



STATUS OF MIGRATORY BEEKEEPING WITH *APIS MELLIFERA* L IN THE GANGETIC PLAIN OF WEST BENGAL

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ABSTRACT

Honey bees are humanity's unique gift. In addition to various hive products, human are benefited with the most valuable ecosystem service, i.e. pollination by honey bees. The study has been attempted to explore the overview of migratory beekeeping with *Apis mellifera* L. in the potential Gangetic delta of West Bengal, India through questionnaire survey. Honey flow season lasts from mid/ end of October to mid/end of May, whereas June, July, August and September are beekeeping dearth in this region. Beekeepers used to move their colonies successively between intra- and inter-district locations to harvest honey from trees like eucalyptus, mustard, coriander, black cumin, litchi, sesame, and/or mangroves. Marketing of honey and middleman issue are the major limitations identified. This study presents an illustrative overview of beekeeping status in this area, its potential as well as limitations, and proper initiative to proliferate the enterprise at its outmost.

Key words: Honey bees, beekeeping, *Apis mellifera*, questionnaire survey, honey flow season, dearth period, intra- and inter-district locations, marketing of honey, middleman, floral sources, limitations, West Bengal.

The practice of keeping and managing of honey bees for production of honey and other products, as well as for pollination of crops is known as Beekeeping (Bradbeer, 2009). It is an eco-friendly and non-farm business activity carried out by farmers and landless citizens, means it does not consume cultivated land, needs less investment and offers rapid economic benefits, as well as a non-polluting intensive farming activity (Conrad, 2007). Honey bees are the member of Apidae family, under the superfamily of Apoidea of order Hymenoptera. The well-known genus *Apis* represents the group of honey bees (or true honey bees) and among the four well-known *Apis* spp. (*Apis dorsata* Fab., *Apis mellifera* L., *Apis cerana indica* Fab. and *Apis florea* Fab.) *Apis mellifera* L. or Italian honey bee and *Apis cerana indica* Fab. or Indian honey bee is suitable for commercial beekeeping. Honey bees provide honey which is most useful product of beekeeping having high nutritional value, much often also employed in both human and veterinary medicine (Joseph et al., 2007). Apart from honey the other bee products are bee wax, royal jelly, propolis and bee venom are of great commercial importance. Another important thing is that they play a vital role in pollination of various fruits and crops worldwide. Over 75% of all the crops worldwide, benefited from animal pollination (Goswami and Khan, 2014). Among the various pollinating agents, insects

hold a key position of the total pollination activities, as over 80% is performed by insects and among them bees contribute nearly 80%, and are considered the best pollinators (Robinson and Morse, 1989). The global annual economic value of insect pollination had been estimated to be € 153 billion (Gallai et al., 2009). It is also estimated that the value of pollination is much more (15-20 times) than the total worth of all bee hive products (Malhotra, 2017). In spite of having significant pollination importance, till now in India, the major need of commercial beekeeping is the honey production. West Bengal considered as "Most Potential States" along with Uttar Pradesh, Punjab and Bihar (share more than 50% of total) in terms of honey production in India (Beekeeping Development Committee, 2019). In Bengal, *Apis mellifera* L. beekeeping started during early 90's when the beekeeping industry with the native bee, *Apis cerana indica* Fab. was badly hit because of the outbreak of Thai sacbrood virus (TSV) (Rahman, 2017) and gradually it emerged as a dominant species for commercial beekeeping due to having of superiority (gentle with high honey yielder) over native one. Generally, the migratory mode of beekeeping is practiced with *Apis mellifera* L. where the bee boxes are shifted from one place to another depending on the availability of bee flora. So, it is of prime importance that beekeepers should be facilitated with knowledge

of the floral resources and evolving issues associated with beekeeping to get the maximum benefit. Hence, in order to evaluate the extent of migratory beekeeping in relation to issues faced by beekeepers in the prospective Gangetic delta of West Bengal, India, the current study was conducted by questionnaire survey and interviews with local beekeepers.

MATERIALS AND METHODS

To conduct the present study, Nadia (22°53' to 24°11' N, 88°09' to 88°48' E, 7.31 to 17.06m above mean sea level) and North 24 Parganas (22°11' to 23°1' N, 88°20' to 89°5' E, 7 to 37m above mean sea level) districts of West Bengal, India had been selected. These two districts represent a major portion of Gangetic plain of the state and beekeeping is a common practice in these districts. A survey was conducted during 2019-2020 to collect information regarding the status of migratory beekeeping with *A. mellifera* in the vicinity of Gangetic plains of the state. The data was collected based on the questionnaires prepared (Das et al., 2019). Beekeepers were selected randomly and the selection was used in order to identify the people who were rearing bees commercially and having at least 30 or more bee boxes. The study was designed to address various aspects viz., time period of honey flow and dearth period, potential migratory locations for box setting, problems faced during migration as well as in beekeeping, honey harvesting, selling etc. and the obtained results are discussed in below. Further Rank Based Quotient (RBQ) was calculated following the formula of Sabarathnam (1988) as cited by Roy and Hassan (2013) to rank the problems identified, as given below

$$RBQ = \frac{\sum fi(n+1-i)}{N \times n} \times 100$$

, where, fi = frequency of respondents reporting the problem under ith rank, i = rank of problems, N = total number of respondents and n = total number of problems.

RESULTS AND DISCUSSION

A total of 23 beekeepers were interviewed representing respondents of age-group 33 - 56 years (44.09± 6.37). Among 23 respondents, 13 from Nadia and 10 from North 24 Parganas district respectively. Some of them practiced beekeeping from their family background (father or uncle practiced since), while others have no such connection, they came by profession.

Honey flow and dearth period: Honey flow period

in this region starts from middle or end of October and continues to middle or end of May. Whereas, the remaining months i.e. June, July, August and September regarded as dearth period for beekeeping. Beekeepers used to harvest honey only in honey flow period by migrating boxes from one place to another depending on floral availability. In a study, Sharma et al., (2015) documented that in Jammu and Kashmir, the migratory beekeeping takes place from October - November to May - June where the colonies migrate from the hills to the plains of Haryana, Punjab and Rajasthan. On the contrary, during dearth, beekeepers return to their home and keep the boxes nearby vicinity in suitable places having of proper shed. For dearth management, they used to provide supplementary feeding of sugar syrup (Fig. 1). Supplementary dearth feeding is essential to survive the bee colony and also help the colony to start early brood production prior to honey flow (Pernal and Currie, 2001; Kalev et al., 2002; Neupane and Thapa, 2005; Prakash, et al., 2007). But they won't provide any of pollen supplements; rather they depend on natural sources. Studies revealed that many of natural vegetation of diverse habitat (weeds, trees, plantations etc.) were found as pollen foraging sources in this area (Pal and Karmakar, 2013; Nandi and Karmakar, 2018).



Fig. 1. Sugar syrup feeding during dearth

Floral services for honey collection: Major floral sources for honey collection reported by beekeepers includes Eucalyptus (*Eucalyptus tereticornis*) during mid/end October to mid-January; Mustard (*Brassica* spp.) during mid-November to mid-February; Coriander (*Coriandrum sativum*) during January to February; Black cumin (*Nigella sativa*) during mid-February to March; Litchi (*Litchi chinensis*) during February to March; Sundarban trees namely, Khalsi (*Aegiceras corniculatum*) during end-February to March, Goran (*Ceriops decandra*) during March to April, Keora

(*Sonnertia apetala*) during March to April etc. and Til/ sesame (*Sesamum indicum*) during mid-April to May. In similar type of studies Negi et al., (2020) reported mustard, eucalyptus and apple as major floral sources for honey collection in Himachal Pradesh, Naveen et al., (2021) documented rapeseed and mustard, coriander, berseem, pearl millet, sesame, pigeon pea, eucalyptus, ber, drumstick etc from Chambal region of Madhya Pradesh. All the beekeepers won't collect honey from all the floral sources in a calendar season, choice depending on the availability of flowering sources and their travelling cost. Some also responded that they won't collect honey from all sources, but keep their boxes for colony development for upcoming dearth survival. Along with the increase in honey production, migration also enhances the colony multiplication (Chaturvedi et al., 1969).

Migration of boxes: Beekeepers went out in search of the ideal locations before moving the boxes. The key factors listed regarding their selection of locations are sound blooming of flowers, presence or absence of other beekeepers within the nearby range, availability of resting place for them, occurrence of pesticidal hazards etc. Beekeepers must know the time and duration of blooming season of every major honey plant including the environmental factors affecting those and carrying capacity of the area, which includes the number of colonies that can be put for maximum production (Rajan, 1980). In their study Sharma et al., (2015) stated that production efficiency in migratory beekeeping can be improved with the knowledge of floral resource and appropriate migration schedules for different beekeeping region. Packaging and migration of boxes took place during the period of night (Fig. 2). During migration, the boxes are covered with only net on the top portion for proper ventilation by removing the outer cover. They also admitted that for long distance transport the bees are fed with sugar syrup by sprinkling over the netted cover. As they used to remain in the field during the entire flowering time to carry out various operations like colony maintenance, honey harvesting etc., they built a temporary tent with bamboo and tripole (cloth type) for their stay in the target locations (Fig. 3).

Location for migration beekeeping: Beekeepers' revealed that migration not only limited within the district, but they also used travel inter-districts locations for collection. District wise major locations for migratory beekeeping corresponding with floral sources are listed in Table 1. Similarly, many workers like Singh et al., (1998) suggested certain migratory



Fig. 2. Loading of bee boxes for migration



Fig. 3. Making of temporary tent with tripole and bamboo for staying in field

routes for honey production and colony multiplication in Bihar and Gatoria et al., (2001) gave a brief account of examples of some routes followed by beekeepers practising migratory beekeeping in different parts of the country. In other studies, Naveen et al. (2021) documented the migratory route for beekeeping in Chambal region of Madhya Pradesh and Negi et al. (2020) reported the same from Himachal Pradesh.

Constraints faced: In this study, the respondent beekeepers were also enlisted the major constraints that they faced. The identification and analysis of constraints would help to understand the obstacles in honey production as well as the prevailing market scenario. In this perspective, seven major problems were identified and categorised in rank based on the respondents' information, which are illustrated herein.

Excessive use of agrochemicals: Many of beekeepers observed large number of dead or dying bees at the entrances of their bee hives, which may

Table 1. Locations for migratory beekeeping

Flowering plants	District	Locations
Eucalyptus	Bankura	➤ Bishnupur
		➤ Taldangra
		➤ Barjora
		➤ Nakaijuri
		➤ Layekbandh
		➤ Piardoba
	Jhargram	➤ Lodhasuli
		➤ Lalgah
	Paschim Medinipur	➤ Salboni
		➤ Goaltore
		➤ Ramgarh
Mustard	Nadia	➤ Chakdah
		➤ Plassey
		➤ Debgam
		➤ Bethuadahari
		➤ Berhampore
	Murshidabad	➤ Sargachhi
		➤ Beldanga
		➤ Hariharpara
		➤ Shonghat
	Malda	➤ Adadanga
		➤ Parbatidanga
		➤ Raigang
	Uttar Dinajpur	➤ Plassey
		➤ Nabadwip
		➤ Chakdah
Coriander and Black cumin	Nadia	➤ Barnia
		➤ Chanderghat
		➤ Sargachhi
		➤ Hariharpara
		➤ Tajpur
	Murshidabad	➤ Lalnagar
		➤ Nabadwip
		➤ Dhubulia
		➤ Moragacha
		➤ Shantipur
Litchi	Murshidabad	➤ Berhampore
		➤ Jangipur
		➤ Kaliachak
	Malda	➤ Patharpratima
		➤ Kumirmari
		➤ Jharkhali
		➤ Satjalia
Sundarban Trees • Khalsi • Goran • Keora	South 24 Parganas	➤ Arambag
		➤ Jayrambati
		➤ Kamarpukur
		➤ Tarakeswar
		➤ Jamalpur
Sesame/ Til	Purba Bardhaman	➤ Chakdighi
		➤ Surekalna
		➤ Chandrakona
	Paschim Medinipur	➤ Garhbeta
		➤ Keshpur
		➤ Dhadika
		➤ Uttarbil

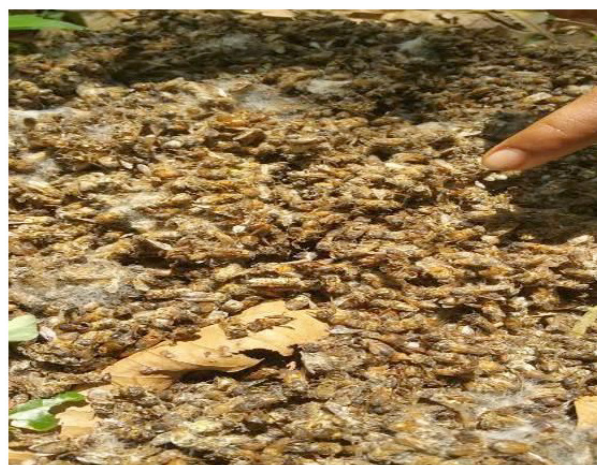


Fig. 4. Heap of dead bees indicating pesticide poisoning

indicate the pesticide poisoning (Fig. 4). According to them, pesticide poisoning frequently observed in mustard blooming compared to others. Thus, many of beekeepers sometimes avoid shifting their colonies in the heavy used pesticide areas. Many workers from different parts of the country reported in their study that problem of pesticide poisoning was faced by majority of the respondents, resulted in killing of honey bees, which caused great loss (Shinde and Phadke, 1995; Kaur, 1998; Kumar, 2000).

Harassment during transport: Majority of beekeepers optioned for vehicle hiring for migration. But excessive vehicle fares sometimes limit their desired place of shifting. Even many of them strongly argued the problems from night traffic guards during transport. In a Punjab based survey, 37.5% of beekeepers responded about these problems during night migration (Kaur, 1998). Many other authors also highlight about the high transport costs in migratory beekeeping (Sharma et al., 2015).

Harassment from land owner and local people and/or governance: Generally the beekeepers set their boxes in the field or orchard of others, very rarely in their own. For this, they have to take permission from the land owner prior to box setting. In this regard, they claimed that, sometimes they have to pay charges to the landlords for box setting, even they have to give sufficient amount of honey with free of cost. Very often, the demand is so high that the poor beekeepers can't effort and they have to return. Apart from landlords, in some cases the local people and/or governance (like club or committee), also forced them to pay. Few of respondents argued that, sometimes extreme level of cruelty had been observed, where locals destroyed the

combs and/ or boxes in order to steal honey or due to having preconception that bees destroy the flowers. Baidya and Purkait, (2019) reported in their field survey that without giving money to the local forest protection committees, beekeepers cannot be allowed to keep their bee colonies in the jungle of Eucalyptus of West Midnapure and Bankura districts of West Bengal. In another study, Bansal et al. (2013) documented that a remarkable number of respondents faced problem regarding theft of bee boxes or colonies.

Middlemen problem: Beekeepers need economic support for supplementary feeding in dearth, migration of boxes, colony maintenances etc. Respondents admitted that due to the lack of proper bank credit facility, they are forced to borrow money from a group of persons known as ‘Mahajons’. These so-called ‘Mahajons’ work as middlemen in honey trade, and beekeepers are forced to sell their honey to them due to debt. Many times, the ‘Mahajons’ fix the price of honey, leaving beekeepers with no choice but to accept it.

Diseases and insect pest problem: Regarding disease infestation, many of beekeepers agreed that, they can’t detect diseases properly many times; as a result, it remains untreated and becomes more serious. Among the diseases, beekeepers claimed that the chalkbrood disease appears more often and sometimes severely affect the colonies (Fig. 5). Apart from this, presence of foul brood and sac brood type of disease appearance also encountered by them, but not in severe form. Among the insect-pests, infestation of varroa mite is of major problem and all agreed with this. Infestation of another ectoparasite mite *Tropilaelaps* also occurred, but not causes any serious threat. The wax moth problem is more severe in empty or old combs rather than healthy ones (Fig. 6). They also



Fig. 5. Symptoms indicating chalkbrood incidence



Fig. 6. Symptoms indicating wax moth infestation

responded about the frequent infestation of ants and wasps irrespective of seasons and locations, but in severe during the dearth or lean period which causes absconding. They also encountered that lacking of expert personnel makes the situation sometimes more worsen. Many workers noted infestation of pests and diseases in bee colonies as one of the major constraint in beekeeping in their study across the country (Bansal et al., 2013; Dalio, 2015; Kumar and Kundal, 2016; Brar et al., 2018; Arya et al., 2021).

Marketing problem: Marketing of honey is a major constraint and all the respondents raised their hands. No specific market and non-fixation of prices impede the marketing of honey for them. In majority, they depend on middlemen (Mahajons) for sale of their produce and they used to sale in wholesale price fixed by the middlemen themselves, which is much more less than the retail price. They argued that this makes the beekeepers dishonest, as the middlemen procure honey without proper quality judge, and give more or less same price to the individual beekeepers. Thus many of beekeepers avoid the quality assurance and even sometimes adulterate the produce. Altogether, the bulk honey collected from different producers is often of poor quality and fails to meet the national and international standards, ultimately ruin the export market. Apart from this, very few of respondents confirmed about retail sell of their marginal produce after bottling and labelling. They also raised the issue of lacking awareness among the people which limit their retail marketing, as many of people think beekeepers’ honey are adulterate and thus avoid to buy, rather they prefer market available branded product. Evaluative studies conducted by Kumar and Singh (2002) reported that 65-70% of beekeepers have highlighted the problem of honey marketing and low price for bee products as one of the

major constraints in beekeeping in Punjab state. Kumar et al., (2020) mentioned in a study that low selling price of honey was one of the major economic constraints for non-adoption of improved beekeeping practices in Jammu Province. Similarly, studies conducted by researchers also reported that no specific market and without any brand name regarding sale of honey, affect marketing for beekeepers (Sharma, 1989; Gatoria et al., 2003). In a study Arya et al., (2021) also reported that unfixed price of honey was one of the major problem of honey marketing for beekeepers of Nainital district of Uttarakhand and beekeepers mostly sold their honey directly to the processor.

Reduction in crop diversity: The gradual increase of depleting floral resources threatens the beekeeping potentials in the country as well as worldwide. The cutting off nectar and pollen producing tree species in many areas makes it difficult to maintain bee colonies (Kerealem, 2005). The respondent beekeepers also agreed about this. They confessed that many of farmers are not interested in growing crops particularly coriander and black cumin, thus resulting in deficit of honey production. They also raised the fact of deforestation, particularly the eucalyptus forests of western districts like Paschim Medinipur, Bankura, Jhargam etc. Kaur, (1998) revealed in study that many of beekeepers face colony migration constraints due to lack of bee flora in Punjab province.

Furthermore, problems identified by the respondent beekeepers are categorised in ranks based on RBQ (Rank Based Quotient) analysis and presented in the Table 2. Among the seven major problems, marketing of honey (RBQ value 91.43) was considered as the principle cue behind the limitation of their beekeeping practice. No specific market and non-fixation of

prices make the marketing window more worsen for them, thus leading the major constraint. The issue of middlemen (Mahajons), that regulate the honey trading secured second rank based on RBQ value (84.29), while use of agrochemicals firmed next position (67.14). Furthermore, the sequential rankings of constraints are diseases and insect pests' infestation (55.71), harassment from land owner and local people and/or governance (54.29), harassment during transport (24.29) and reduction in crop diversity (22.86). This finding resonates with findings from Khanra and Mukherjee (2018), where overall marketing of honey and honey products reported as major constraint with the highest RBQ value (69.79) in a Jharkhand based study. Simultaneously, other constraints ranked sequentially in their study were disease infestation in colonies (68.09), land availability for keeping the bee boxes (61.70), chemical treatment (53.19) and transportation for forward and backward linkages (48.09). Similarly, in a study, Bhattacharyya et al. (2017) attempted to find out the general bee awareness of local people in West Midnapore (Paschim Medinipur) district of West Bengal, India revealed that, "pesticide application" and "pesticide application time" were the major and the second major problems respectively (RBQ value 80.625 & 75.625) among the eight problems identified by the informants as the principle cause behind the perceived decline in honeybee populations. Baidya and Purkait (2019) revealed that 42.77% of respondent beekeepers faced problem regarding box setting as they are not allowed to keep their bee-boxes in the farmers or landlords fields at any cost, while 21.05% respondents are allowed to keep their bee-boxes by paying some money and/ or honey in a survey based study conducted in South Dinajpur and Malda, northern districts of West Bengal, India. Simultaneously, 19.74% beekeepers reported to face problems of uncontrolled usages of pesticides followed by harassment by local club or authority near the field (6.58%), harassment by traffic police during transportation from one field to another (5.26%) and reduction of bee pasturages (2.63%). In their study, Nagma et al., (2021) enlisted that 100% respondents mentioned low selling price and increasing production cost as major problems in Uttarakhand based study, while 86.44% and 72.88% optioned infestation of mite pests and wax moth as subsequent constraints.

Honey production and honey harvesting: Beekeepers confirmed that the honey production and honey harvesting rate depend upon the flowering situation, atmospheric condition and also on colony

Table 2. Ranking of problems following RBQ analysis

Sl. No.	Problems identified by informants	RBQ values	Ranks based on RBQ values
1.	Excessive use of agrochemicals	67.14	III
2.	Harassment during transport	24.29	VI
3.	Harassment from land owner and local people and/or governance	54.29	V
4.	Middlemen problem	84.29	II
5.	Diseases and insect pest problem	55.71	IV
6.	Marketing problem	91.43	I
7.	Reduction in crop diversity	22.86	VII

strength. Honey yield computed as average honey production per colony (in kg/box). Here also the honey production from Sundarban plants computed together, as they argued due to having of overlapping flowering window. The crop wise average honey production, number of harvestings and harvesting interval are presented in the Table 3.

Honey price (selling price): They used to sell their honey to the ‘Mahajons’ in bulk at wholesale, the main route of honey selling prevailing in this area. Here, the beekeepers have no right to fix the price of honey, rather solely decided by the ‘Mahajons’. Even they unaware of the exact price when they are going to sell, generally price decided after staking of all the honey from all the beekeepers. Discrimination in price fixing also observed, where those who close with ‘Mahajons’ get sometimes higher price than others. Retail marketing is also registered by some of respondents, though is negligible. For retail, they used to sell their produce after bottling and labelling by own effort, two types of bottle weighing 250 and 500 gm were done. Where in

wholesale they get separate price for separate honey type, but in retail, selling is done irrespective of honey type, though major honey for retail sell are Eucalyptus, Litchi and Sundarban. Average honey price (both wholesale and retail) for the two successive years (2019 & 2020) are presented in Table 4.

Marketing of other products than honey:

Informants revealed that expect honey, none other bee products are being marketed. But the honey bees (bee colony) are being sold frequently and the majority agreed with this. Generally bees are sold in terms of number of frames containing adult bees, rearing brood with good and prolific queen. Single colony having 2 to 6 frames (more commonly 4 frames) is being sold. Respondents registered two distinctive period of bee selling, firstly at the end of honey flow season (May to June/July) and secondly with the onset of honey flow season (September to October/November) with an average rate of 80-120/- and 200-250/- per frame respectively (average data of 2019 & 2020). They answered that beekeepers from within state as well as from outside of the state came for buying the bees (colonies).

Global decline of pollinators put serious threat on biodiversity sustainability and human food security. Hence encouraging in the beekeeping practice can illuminate a lit bit of hope in the crop pollination service. The varied crop diversity from south to north flourishes the beekeeping practice as one of most potential agro-based enterprise of the state. Even the honey from Sundarban Biosphere Reserve has its own trademark in national and international level. But the faulty system and lack of people awareness make the situation more difficult. From land owner to local authority or club or even night traffic gourd harass the beekeepers starting from migration to box setting. Simultaneously, due to lack of proper credit facility, they have to depend on the third party or middlemen who ultimately regulate the whole trading system

Table 3. Crop wise honey production, harvesting and harvesting interval

Flowering plant (Honey type)	Average Honey production (kg/box)	Average Number of harvesting	Harvesting interval (in days)
Eucalyptus	15-17	3-5	15 days
Mustard	15-18	4-5	8-10 days
Coriander	2-3	1-2	15 days
Black Cumin	2-3	1-2	15 days
Litchi	4-6	2-3	8-10 days
Sundarban plants	40-45 (all together) in deep forest area	5-6	10-12 days
• Khalsi	10-12 (all together) in locality area	2-3	
• Goran			
• Keora			
Sesame/Til	5-6	2-3	12-15 days

Table 4. Honey price at wholesale and retail rate

Sl. No.	Wholesale price (Rs./kg)			Retail price (Rs./kg)		
	Type of honey	2019	2020	Type of honey	2019	2020
1	Eucalyptus	70-80/-	80-85/-	(major honeys for retail sell are Eucalyptus, Litchi and Sundarban)	300-350/-	300-350/-
2	Mustard	60-65/-	70-80/-			
3	Coriander & Black Cumin	70-75/-	70-80/-			
4	Litchi	70-80/-	80-90/-			
5	Sundarban	80-90/-	110-120/-			
6	Til	50-55/-	50-60/-			

of honey. Situation becomes more worsen when the beekeepers have no right to sell their produce at their own price rate and the price decided by the middlemen only. All these hindrances lowering beekeepers interest in this profession, making them to quit. Thus, a comprehensive approach needs to be taken for sustaining this enterprise as well as for continuing ecosystem service. Few of measures may be adopted to overcome the associated problems:

- Awareness programme have to be conducted to popularise pollination service or importance of honey bees in the ecosystem among the general people especially among the farmers and farm owners.
- Government intervention required to take action immediately whenever the beekeepers face any obstruction during box migration to keep their colonies in the fields.
- Credit feasibility to the beekeepers should be incorporated in policy, so that like other agricultural activities beekeepers can also access credit for their enterprise.
- Encouraging beekeepers to collect other hive products to enhance their economic benefit, thus training with modern technologies should be arranged.
- Government as well as non-government initiative should be required for developing marketing facility of the produce. For this, cooperative societies, beekeepers club (like farmers club) can be constructed.
- Policy should be adopted to introduce MSP (Minimum Support Price) in honey trading like other agricultural produce to prevent deception from the middlemen.
- Initiative should be taken to meet the quality assurance of the produce, thus need to develop quality control laboratories across the state.

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AUTHOR CONTRIBUTION STATEMENT

R D and S J conceived and designed the study. R D, A L and G K collected the experimental data. R D wrote the original manuscript. All authors read and approved the manuscript.

CONFLICT OF INTEREST

All the authors declare that they have no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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