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Socio-Economic Analysis of Traditional and Modern Beekeeping in Western Himalayan Region Uttarakhand, India

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Abstract: Beekeeping is essential for the development of bio-economy practices; it provides tremendous social benefits on both economic and ecological fronts. The objectives of the present study were to explore the socio-economic status of all traditional and modern beekeeping populations, the role of anthropogenic movement, manipulation, filthy beekeeping practices, bacterial pathogenesis, irrational use of antibiotics and the agricultural intensification of managed and native bee species in the selected study sites. The required data was collected through in-depth personal interviews and questionnaires. A total of 101 (42 traditional and 59 modern) beekeepers were interviewed from randomly selected five blocks in the Nainital district. Out of 18 selected study sites, 16 sites fall under rural areas, one is an urban town, namely Kathgodam and the remaining one is a town, namely Fatehpur Range. The present investigation reveals that 70% of total modern beekeepers are of 20-49 years old and reside in rural areas. It is encouraging that people have adopted beekeeping in rural areas for livelihood and modern purposes. During the present study, it was observed that females are least interested in beekeeping practices due to extensive touring and shifting to remote areas for qualitative nectar and pollen.

Keywords: Beekeeping, Honey, Nectar, Socio-economic status, Livelihood, Western Himalayan region

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Introduction

Demand of honey on a global scale has made beekeeping an important asset. Beekeeping provides a variety of benefits, including the preservation of natural plants from which bees gather nectar, as well as the therapeutic uses of honey. Bees and beekeeping can contribute significantly to rural populations by providing a secondary source of income with less input (Kumari and Laxmikant, 2016). Beekeeping has

been practised since historical times in several parts of the world, including Africa, Europe and Asia. The ancient epic Ramayana chronicles reveal that King Sugriva maintained Madhuban in Kiskindya. This Madhuban was kept only to tame bees in order to provide honey to the Emperor and his subjects. This reveals that organized beekeeping existed in India as early as 2000 B.C. (Ghosh, 1994).

Traditional and modern beekeepings are two stages in the evolution of beekeeping. People of almost all Indian states and economically significant cities have opted for modern beekeeping not only for their livelihood and capital generation but also for the pollination services provided by bees. Bees are sensitive indicators of a healthy ecosystem and shapers of the environment, so their value can't be overstated (Abbott, 2016). Honey bees are a wonderful gift to humanity since beekeeping may be done for both pollination services and treasured goods such as honey, beeswax, propolis and bee venom (Tej *et al.*, 2017).

The Indian subcontinent is home to two domesticated species, namely the native honey bee (*Apis cerana indica*) and the European honey bee (*Apis mellifera*), as well as two species of wild bees, which are the giant/rock honey bee (*Apis dorsata*) and the dwarf honeybee (*Apis florea*) (Abbott, 2016; Tej *et al.*, 2017) (Fig. 1). While three out of four species found in India are native, the fourth, *A. mellifera*, is an exotic species, brought and introduced to the country from Thailand as it is resistant to the Thai Sac Brood Virus (TSBV) and more friendly to modern beekeeping (Tej *et al.*, 2017; Chhuneja, 2017). *Apis cerana indica* is reared in traditional beekeeping and has a limited role in commercial apiculture practices.

All life forms require a healthy diet of macronutrients (proteins and carbohydrates) and micronutrients (minerals and salts) to carry out their daily functions. The diet of bees is classified into two categories-- nectar and pollen obtained from flowers. Carbohydrates are obtained mostly from floral nectar, whereas proteins, lipids, vitamins, and important sterols are obtained through pollen (Khan *et al.*, 2021). India produces a variety of honey due to its diverse geological conditions and floral/vegetative diversity. Rapeseed/Mustard Honey, Eucalyptus Honey, Lychee Honey, Sunflower Honey, Karanj/Pongamea Honey, Multi-flora Himalayan

Honey, Acacia Honey, Wild Flora Honey, Multi and Mono floral Honey are some of the major varieties of Natural Honey. The North East Region of India and Maharashtra are the key areas for natural honey production. India has exported 59,536.75 MT of Natural Honey to the world worth 88.65 million USD during the year 2019-20. Indian honey is mainly exported to the U.S.A, Saudi Arabia, the United Arab Emirates, Bangladesh, Canada and Qatar (APEDA, 2021).

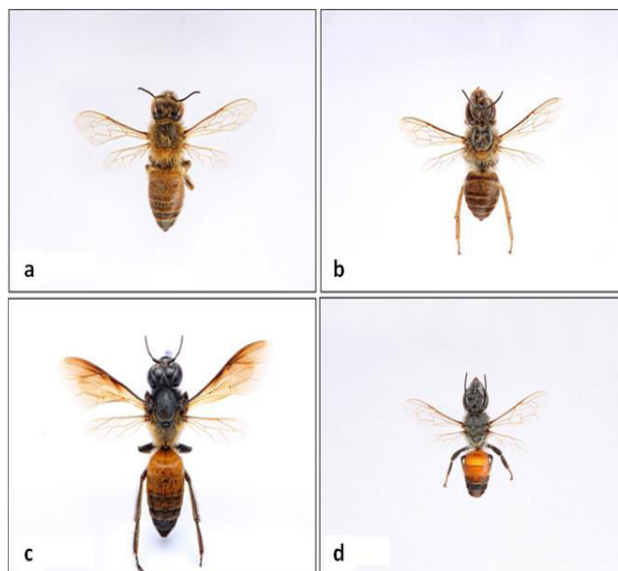


Fig. 1: *Apis* species: (a) *Apis mellifera*, (b) *Apis cerana*, (c) *Apis dorsata*, (d) *Apis florea* (Makkar *et al.*, 2020).

Beekeeping is a long-standing and deeply established tradition in the country. As per the records available, a total of 9698 entities are registered with the National Bee Board in India. Amongst them, 9580 are registered as individual beekeepers, 48 are Beekeeping and Honey Societies, 40 are firms, 27 are companies and the rest 3 are registered as Self Help groups. All these entities collectively have more than 15,59,771 maintained bee hives and the highest percentage of colonies are of individual beekeepers, i.e., 90.56%, followed by companies, 5.41% and firms, 2.59% (Table 1). Beekeeping is modernly practiced in 28 states of India. In terms of the distribution of colonies, the highest percentage of colonies 27.19%, 17.38% and 13.12% are possessed by Uttar Pradesh, Punjab and Haryana

Table 1: Details of Entities/Beekeepers Registered with National Bee Board

Beekeeping entities	Owned hives	Percentage share
Individual Beekeepers	1412659	90.56
Beekeeping & Honey Society	21502	1.37
Companies	84390	5.41
Firms	40490	2.59
Self Help Group	730	0.04
Total	1559771	100

Source: <https://nbb.gov.in/pdf/Registered%20Beekeepers%202019.pdf>

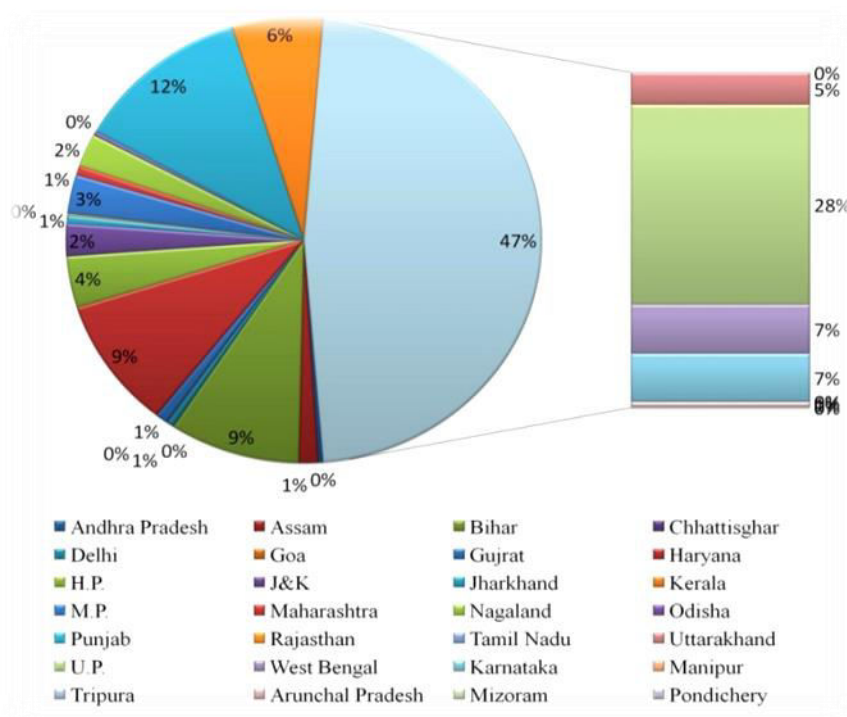


Fig. 2: State wise status of beekeepers registered with National Bee Board (NBB, 2019).

State, respectively while Mizoram holds only 0.011% of colonies (Fig. 2). In the Himalayan state of Uttarakhand, 434 beekeepers, 2 beekeeping and honey societies, 1 company and 2 firms are registered and collectively possess 81375 bee colonies. Amongst these colonies, 88.30% of colonies are acquired by beekeepers (NBB, 2019).

All living organisms are subject to infestation or attack by their natural enemies and honey bees of the genus *Apis* are no exception. In the recent past, several provinces in the world have

experienced a notable decrease in honey bee colonies (Hristov *et al.*, 2021). Modern agriculture has adverse impacts on pollinators (Miglani *et al.*, 2020). There have been several reports of pollinator losses in the previous decade, including wild bee declines (23%), and modern bee colony losses (40% yearly winter fatality) (Metz *et al.*, 2020). Many researchers conducted worldwide studies on honey bee colony mortality from a number of perspectives, including the global transmission of diseases and pests through the commerce in bees and bee products (Currie *et al.*,

2010; Brodschneider *et al.*, 2018; Castilhos *et al.*, 2019; Tang *et al.*, 2020). The decline in the honey bee population does not just affect pollination but also the economic entity of their keepers. There was a lack of data on the socio-economic profiles of beekeeping and the factors influencing the adoption of improved beekeeping technologies. Despite the significant beekeeping activities in Uttarakhand, meaningful information on the socio-economic characteristics of beekeeping and variables influencing the adoption of better beekeeping technology is scarce.

The objectives of the present study were to explore the socio-economic status of all traditional and modern beekeeping populations, the role of anthropogenic movement, manipulation, filthy beekeeping practices, bacterial pathogenesis, irrational use of antibiotics and the agricultural intensification of managed and native bee species in the selected study sites.

Materials and Methods

Description of the Study Area:

The Nainital district is located at an elevation of 1948 MASL (6,385 feet), with a latitude of 29°22'48.00" N and a longitude of 79° 27'0.00" E. During the study period, eighteen areas (villages, urban town and town) and residences of modern and traditional beekeepers were surveyed from five blocks in Nainital district (Fig. 3).

Data collection:

The survey was conducted from June 2019 to July 2021. The questions for scheduled interviews were designed to elicit information about-- the socio-economic status of beekeeping populations, the role of anthropogenic movement, manipulation, filthy beekeeping practices, the role of agricultural intensification on managed bee species, beekeeping in Nainital district, knowledge of beekeepers regarding bacterial pathogenesis in honey bee colonies and their treatment with help of antibiotics and other therapeutics. Numbers of beekeepers per site is listed in Table 2.

Results and Discussion

Amongst the study sites, 88.88%, 5.55% and 5.56% of the sites have the status of villages (rural area), town and urban towns, respectively. Out of a total of 101 beekeepers, 59 are modern (from 13 sites) and the rest, 42 (from 5 sites), are traditional beekeepers. Amongst the modern beekeepers, 89.83% of the beekeepers belong to rural areas, while 6.77% and 3.38% of the beekeepers are from urban town and town, respectively. In traditional practice, all the respondents are from rural/village areas.

Economic Status of Beekeepers:

The present investigation revealed that 24% and 25%, or a total of 49% of the interviewed beekeepers earn between 0.00-0.99 lac and 2.00-2.99, respectively. Only 1.69% of the beekeepers were able to earn more than 8 lac and 6.77% of the beekeepers in the area earn more than 9 lac INR annually (Fig. 4). The annual income per hive ranges between 1,153 INR to 1,728 INR, depending upon the selling price and yield of honey from the hive per year. Beekeepers' income per hive is positively correlated with the number of hives beekeepers possess (Table 3). It has been found that the main and most common problems for all modern beekeepers are low selling prices and rising production costs and the attack of mites is the second most common problem. The possible reasons behind the low income of the respondents are listed in Table 4.

Social Structure:

Male and Female Participation in Beekeeping:

The male and female ratio in the field of beekeeping is very unfortunate in the study area, especially in modern beekeeping. Amongst the modern beekeepers, only 1 (1.69%) female beekeeper was found practicing beekeeping, belonging to Madanpur Kurmi, a village in Ramnagar block. In traditional beekeeping, females are more active. It could be due to the fact that the traditional system comprises wall, window and log hives, thus women do not need to

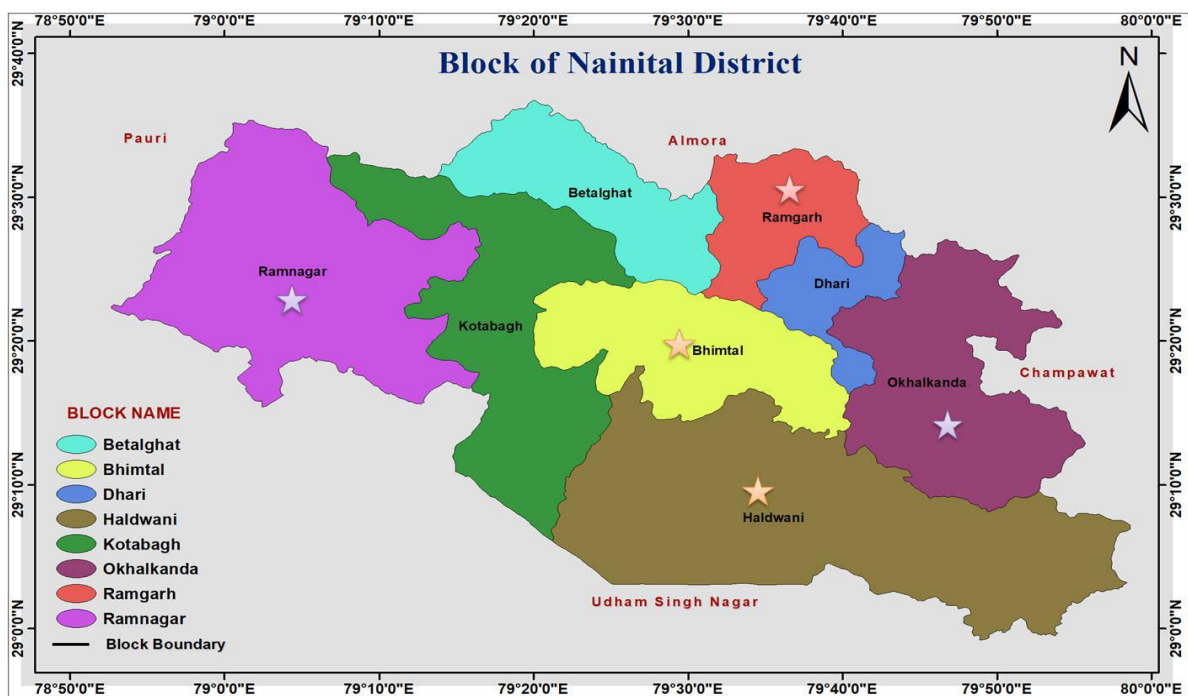


Fig. 3: Map showing Study Sites surveyed and studied.

Table 2: Number of Respondents in different study sites

Name of the Block	Name of the local area	No. of Beekeepers
Bhimtal	Jyoli	20
	Bhalyuti	6
	Dhakakhet	3
Haldwani	Lohariyasal Talla	5
	Kathgodam	4
	Basantpur	2
	Kunwarpur	2
	Fatehpur	2
	Halduchaur	2
	Dewla Talla	2
Ramnagar	Bailparao	4
	Nathupur Chhoi	2
	Neripura Chhoi	4
	Madanpur Kurmi	4
	Shivlalpur Pandey	5
Okhalkanda	Okhalkanda Malla	4
	Moora	11
Ramgarh	Ramgarh	19
Total		101

Table 3: Annual Income of beekeepers Hive/year

Number of Hives	Income/Hive/Annum (INR)	Average Annual Income/Annum (INR)
0-50	1,153	54,620
51-100	1,539	1,33,385
101-150	1,567	2,30,233
151-200	1,600	3,20,000
201-250	1,630	4,07,100
251-300	1,680	5,04,000
401-450	1,728	7,68,800

Table 4: Description of major problems of Apiculturists

On site Problems	No. of Respondents	Percentage (%)
Low selling price and increasing production cost	59	100
Lack of contact between apiarists and honey bee authorities	13	22.03
No or insufficient rainfall (climate change) excess warmth and drought	8	13.55
Insecticide spraying kill honeybees, resulting in their decline	16	27.11
Attack of mites	51	86.44
Bee goods are poorly marketed and poorly advertised to consumers	9	15.25
Attack of Wax moth	43	72.88
Bacterial Pathogenesis	24	40.67

go out of their houses to practice it. In Moora and Ramgarh, collectively 11 (26.19%) females of total traditional beekeepers were in-charge of their families and were actively engaged in traditional beekeeping (Fig. 5).

The present investigation reveals that 44.55% of total and in particular, 70% of total modern beekeepers are in their active age (20-49 years) and reside in rural areas (Fig. 6a), while consideration of beekeeping as a livelihood source is an emerging one to which the youth are attracted in order to generate income. Findings of Sharma and Dhaliwal (2014) are consistent with these findings, as they revealed that the majority of successful beekeepers were in their young age (67.8 %) in the respective study area. From a total of 101 respondents, 48.77% are farmers,

12.87% are daily wagers, 6.93% are salespersons/shopkeepers, 1.98% are government employees, and 29.70% of respondents specifically rely only on beekeeping for livelihood (Fig. 6e). In both modern and traditional beekeepers, the literacy rate was quite good. 100% of beekeepers were literate and were able to read and write their mother language, although very few beekeepers had higher education. Only 5.94% of beekeepers were undergraduates, while only 1.98% was postgraduates (Fig. 6c).

In the present study, it has been found that beekeepers practicing traditional beekeeping are economically weaker than modern ones. 59.52% of traditional beekeepers were under the poverty line and 40.47% were above the poverty line,

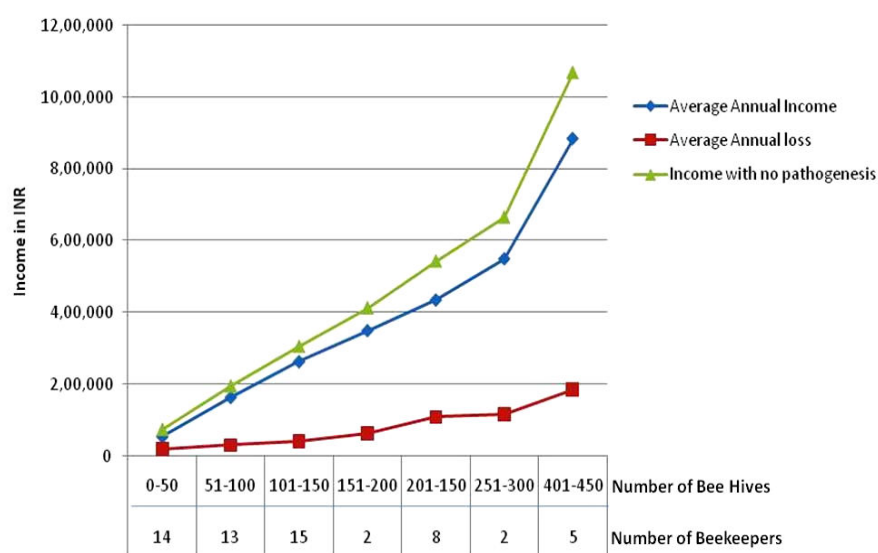


Fig. 4: Average annual income and loss of beekeeping ventures per apiary.

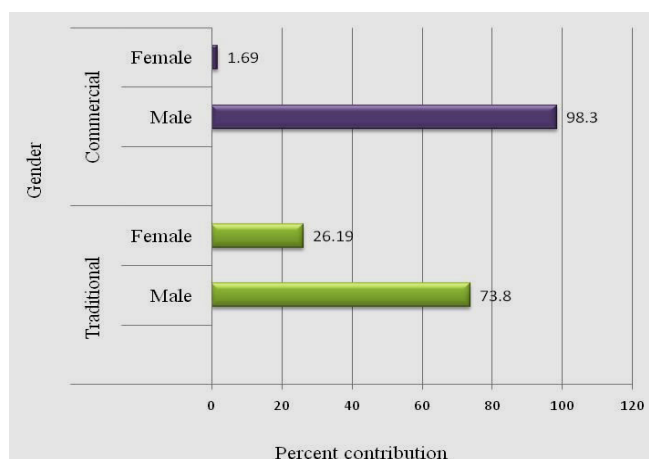


Fig. 5: Contribution of Male and Female Beekeepers in Modern and Traditional Beekeeping in the study area.

while only 16.94% of modern beekeepers were under the poverty line and 83.05% were living above the poverty line (Fig. 6d).

Type of bee reared in study areas:

There are a very small number of beekeepers rearing native honey bee, *Apis cerana indica*. The reason for this, as concluded from the survey, is that *A. cerana indica* is more susceptible to diseases and its honey production is very low in comparison to *Apis mellifera*. Amongst all

the modern beekeepers, 100% are rearing *A. mellifera* and 15% are rearing *A. cerana indica* in combination with *A. mellifera*. For example, a beekeeper having more than 100 bee hives (boxes) of *A. mellifera* keeps only 5-6 hives of the Indian honey bee, *A. cerana indica*. There was no beekeeper rearing only *A. cerana indica* in the entire study area (Fig. 7).

Status of Antibiotic usage in the region:

During the present investigation, it was observed

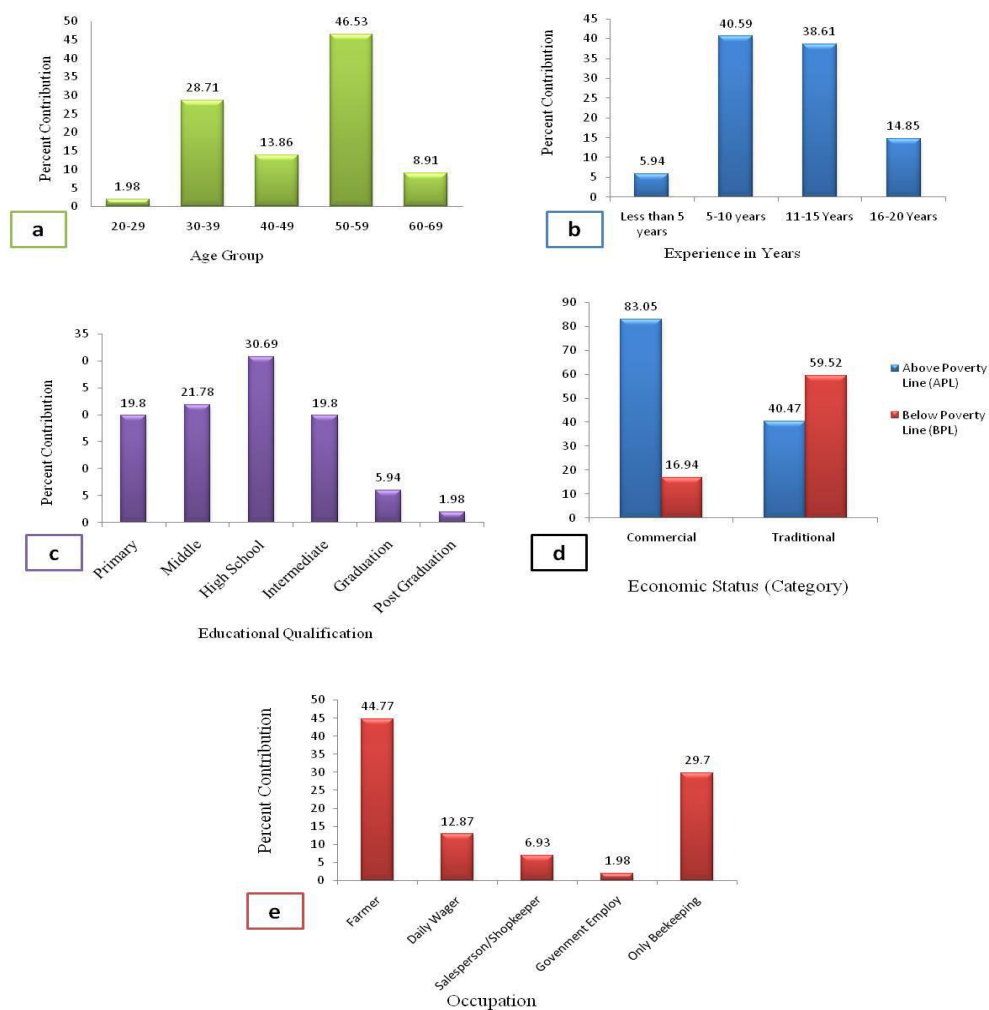


Fig. 6: Socio-economic characteristics of Beekeepers.

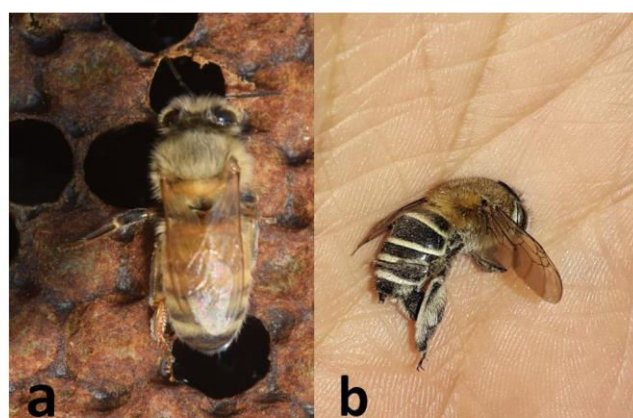


Fig. 7: *Apis* species found in study sites; a: *Apis mellifera*, b: *Apis cerana indica*.

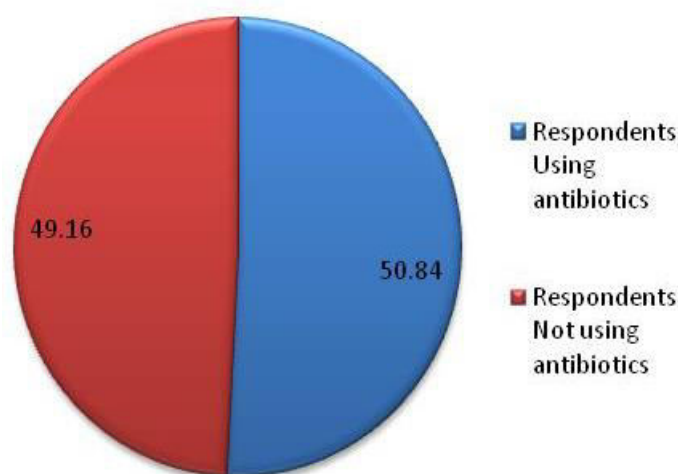


Fig. 8: Status of Antibiotics used in Modern Beekeeping.

that 50.84% of modern beekeepers are using antibiotics in their apiaries to treat bacterial pathogenesis and population growth (Fig. 8). With this observation, residues of various antibiotics can't be ruled out in the honey produced by modern beekeepers. Antibiotics are being applied by the beekeepers in varied manner, commonly used antibiotic is Terramycin and 70% of beekeepers feed antibiotics along with sugar syrup, which is made by combining sugar, Terramycin and B-complex without any standardization.

There are reports that the European Union has complained about the presence of various antibiotics and other related chemicals in exported honey, which is not a very good sign of international business. In the recent past, most of the honey brands failed to pass the NMR test on quality check. The EU's (European Union) food and feed safety regulators identified Indian honey tainted with banned antibiotics like nitrofurans and chloramphenicol. Traces of Tetracycline and streptomycin were also reported in Indian honey. In an exported consignment to the USA, ciprofloxacin was detected in Indian honey. Therefore, it is important to make farmers aware of these chemicals and their undesired applications (Johnson and Jadon, 2010).

Conclusion

The present study revealed various factors affecting the socio-economic condition of marginalized beekeepers therefore it is important to be aware of and support them in improvised beekeeping practices. This can be achieved by reaching out to them and encouraging their participation in skills development programmes. In the current study, "low selling price and increasing production costs" were the most common problems found in modern beekeeping and were shared by all 59 modern beekeepers. Despite its numerous obstacles, beekeeping is a profitable enterprise that helps many rural people in the Nainital district of Uttarakhand to increase and diversify their sources of income. It has been observed that amongst the total number of traditional beekeepers, 59.52% were under the poverty line and 40.47% were above the poverty level, while just 16.94% of modern beekeepers were living in poverty, 83.05% were living above the poverty level. This clearly indicates that the rural population can opt for modern beekeeping as a profession and enhance their living standards.

In the investigation sites, modern beekeeping is mainly practiced by men, and women's representation is less than 1%. It needs to be

addressed as early as possible. It has also been observed that only 15% of modern beekeepers are rearing *A. cerana indica*. This could be a threat to the population of native bee species, *A. cerana indica*, as very few beekeepers are rearing it in combination with *A. mellifera* and that too in a very small number of hives.

If the government and non-government organizations focus on scaling up and encouraging the use of transitional bee hives, they will be able to provide a significant advantage to small- and medium-scale farmers with limited financial and technical resources. The issues related to honey and honey bees can be addressed by providing capital and medicinal support.

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