According to the beekeeper's association, over 50,000 farmers are directly and indirectly involved in honey production, whereas there are more than 100 cooperatives maintaining 25-300 beehives each (Bhandari and Kattel, 2020). The districts which are leading in the honey production are Chitwan, Nawalparasi, Rupandehi, Dang, Sarlahi, Kapilvastu, Bardia, Kailali, Pyuthan, and Surkhet. Nepal is rich in ecological resources and is one in all best places for beekeeping with wide range of honey production area i.e. from 70 to 4,200 meters above sea level in Nepal (Shrestha and Verma, 1992; Joshi, 2008). The majority (98.26%) of the respondents follow traditional production system with few respondents (0.38%) follow transitional and movable frame (1.36%) beekeeping production system (Tesfaye et al., 2017). Honey yield of *Apis cerana* has been reported

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as 8.1kg/colony/year, 8-15kg (Panthi, 2013) and 20kg (Pokhrel et al., 2006; Gurung, et al., 2012). *A. mellifera* was found promising in terms of honey production, harvesting frequency, per capita colony holding and annual income, where commercialization of beekeeping with *A. mellifera* can earn higher than crop production (Pokhrel, 2009).

*Apis cerana* bee have a high tendency of absconding behavior and migration creating problems to the farmer than *Apis mellifera* (Baidhya, Shrestha, & Bhandari, 1997). Beekeeping can be performed by all age groups without any difficulties and more actively performed by younger age groups (Tesfaye et al., 2017). It has the potential to transform thousands of lives of Nepali people by making use of natural resource in sustainable manner (CAC, 2006). Those who are willing to initiate the beekeeping enterprise, he/she must manage the artificial feeding during severe winter and rainy months and management when necessary (Bista and Shivakoti, 2001). One study in supplement feeding resulted that low dose of sugar syrup with 30g pollen was suitable in off season honey bee colony management which also helps high rate of flight activities (Suroj, 2006). It had been found from the experiment that the cost of sugar feeding during off-season can be reduced by more than 50% by feeding bees with banana syrup (Neupane and Thapa, 2005). Application of herbicides and pesticides ranked as 1<sup>st</sup> position for major constraint of and there is lack of effective value chain linkages among the value chain actors and service providers. Most of the honey produced in Nepal generally sold individually by beekeepers to small shops and private consumers (Bhandari and Kattel, 2020).

Low-cost honey production technology with proper feeding management, mite and other pest's management are prerequisite for good honey production (Bista et al., 2015). And with improved beekeeping enterprise with high yielding race, people can generate income, solve unemployment problem and help alleviate poverty thereby preventing migration as well (Bhusal and Thapa, 2005). Beekeeping has been carried out across many generations in the Dang district that contributes about 14% to the national production (Taylor, 2014). It has been playing crucial role in the livelihoods of the rural communities in three native dynamics; one: income generating activities, two: medicinal value of honey; three: it supports agricultural production by facilitating pollination via bees. However, the activity has not gained its climax though it has a lot of potentiality in honey production. Hence to improve the production in the sector of honey bee farming, Government of Nepal has declared as mauri zone at Tulsipur sub metropolitan areas, Ghorahi sub metropolitan areas and Banglachuli Rural municipality areas of Dang district under PMAMP.

Agriculture Knowledge Centre Dang, has declared Banglachuli pocket areas named Kavre, and Loharpani for *Apis cerana*, Ghorahi Sub-metropolitan pocket areas named Hapur, Laxmipur, Rampur and Githhe pani for *Apis mellifera* and Tulsipur sub metropolitan pocket areas named Pawannagar, Chillikot, Tulsipur and Bijauri. Tulsipur and Bijauri for *A. mellifera* keeping whereas Pawannagar for both *A. cerana* and *A. mellifera* species and Chillikot for *A. cerana* species only. The production of honey is quite more in dang districts so only the local market cannot fulfill the supply of honey so need to export other district like Rupandehi, Kathmandu etc. Having the great potentiality of honey production enterprise in Dang district, the demand of pure honey is not fulfilled yet. So, this research tried to find out the actual current production and marketing chain of honeybee in order to address its problems and help in increased production and productivity, and income of households sustainably.

## 2. MATERIALS AND METHODS

The study was conducted at Tulsipur sub metropolitan city, Ghorahi sub metropolitan city and Banglachuli Rural municipality of Dang district as they were selected areas for Bee zone program under PMAMP. District lies in the geographical coordinates of 27.9904° N and 82.3018° east. Cross sectional and mix method design was used. Both qualitative and quantitative methods were used to address the key objectives. And then the interview schedule was pre-tested prior to administration to actual respondents for checking the reliability and validity of interview schedule.

The pretesting was done on 5 households of Tulsipur sub metropolitan city and correction was made in finalized questionnaire.

A total sample of 35 sampling household were purposively selected and interviewed from Tulsipur sub metropolitan city, Ghorahi sub metropolitan city and Banglachuli Rural municipality of Dang districts out of 141 total registered commercial bee keepers according to Bee zone program All the respondents were commercial beekeepers rearing above 20 beehives and service receiver from Agriculture Knowledge Centre Dang, PMAMP. Face to face interview based on pre-structured

questionnaire using mobile application M-water surveyor was taken with the 35 respondents who were living in Tulsipur sub metropolitan city, Ghorahi sub metropolitan city and Banglachuli Rural municipality of Dang districts. For this, background information of each beekeeper was collected from secondary sources, books and paper published by Agriculture Knowledge Centre, Dang. After collection of primary data from field survey in M-water surveyor mobile app was derived in MS-Excel 2016. Data analysis was done by using MS-Excel, and SPSS version 23.0. Different statistical tests like Descriptive statistics, multiple response analysis, prioritization and problem ranking, were done whenever appropriate. The analyzed data was presented by using text, Table, Bar-diagram, Graph and Pie charts with the help of MS-Excel.



Figure 1: Dang district map

## 3. RESULTS AND DISCUSSION

### 3.1 Honey bee species reared by entrepreneurs of Dang district, 2019

*A. mellifera* was found rearing most of the respondent (72%) concentrated on Terai region of Dang. In a study stated that *Apis mellifera* has better performance on Terai region followed by both *A. mellifera* and *A. cerana* the least reared species was found to be *A. cerana* which was only 11% concentrated on the hilly areas (Banglachuli) of Dang (Aryal et al., 2015). According to *Apis cerana* performance better in Hilly region (Pokhrel, 2009).

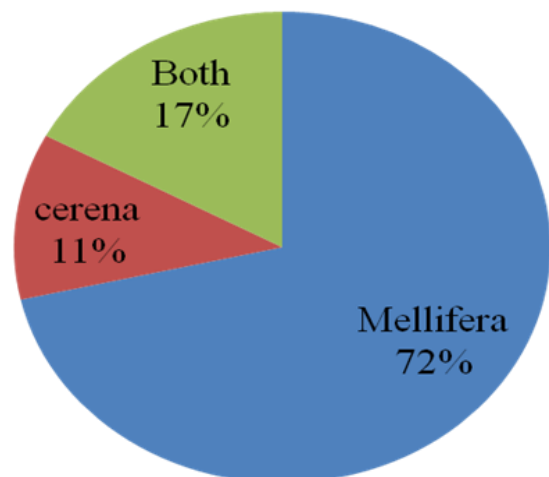
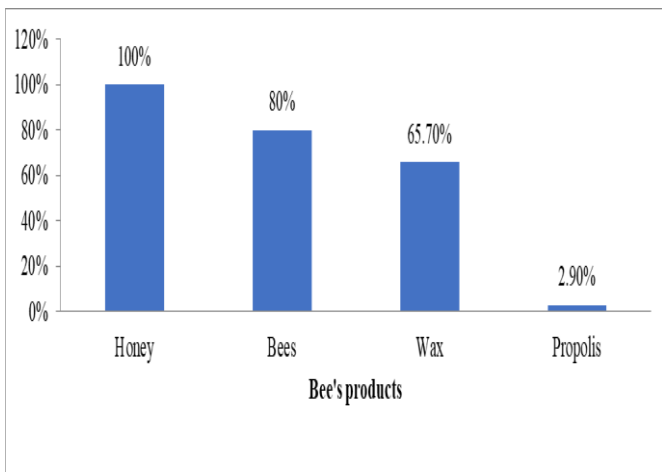


Figure 2: Honey bee species reared by entrepreneurs of Dang district, 2019

### 3.2 Sources of income from beekeeping in dang district, 2019

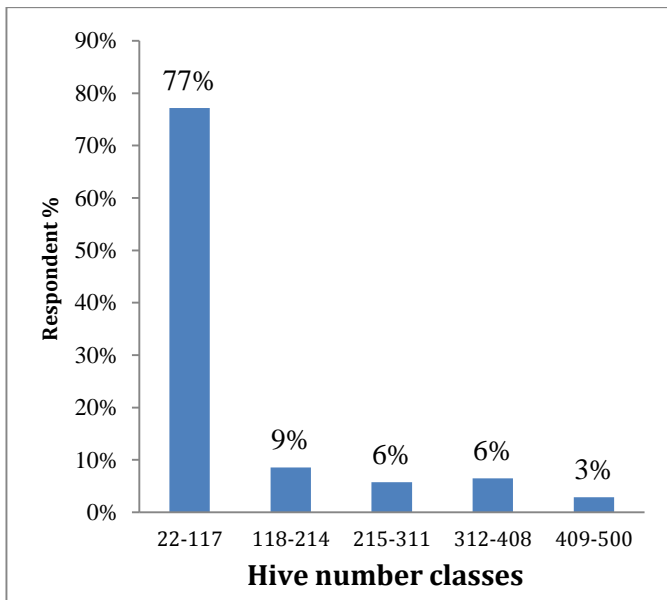
From the result, the main purpose of Beekeeping for bee keepers was honey i.e. 100% respondents sold honey, this result was also in consistent with the result of the research done, followed by selling of bee frame then wax and only 2.9% respondents sold propolis and included as a source of income from bee keeping (Pokhrel, 2009).

**3.3 Current hive number of beekeepers in Dang district, 2019**



**Figure 3:** Sources of income from beekeeping

Beekeepers rearing 22-117 hives were found maximum (77%) in Dang District. Commercial grower of honey bee had been rearing minimum 22 beehives, average 98 bee hives and maximum up to 500 bee hives. PMAMP, Dang Mauri Zone also stated that beekeepers rearing above 20 beehives are commercial beekeepers.



**Figure 4:** Current hive number of beekeepers in Dang district, 2019

**3.4 Average hive number and productivity of honey in dang**

The average honey productivity of *Apis mellifera* of the sample was found 31.2 kg/year/hive which met with the PMAMP (2075) average productivity of *mellifera* in dang was 30-40kg while Average honey productivity of *Apis cerana* in Banglachuli rural municipality was found 8.5 kg.

	Field survey 2019	Bee Zone Program, PMAMP.
Average hive number	98	94
Average productivity (kg/hive)	31.2 (A. mellifera) 8.5 (A. cerana)	30-40A. mellifera) 10 - 15 (A. cerana)

**3.5 Trend of increasing and decreasing beekeeping in Dang district, 2019**

89% of the respondents were found increasing their beekeeping enterprise.

Trend	No. of Respondents	Percentages
Increasing	31	89
Decreasing	4	11

According to the respondents, the main reason behind the increase of enterprise were ranked where good source of income was found as the main reason to increase their enterprise. ICIMOD reported that this enterprise can be started with low investments, carried out with limited space requirements and get yield within the first year of operation, market demand ranked as 2<sup>nd</sup> government allowances on tools, equipment, technical assistance and other services ranked as 3<sup>rd</sup>, training conducted by PMMP, AKC, other NGO and INGO'S became the 4<sup>th</sup> reason to expand their enterprise and foraging areas was ranked as least reason of the respondents which means the majority of the respondents had not been satisfied with the foraging areas needed for the honey bees (ICIMOD, 2012).

S.N	Reason of increasing	Percentages	Rank
1.	Government Allowances	18	3 <sup>rd</sup>
2.	Market Demand	23	2 <sup>nd</sup>
3.	Foraging Areas	15	5 <sup>th</sup>
4.	Training	16	4 <sup>th</sup>
5.	Good Source of Income	28	1 <sup>st</sup>

Out of 35 respondents only 4 respondents (11%) responded their enterprise has been decreasing.

According to the farmers, the main reason behind this decrement had been tabulated below where shortage of forage for bees was the main cause to decrease their enterprise and this finding agree with who reported shortage of forage, lack of improved beehives and poor managements as the reason of decreasing honey bee colony (Tesfaye et al., 2017). Second reason was marketing problem where they were suffered from middle man collection center to give products at low price. Similarly, 3<sup>rd</sup> reason was high cost of modern hives, tools, then fourth cause was poor managements, off season managements and farmers were unknown about disease predators and its controlled measures was found as fifth reason to decrease their enterprise.

S.N	Reason of Decreasing	Percentages	Rank
1.	High investment cost	20	3 <sup>rd</sup>
2.	Shortage of forage	25	1 <sup>st</sup>
3.	Predators and Diseases	15	5 <sup>th</sup>
4.	Poor Management	18	4 <sup>th</sup>
5.	Marketing	22	2 <sup>nd</sup>

Finally, it was found that the overall beekeeping enterprise was expanding in Dang district.

**4. DEARTH MANAGEMENT OF HONEY BEE IN DANG DISTRICT, 2019**

**4.1 Rainy and summer season hive management**

From the study hive cleaning Practice was adopted by majority of the farmers (40%) for summer and rainy season hive management in beekeeping which was consistent with the result of research done by in which majority of the respondents responded cleaning the bottom board of the hive to protect from the mite infestations, followed by hive covering with jasta pata, water soaked jute etc (Pokhrel, 2004). Repair and maintenance, Shade replacement Only few respondents i.e. 6% who were rearing *Apis mellifera* responded not apply to hive management during summer and rainy season.

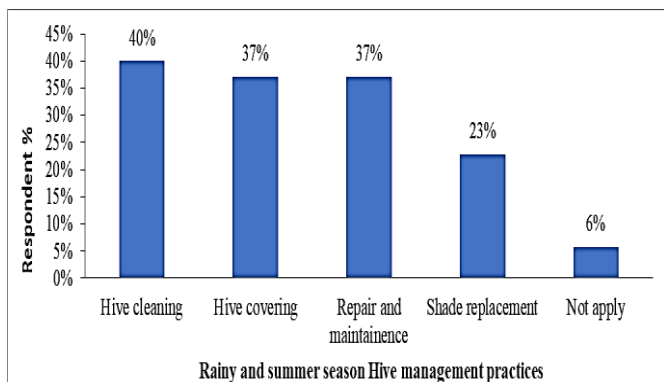


Figure 5: Rainy and summer season hive management

4.2 Rainy and summer season Feed management

It was found that most of the respondent (80%) fed their colonies with sugar syrup/ solution followed by pollen and other like soya bean floor, chick pea floor protein powder and honey constitutes (23%) each and only 4 % responded not apply to feed management. Sugar solution and its items had been widely used in dang District for feed management during summer and rainy season. This result is in near to consistent with the research done by where 100% respondents responded to sugar solution for dearth season feed management (Pokhrel, 2004).

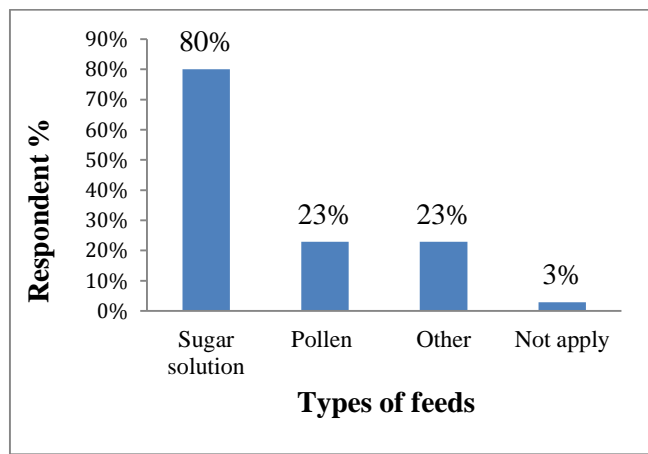


Figure 6: Rainy and summer season Feed Management

4.3 Winter season hive management

It was found that most of the respondent (69%) adopted to hive covering by the jute sacs and straw to protect the bee colonies which is in consistent with the previous result done by where many of the respondent focused on hive covering to protect the bee colonies rather than other (Pokhrel, 2004). Followed other management activities such as transfer to sunny areas, using self-made hive and oxalic acid placement to varroa control (40%) also reported that Varroa destructor control methods were combination of long-term formic acid treatment in summer and oxalic acid trickling in winter, narrowed the ventilation and entrance hole (23%) and 3% responded to not apply any management activities to Apis cerana (Thapa et al., 2000; Oberrieter and Brodschneider, 2020). Also reported that the tendency of swarming absconding and robbing in Apis cerana which complicate the management of the bees.

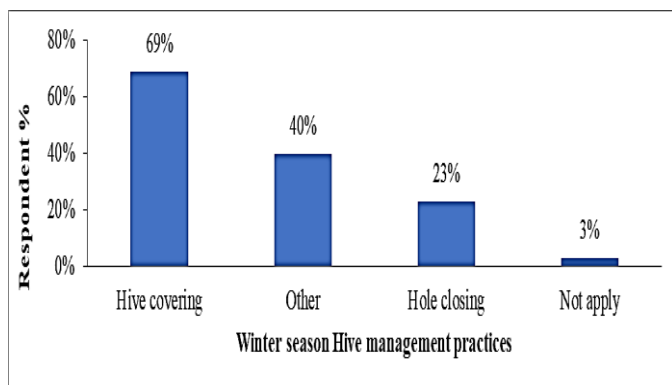


Figure 7: Winter season hive management

5. FREQUENCY OF HONEY HARVESTING IN DANG DISTRICT, 2019

Farmers harvesting four and more times in a year were found maximum (69%). This includes those commercial bee farms of Apis mellifera having comparatively more no. of hives and used to take for foraging outside the district to different places. According to the respondent if the weathers condition favors and feels sound a year-round then a hive can be harvested up to 6 times a year. Pokhrel stated that beekeepers extracted 3-7 times (mean 4.8) from A. mellifera in Terai during winter and spring. 20% respondent were harvesting three times a year (Pokhrel, 2009). this include those commercial farms of Apis mellifera having comparatively lesser number of hives and took to forage inside the valley and only 11% respondent were found harvesting two times in year. These include those farmers rearing Apis cerana and did not migrate their bees to forage from one place to another. Pudasaini also found that majority of the people of Chyangli VDC, Gorkha were harvesting 2 times a year in Apis cerana (Pudasaini, 2018). Kafle reported that farmers harvest honey 3 times in year (Kafle, 1992).

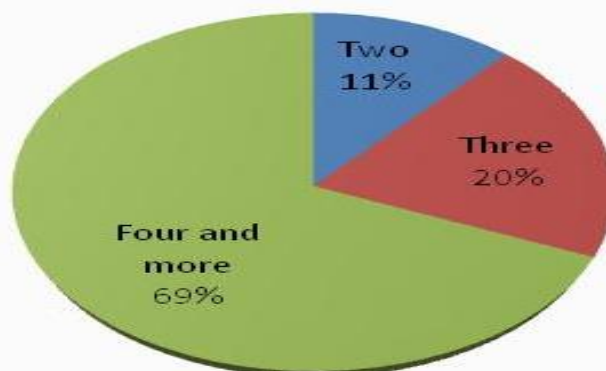


Figure 8: Frequency of honey harvesting in Dang district, 2019

6. MAJOR PREDATORS AND PARASITE OF HONEY BEE IN DANG DISTRICT, 2019

Major five predators and parasites found which declining the honey productions in the Dang district were listed and ranked. Among these Bee eater birds locally called Dum chara had been found as the major predator which uses to kill and eat the honey bee. Similarly, Asian Hornet locally called Aringal had been ranked as a second major predator followed by Ants, lizards and finally the parasites named mites ranked as 5<sup>th</sup> major. Apis cerana were infested with Varroa jacobsoni while Apis mellifera colonies were suffered from Tropilaelaps clareae. Pokhrel, also reported that mellifera were severely suffered with Tropilaelaps clareae in chitwan Terai whereas cerana colonies with Varroa jacobsoni (Pokhrel, 2004).

Some researcher also found that predators like bee eater birds and vespa (hornet) like V. vetulina, V. tropica and V. magnificia are the major predators to decrease the honey production (Thapa et al., 2012). Almost all beekeepers of the dang managed these predators like bee eater birds Asian hornets, lizard, wasps, spiders from traditional methods like nest burning and beating with a wooden flapper against the hornets wasps, lizards, while use of ghanti (bell) and making noise, sound used to chase the bee eaters birds, while ants were managed my putting hive stands at the waters cup, bottom board cleaning to protect from the spiders and other predators. Some farmers were found putting oxalic acid to control the mite infestation.

S.N	Predators and parasites	Percentages	Rank
1	Ants	21.67	3
2	Bees Eater Bird	28.90	1
3	Mites	12.55	5
4	Lizards	14.26	4
5	Asian Hornet	22.62	2

6.1 Farmer response on honey bee disease infestation in Dang, 2019

From the study it was found that majority of the respondent (77%) were troubling from various types of diseases occurring in the honey bees and

colonies, while 23% of the respondent did not observe any types of diseases in the honey bees and colonies. Shivakoti and Bist Mentioned that loss of vigor and defensive power, poor hygienic behavior, reduced body size, more swarming, frequent incidence of pests and diseases contribute to unproductive and weak colonies of honey bees (Shivakoti and Bist, 1999). From the study the major diseases found in honey bee colonies in dang district were European foul brood (37%) caused by bacterium called Bacterium *Melissococcus plutonius* followed by Nosema disease (31%) caused by protozoan, *Nosema apis*, Thai sac Brood disease (29%) caused by Thai sac brood virus, and Paralysis (6%). Pokhrel Identified that Paralysis, foul brood and Nosema disease were important diseases of honey bee in Chitwan (Pokhrel, 2008). European foul brood attacking mostly on *Apis mellifera* and somewhere found on *Apis cerana* too. Nosema diseases mostly occurred on the digestive system of the adult honey bee causes diarrhea affecting all types of bees like worker drone and queen. Thin faeces were seen inside and outside the bee hives having foul odor. Thai sac brood virus was found attacking *Apis cerana*.

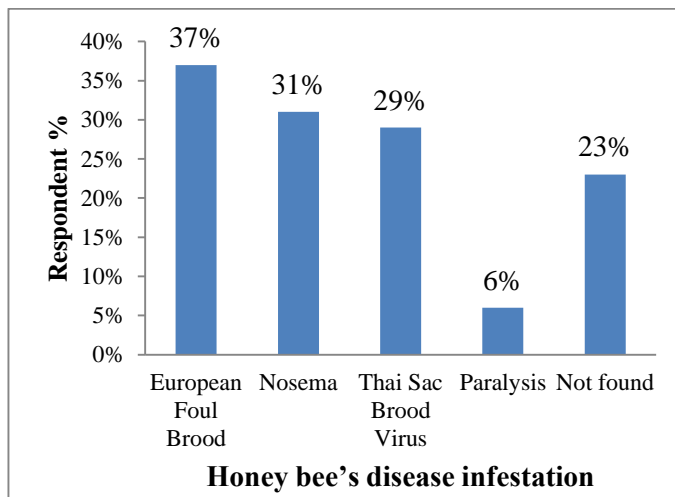


Figure 9: Farmer response on honey bee's disease infestation in Dang, 2019

Shrestha and Shrestha identified that Thai sac virus infecting colonies of *Apis cerana* in mid hills of Nepal (Shrestha and Shrestha, 1997). Few farmers of Dang district responded to Paralysis in honey bee where the bee unable to fly having deformed wings crawling on the ground. Farmers were unknown about this. According to ICIMOD having symptoms of above mentioned it might be the reason of infecting with deformed wing virus (ICIMOD, 2012).

## 7. OUTLET OF HONEY MARKETING IN DANG DISTRICT, 2019

It was found that most of the respondent sold and preferred to farm gate consumer selling due to relatively higher price rate. Remaining 6% did not sell to farm gate consumer selling because they own had processing factories to refine the honey to get better price of processed honey. Also they used to collect bulk amount of honey from the farmers at wholesaler rate and sold to the out of Dang valley like Butwal, Kathmandu, Pokhara and export to foreign countries at Retail price. However most of the selling was done to the whole seller due to lack of processing and storing materials themselves.

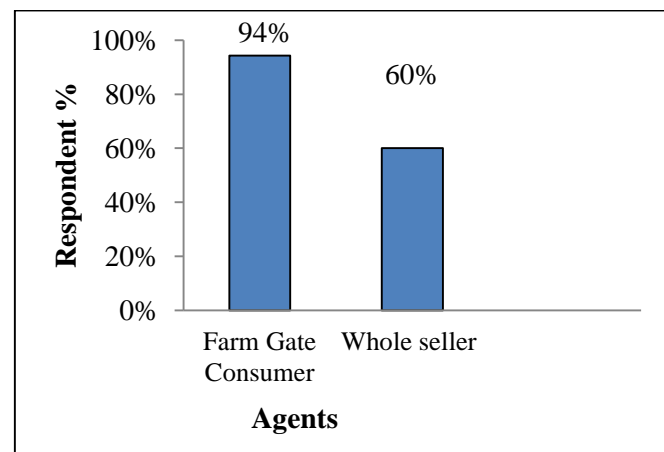


Figure 10: Outlet of honey marketing in Dang district, 2019

## 7.1 Price of Raw Honey at Dang in 2019

Price of honey differs with the species of honey bee from which it produces, i.e. the *cerana* honey had been found getting more price than *Apis mellifera* honey bee. The mean whole sell rate for *Apis cerana* honey was Rs 500-550 per kg and farm gate consumer rate was Rs 700 per kg while farm gate consumer rate and whole seller rate for *Apis mellifera* honey were found Rs 375-400/kg and 250-350/kg respectively. Thapa stated in his research that autumn honey harvested from *cerana* is considered as the best medicinal honey for apitherapy purposes (Thapa, 2003). It was found that better price was obtained from directing selling rather than whole seller to the farmers.

S.N	Agent	Rate (Rs/kg)	
		Mellifera	Cerana
1.	Farm Gate	375-400	700
2.	Whole seller	250-350	500-550

## 8. CONCLUSION

A study was conducted to study the production and management of honey bee in Dang district. An individual farmer survey was carried out with the help of pre-structured questionnaire in Tulsipur and Ghorahi sub-metropolitan city and Banglachuli rural municipality of Dang. It was found that 72% of them were rearing *Apis mellifera* only which was concentrated on Terai region whereas 11 percent rearing *Apis cerana* only concentrated on hilly regions. Almost all of the respondents (100%) were found selling honey and include as a major source of income from beekeeping and only 2.9 % were selling propolis. Farmers having bee hives number 22-117 were found maximum i.e.77%. The average hives number, average productivity for *mellifera* and *cerana* were 98, 31.2kg per hive per year and 8.5 kg per hive per year respectively. Overall, 89% of the respondents were increasing their beekeeping enterprise and good source of income from beekeeping was found as the major reason. Minority of the respondent i.e. 11% were decreasing their enterprise due to the shortage of forage. Hive cleaning practice for rainy and summer season hive management was adopted by majority of the respondent (40%). Feeding with sugar solution during rainy and summer season feed management was adopted by majority of the respondent (80%). 69% of the respondent responded to hive covering to protect the honey bee colonies from severe cold and winter. 69% of the respondents were harvesting honey four and more times whereas only 11% respondent were harvesting honey two times. Bee eater bird and European foul brood were found. Most of the respondent (94%) used to sell honey farm gate however the most selling was done to the whole sellers.

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## AUTHOR'S CONTRIBUTION

Ghanshyam KC conducted research and collected data, analyzed and prepared the final manuscript. Pradeep Bhusal guided during analysis and manuscript preparation.

## CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this manuscript.

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