



## CHALLENGES FACED BY FARMERS IN BEEKEEPING AND BEE POLLINATION IN HIMACHAL HIMALAYA, INDIA

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### AUTHOR'S CONTRIBUTION

The sole author designed, analysed, interpreted and prepared the manuscript.

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### ABSTRACT

Beekeeping in Himachal Pradesh plays very important role not only in fruit pollination but also in honey production. The farmers here are facing many problems in bee rearing during recent years. This survey was conducted to assess the problems of beekeepers and orchardists in Himachal Himalaya. It was observed that beekeeping is important for securing food, poverty reduction, health, environmental protection, honey production and plant pollination. The farmers here practiced beekeeping as a part time or whole time job and were engaged in this venture for the last many years. Commercial beekeepers stressed on the role of honeybees as honey producers than pollinators of horticultural crops. Most of the farmers also earned extra income from honey and other bee products besides using them for pollination purposes. The farmers had knowledge regarding different aspects of honey production, processing and marketing i.e. constituents of honey, nutritional value, different type of honey containers used for honey storage, honey processing, marketing problems etc. But only some farmers were acquainted with different pests, predators and diseases of honeybees and their remedial measures.

Most of the farmers wanted to have financial support for different horticultural practices and training purposes. They preferred to be trained in orchard management technology and beekeeping practices. There were different types of constraints faced by beekeepers regarding the beekeeping practices which included non availability of bee flora throughout the year, heavy snowfall, shortage of labour, habit of absconding of bees and poor knowledge about medicines. Apiculture requires organizing honey marketing channels and raising awareness on limiting the use of pesticides in agriculture to protect the bees and the environment as well. The renovations and application of improved beekeeping technologies not only benefits beekeepers but also farmers and the general public in pollinating their crops, maintaining plant biodiversity, and the ecology at large.

**Keywords:** Beekeeping; pollination; Himachal Himalaya; bee management; honey; farmer's perception.

### 1. INTRODUCTION

The diversities of honeybees are important for stabilizing plant pollination and its yield. The pollination deficits are the main determinant of the crop yield over the diverse agronomic inputs such as fertilizer, pesticides, and fossil fuel energies [1]. The number of worker honeybee colonies per hectare

provides a critical metric of crop health. The honeybees cannot keep pace with the winter die-off rates and habitat loss. Hypothetically, the loss of the plant pollinators may affect the yield of the crops with varying degrees of their dependence. Insect pollinators mainly belong to the orders of Hymenoptera (bees), Lepidoptera (butterflies), and Diptera (syrphid fly). There are also vertebrate

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pollinators like birds, bats, monkeys, etc. but honeybee (*Apis sp.*) is dominant pollinators of crops [2]. In addition to climate change, higher pathogen prevalence [3], Cordes et al., 2012; [4] and competition between native and invasive species [5] has brought the instabilities in pollinator population, and plant diversity. The decline of pollinators caused the lowering of yield of pollinator-dependent crops and referred to as pollination crisis and subjected to different sciences like politics and economy [6].

Beekeeping is important for securing food, poverty reduction, health, environmental protection and plant pollination. These important practices are challenged by many biotic and abiotic factors in recent years. These factors affect honeybees and their valuable products either in combination or alone [7]. There are many abiotic and biotic factors that that weaken honeybee-keeping and its values. Among the abiotic factors, climate change is a major factor [8]. It caused the decline of honeybees by asynchronizing the season of flowering plants [9,10]. Global warming due to climate change may have a substantial negative impact on the production of honey [8]. A worker honeybee preferred the nectar of one or many flower species and visited different plant species that helped to capture a higher sugar concentration of nectar. Surprisingly, if high-quality nectar is available, a forager honeybee, *Apis mellifera*, carried as much as 80% of their body weight [11]. Birhan et al. [12] reported that lack of honeybee forage, shortage of rainfalls, agrochemical poisons, pests, absconds, and lack of honey storage facilities affected honeybee production and productivity negatively.

There are 10,000 beekeepers/ beekeeping & honey societies/firms/companies and 16 lakhs honeybee colonies from all over India registered with National Bee Board whereas there are only 363 agencies and 56252 honeybee colonies registered from Himachal Pradesh [13]. Lack of honeybee professionals and trained bee labours allows poor management of colonies. The transport costs are also high in migratory beekeeping [14]. Many commercial beekeepers face problems including interference of police and octroi people during the migration of their bee colonies. Indiscriminate use of pesticides poses a major threat to honeybees [15,16]. Depletion of floral resource because of growing concrete jungles is one of the major concerns in beekeeping. The bees boxes are placed in field where day-night care is not possible and there are chances of stealing boxes [17]. Producer price for honey and other products from beekeeping is very low compared to retailer price, and this always irritates the beekeepers [18]. Many beekeepers report that the cost of the equipments is too high and this will also discourage the

entrepreneurs in this field. There is no separate market for honey and beekeepers selling their honey to local markets. Most of the commercial beekeepers are troubled by the international standards for exporting honey as the beekeepers have poor knowledge of the standards [17,14,19].

## 2. MATERIALS AND METHODS

A Field Survey was conducted at different localities in Himachal Pradesh. The data prepared for the present study is primary as well as of secondary nature. Primary data was collected with the help of a questionnaire prepared for the purpose. Farmers were also asked about the various types of bee management practices they practice and about migratory beekeeping. They were also asked about different hive products, honey bee diseases and pests they know. Finally, farmers were questioned about different problems they faced in beekeeping and whether they got some kind of institutional support. The secondary data was collected from different agencies like Directorate of Horticulture and Directorate of Industries Govt. of Himachal Pradesh, Khadi and Village Industries Commission (KVIC) and Central Bee Research and Training Institute (CBRTI), Pune. Elaborate interactions were made with the district and state level officials of beekeeping department of Govt. of Himachal Pradesh.

## 3. RESULTS

Despite of overall success in promoting honeybees as pollinators, the survey indicated that about a quarter of farmers had still not understood the potential role of honeybee pollination in enhancing fruit yield. Most of the fruit growers in Himachal Himalaya were aware that introduction of honeybee colonies in orchards at the time of flowering can help in fruit set and yield. Although they came to know about this fact only a few years back. The fruit growers are using both native *Apis cerana* and exotic *Apis mellifera* for pollination purposes but most of them have a preference for native *Apis cerana*. They are either maintaining honey bee colonies or hiring them during flowering period from government agencies or private beekeepers for pollination purposes. Despite the overall success in promoting honeybees as pollinators the survey indicated that some of the farmers are still not aware regarding the potential role of honeybee pollination in enhancing fruit yield. In Himachal Himalaya, many farmers were aware about the local bee flora and they agreed that they had sufficient availability of honey plant resources like mustard, pear, apple, plum, peach, almond, rose, bottle brush etc. in their regions. The data collected from

farmers/orchardists through questionnaire on various parameters is tabulated and described as below:-

### 3.1 Farmers' Perception of Pesticide Use and Its Impact on Insect Pollinators

More than two third (68%) of the farmers used some type of pesticides in their orchards. They commonly used fungicides, insecticides and other pesticides obtained from government stores. Less than half of the farmers knew that pesticides kill insects. Most of them used wettable powder.

### 3.2 Pests and Diseases of Honeybee

There are many types of pests, predators and diseases affecting the beekeeping industry in Himachal Himalaya (Table 2).

Only some of the farmers (42.10%) had knowledge about pests and diseases of honey bee, and a few persons (34.50%) used medicines for the cure of bees. Mostly there occur attacks of pests on bees Table 3.

### 3.3 Farmers' Knowledge Regarding Bee Management Practices

Less than half of the farmers know about the bee management practices to be taken. Most of the farmers (65.10%) handled the bees by themselves while some (34.90%) of them employed some extra employees. Most (49.50%) of the farmers got the nucleus stock from the horticulture department. Most

of the farmers (84.30%) multiply the bees only once and (75%) used smokers for handling bees Table 4.

### 3.4 Migration of Bee Colonies

Most of the farmers migrated the bee colonies and were satisfied with their migration. Farmers used different types of mode of transportation and faced many types of problems during migration (Table 5).

### 3.5 Marketing of Honey

Collection of honey was made available at different intervals. Most of the persons (61.40%) were satisfied with the collection interval. Most of the farmers (66.30%) were not satisfied with the transport arrangements in their regions. Most of them (79.90%) faced marketing problems of different kind (Table 6).

### 3.6 Institutional Support

Only some of the farmers (38.30%) got financial assistance from the department of beekeeping. Around a quarter reported that they had already received some form of awareness or training support from NGOs and Govt. agencies. Most of them (83%) wanted training in orchards management and improved methods of beekeeping. About half (61%) wanted to have support from the government and technical knowledge about pollination. About 49% of farmers wanted financial support to buy orchard equipments and honeybees (Table 7).

**Table 1. Farmers' perception regarding the use of pesticides in orchards**

	% age of responses
<b>a. Pesticides used in orchard</b>	
Yes	68
No	25
DNK	7
<b>b. Do pesticides kill pollinators</b>	
Yes	49
No	32
DNK	19
<b>c. Type of pesticide formulation used</b>	
Dust	8.60
Spray	27.20
Wettable powder	56.10
DNK	8.10
<b>d. Type of pesticide used</b>	
Fungicides	46
Insecticides	24
Others	30

Table 2. Various pests, predators and diseases

Honeybee Predators	Honeybee Diseases	Other Problems
<b>Mammals</b>	<b>Viruses</b>	Dysentery
Humans	Sacbrood	Chilled brood
Rodents	Thai sacbrood	Laying workers
Honey badgers	Chinese sacbrood	Drone-laying queens
Bears	Chronic paralysis virus	Pollen shortage
<b>Insects</b>	Kashmir bee virus	Honey shortage
Moths	Deformed wing virus	Pesticide poisoning
Ants	<b>Fungi</b>	
Small hive beetle	Chalkbrood	
<b>Mites</b>	<b>Bacteria</b>	
<i>Acarapis woodi</i>	American foulbrood	
<i>Tropilaelaps clareae</i>	European foulbrood	
<i>Varroa destructor</i>	<b>Protozoa</b>	
<b>Spiders and pseudo-scorpions</b>	<i>Nosema</i>	
<b>Birds</b>	<i>Amoeba</i>	

Table 3. Disease of honey bees

	% of responses
<b>a. Knowledge about diseases of honey bees</b>	
Yes	42.10
No	55.20
DNK	2.70
<b>b. Knowledge about medicines for cure of bees</b>	
Yes	34.50
No	29.10
DNK	6.40
<b>c. Types of diseases and attacks</b>	
Wasps	36
Viral	24
Acarine	11
Mites	26
Wax moths	3

Table 4. Farmers' knowledge regarding Bee Management Practices

	%age of responses
<b>a. Farmers understanding about bee management practices</b>	
Yes	56.40
No	40.60
DNK	3.00
<b>b. Handling of bees</b>	
Themselves	65.10
Extra hand	34.90
<b>c. Source from where nucleus stock is obtained</b>	
Forest Department	36.10
Horticulture Department	49.50
Grew Themselves	14.40
<b>d. Multiplication of honeybees</b>	
Once	84.30
Twice	14.20
DNK	1.50

	<b>%age of responses</b>
<b>e. Equipments used for handling bees</b>	
Smoker	75.00
Bee veil	16.00
Gloves	6.00
Bee bush	3.00

Table 5. Migration of Bee Colonies

	<b>% age of responses</b>
<b>a. Do the farmers migrate the colonies</b>	
Yes	64.10
No	30.20
DNK	5.70
<b>b. Mode of transportation</b>	
Mini Trucks	51.40
Maxi Cabs	22.50
Trucks	11.20
Medium Vehicles	14.90
<b>c. Problems in migration</b>	
Bees fly during migration	14.30
Bees die during migration	31.50
Money and man power needed	9.10
Transportation problem	22.50
Difficult terrain	22.60

Table 6. Marketing of Honey

	<b>% of responses</b>
<b>a. Satisfied with collection interval?</b>	
Yes	61.40
No	35.30
DNK	3.30
<b>b. Satisfied with transport arrangements</b>	
Yes	30.00
No	66.30
DNK	3.70
<b>c. Marketing problems</b>	
Yes	79.90
No	11.10
DNK	9.00
<b>d. Types of problems</b>	
Less price for honey	49.90
Market was away	8.70
Time consuming	11.30
Long processor	2.30
Winter snow falls	7.80
Need of genuine support price	3.30
Need of guidance	10.60
No marketing facility	6.20
<b>e. Sell the honey to private parties</b>	
Yes	84.60
No	14.40
DNK	1.00

	% of responses
<b>f. Preferences for private parties</b>	
Easily available	54.30
Advance payment	6.70
High incentive	9.80
Better rates	21.20
Economic regions	3.90
Money of transportation saved	4.10

Table 7. Institutional Support

a. Financial assistance from the government	% of responses	Remarks
Yes	38.30	
No	58.50	
DNK	3.20	
<b>b. Sources from where financial assistance obtained</b>		
Department of Khadi Village and Industry	15.20	
Department of Horticulture	23.40	
Beekeeping farm	17.70	
DNK	43.70	
<b>c. Desired institutional support</b>		
Training in orchards management and beekeeping	83	Training in orchards management, improved methods of beekeeping and pollination management using honey bees
Financial support	49	To buy farm equipments and for planting materials
Increasing awareness	61	Support towards increases awareness of technical aspects of pollination including honey bee pollination

Table 8. Major constraints

	% of responses
Non-availability of flora throughout the year	29.30
Heavy snow fall	22.60
Lack of latest knowledge	16.50
Lack of labour	14.90
Habit of bee to leave the hive	11.00
No knowledge about medicine	4.70

### 3.7 Constraints in Beekeeping

There were different constraints encountered by farmers of Himachal Pradesh in practicing apiculture which are shown in (Table 8).

Most of the surveyed farmers knew that insecticides could kill honeybees and other useful insect pollinators but even than they were making excessive and indiscriminate use of pesticides on cash crops. Insecticides have affected both the diversity and abundance of pollinating insects, which was clearly reflected in farmers' perception because they observed that in the past there were large number of insects like

honeybees, butterflies and wild bees during the flowering season of temperate fruit crops. But now there is decrease in their population which is affecting the crop productivity.

### 4. DISCUSSION

In the recent years, yield and quality of fruit crops is diminishing due to insufficient pollination. The number, abundance and biodiversity of insect pollinators is decreasing due to hazardous human activities. Various threatening factors to the biodiversity of insect pollinators observed in Himachal Himalaya are: - loss of habitat; introduced

species; mono-cropping; grazing and mowing; Forest fires; Honey hunting; Exotic honeybees and local honeybees; Pesticides; Diseases and parasites; Cell phone radiations; Environment pollution, and Climate change. The decline in pollinator diversity, presents a serious threat to crop production and the maintenance of biodiversity [20]. A few studies have been conducted on farmers' perception regarding role of insect pollinators in crop improvement in various parts of the world. Matsuka et al. [21]; Minakshi [22] have stressed on raising awareness at all levels about the importance of managed crop pollination through beekeeping and other pollinators is the first step as part of development efforts. Similarly, Thomas et al. [23] found that degradation and fragmentation as the main adverse habitat changes for pollinator populations. Moreover, fragmentation and habitat destruction can add to the rate of genetic erosion by reducing gene flow between demes (locally interbreeding group within a geographic population), and increases the likelihood that populations and species will become extinct [24].

Kumar et al. [16] revealed that the major economic constraints in Jammu and Kashmir include high cost of beekeeping equipment and low selling price of honey. The major technological constraints include lack of knowledge about honeybee enemies and new technologies while as the major administrative and infrastructural constraints included lack of state government support, non-availability of honey processing units and skilled labour. There is a need to conduct effective promotional and awareness campaigns to remove the myths about honey and bees. Government must take steps for selling the honey at best price which helps in beekeeper's economy. The concept effect of pesticides on honeybee should be understood by the farmer so the beekeeper will be forewarned by the farmer before spraying. Presently government is encouraging organic farming (Sikkim was declared as a first organic state in India) which is a good initiative for saving bee health and consuming organic honey [17,7].

## 5. CONCLUSIONS

The farmers of Himachal Pradesh practiced beekeeping as a part time or whole time job and were engaged in this venture for the past many years. Commercial beekeepers stressed on the role of honeybees as honey producers than pollinators of horticultural crops. Most of the farmers also earned extra income from honey and other bee products besides using them for pollination purposes. The farmers had knowledge regarding different aspects of honey production, processing and marketing like

constituents of honey, nutritional value, different type of honey containers used for honey storage, honey processing, marketing problems etc. But only a few farmers were aware about with different pests, predators and diseases of honeybees and their remedial measures. Regarding the institutional support, only some of the farmers got financial assistance from Government agencies like Department of Horticulture and most of them did not know resources from where to get the financial support. Most of the farmers wanted to have financial support for different horticultural practices and training purposes. They preferred to be trained in orchard management technology and beekeeping practices. There were different types of constraints faced by beekeepers regarding the beekeeping practices which included non-availability of bee flora throughout the year, heavy snowfall, shortage of labour, habit of absconding of bees and poor knowledge about medicines.

## CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

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## COMPETING INTERESTS

Author has declared that no competing interests exist.

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