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Seminar Report

On

Sweet Revolution in India

Submitted to

Seminar Teachers

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Introduction

India has witnessed many revolutions in the arena of agriculture such as the Green, White, Blue and Yellow revolution that were related to food grains, milk, fish and edible oilseed respectively. Under the Sweet revolution, the focus is on the beekeeping through scientific methods and production of quality honey and other beehive products. The focus is to increase the income of India's small and marginal farmers. India being a country that is rich in floral resource and geographical advantage has a high potential to grow in this sector. Sweet Revolution in India also known as Honey Mission or Mithi Kranti is launched to increase the promotion of the development of scientific beekeeping and production of honey and related products to double the farmers' income.

Beekeeping is an agro-based activity which is being undertaken by farmers/landless labors as an integrated farming practice. Beekeeping supplements income & employment generation and nutritional intake of rural population. Though the honeybees are best known for the honey they produce, their economic role in nature is to pollinate hundreds and thousands of flowering plants and assure setting of seed or fruit. Honeybees have been offering services to the society through ensured pollination in cross-pollinated crops as well as by providing honey and a variety of beehive products. Honey Bees have vital role in sustaining plants bio-diversity resulting in environmental stability. Beekeeping is one of the thrust areas and flagship programmes of Ministry of Agriculture & Farmers Welfare.

World Bee Day 2022

Beekeeping is a widespread and global activity, with millions of beekeepers depending on bees for their livelihoods and well-being. Together with wild pollinators, bees play a major role in maintaining biodiversity, ensuring the survival and reproduction of many plants, supporting forest regeneration, promoting sustainability and adaptation to climate change, improving the quantity and quality of agricultural productions.

This year FAO will celebrate World Bee Day through a virtual event, under the theme **'Bee Engaged: Celebrating the diversity of bees and beekeeping systems'.** The event featuring bee and pollinator experts and practitioners from across the world will open with a video message by FAO Director-General QU Dongyu. The event will raise awareness on the importance of the wide variety of bees and sustainable beekeeping systems, the threats and challenges they face and their contribution to livelihoods and food systems.

Why a World Bee Day?

By observing World Bee Day each year, we can raise awareness on the essential role bees and other pollinators play in keeping people and the planet healthy, and on the many challenges they face today. We have been celebrating this day since 2018, thanks to the efforts of the Government of Slovenia with the support of Apimondia that led the UN General Assembly to declare 20 May as World Bee Day. The date for this observance was chosen as it was the day Anton Janša, a pioneer of modern apiculture, was born. Janša came from a family of beekeepers in Slovenia, where beekeeping is an important agricultural activity with a long-standing tradition.

Today bees, pollinators, and many other insects are declining in abundance. This day provides an opportunity for all of us – whether we work for governments, organizations or civil society or are concerned citizens – to promote actions that will protect and enhance pollinators and their habitats, improve their abundance and diversity, and support the sustainable development of beekeeping.

Global Scenario

The global demand for honey continuously increased since the year 2010. On an average 19 thousand tonnes per year. In the year 2018-19, China ranks the first position in honey production i.e., 4, 46,900 metric tonnes. Followed by other countries Turkey, Argentina, Iran, Ukraine, USA, India, Russia, and Mexico. Whereas, Ethiopia placed last in honey production with 50,000 metric tonnes. India is in eight places with 67,442 metric tonnes.

The details of the Export of honey by different countries of world presented in Table, 1, China stands first in the export of honey to different countries of world which was 1, 40,726 tonnes value of 255.46 USD million which is almost 30 percent of total export and India stands 8 th position which export 50,173.31 tonnes and value 88.65 USD million and

The details of the import of honey by different countries of world presented in Table,7,USA stands first in import of honey from various countries which was 1,75,866 tonnes and value of 568.770 USD million. This is almost 42 percent of total import, followed by Germany and Japan 80,596 and 42,821 tonnes respectively.

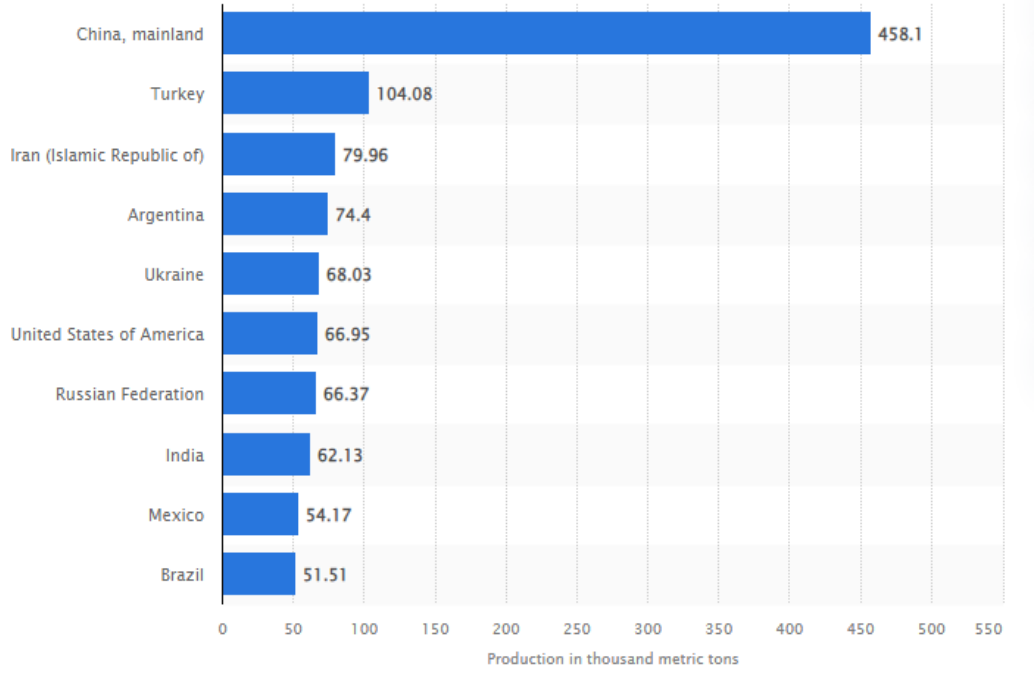


Figure 1: Largest Honey producing countries in the world during 2020

Source: statista.com

Table 1: Export of honey by different countries of world

Exporting country	2018-19		2019-20	
	Qty (tonnes)	Value (USD million)	Qty (tonnes)	Value (USD million)
China	1,31,361.66	250.75	1,40,726.06	255.46
New Zealand	23,576.19	286.33	18,951.59	211.93
Argentina	61,323.20	180.21	67,226.02	177.94
Germany	25,134.34	136.49	24,142.54	134.3
Ukraine	61,900.59	140.96	50,173.31	116.08
Mexico	30,070.40	100.41	33,500.28	115.67
Brazil	37,072.93	128.93	30,052.54	110.04
India	34,857.04	107.36	59,536.75	88.65
Hungary	25,726.82	94.42	24,269.38	96.38
Spain	22,907.52	105.19	22,493.78	93.49

Source: FAOSTAT

Table 2: Import of Honey by different countries in the world

Importing Country	2018-19		2019-20	
	Qty (000' tonnes)	Value (USD million)	Qty (000' tonnes)	Value (USD million)
U S A	175.866	568.770	197.867	497.710
Germany	80.596	281.940	82.350	296.510
Japan	42.821	143.010	44.521	145.370
France	35.493	130.490	37.678	129.300
U K	46.092	130.890	50.597	128.290
Italy	23.414	81.250	27.833	100.310
Saudi Arabia	16.417	67.550	16.970	76.980

Belgium	25.931	79.650	24.858	72.860
Spain	31.871	76.790	27.942	67.980
Poland	25.620	53.840	25.712	62.420

Source: FAOSTAT

INDIAN SCENARIO

The details of the honey production in India presented in Table, 3**,** the honey production in the India was estimated to be 116.9 MT in 2019-20, registering a CAGR of 4.24 % during 2005-2020. In India Uttar Pradesh stands first in production with an amount of 22 MT which is almost 19% total production of country, Uttar Pradesh West Bengal Punjab together accounted for 50% of total production.

Table 3: Honey production in India from 2004-05 to 2019-20

Year	Production (In ' 000 MT)	Percentage Change (%)
2004-2005	10	-
2005-2006	52	420.00
2006-2007	51	-1.92
2007-2008	65	27.45
2008-2009	65	0.00
2009-2010	65	0.00
2010-2011	112	72.31
2011-2012	84.1	-24.91
2012-2013	91.7	9.04
2013-2014	76.2	-16.90
2014-2015	80.5	5.64
2015-2016	88	9.32
2016-2017	95	7.95
2017-2018	105	10.53
2018-2019	113.50	8.10

2019-2020*	116.9	3.00
CAGR (In percent)	4.24	

Source: NBB, MoA&FW

Table 4: Export of natural honey from INDIA (2019-20)

Sl. No	COUNTRY	QTY (in MT)	VALUE (in LakhRs)
1	U S A	49237.34	47572.81
2	Saudi Arab	2018.21	3353.56
3	U A E	1774.31	2592.16
4	Canada	787.67	1224.28
5	Qatar	598.81	1067.40
6	Morocco	805.40	950.63
7	Nepal	689.99	800.73
8	Bangladesh	531.11	700.68
9	Libya	347.40	497.70
10	Kuwait	272.39	496.93

Source: DGCIS Annual Expo

Table 5: Top 10 Honey Producing States in India

States	2018-19 (in '000MT)
Uttar Pradesh	22
West Bengal	18.5
Punjab	16.5

Bihar	15
Rajasthan	10.5
Himachal Pradesh	6
Haryana	4.8
Uttarakhand	2.8
Madhya Pradesh	2.6
Karnataka	2.2

Source: theindianblog.in

Karnataka Scenario

Before 1985 Karnataka dominated in honey production in India, producing 7,50,000 kg of honey and about 6,000 kg of bees wax. Thereafter the bee beekeeping industry suffered a collapse due to infection by "Thai sac brood" virus which made most people shy away from beekeeping. With the unplanned urbanization and rampant cutting of trees and also reduction in agriculture in rural areas, the production of honey and beehives has decreased in the recent past, honey collection has been severely dented as the use of pesticides these days is killing the bees, As much as 30 to 50 per cent of bees are dying due to mobile tower radiation and another 80 per cent because of the use of pesticides

Thedetails of the honey production in Karnataka presented in Table,7 The honey production in the Karnataka was estimated to be 2.2 MT in 2019-20, registering a CAGR of 7.86 % during 2005-2020. From the table we can see that from 2010-11 to 2012-13 honey production in the state decreased drastically. Whereas it is constant from 2013-14 to 2016-17 but, a slight increase in production was observed during 2018-19.

Table 6: Honey production in Karnataka (2005-2020)

Year	Production (In ' 000 MT)	Percentage Change (%)
2005	0.9	-
2006	1.72	91.11
2007	2.60	51.16

2008	4.20	61.54
2009	2.01	-52.14
2010	1.89	-5.97
2011	6.37	237.04
2012	4.67	-26.69
2013	5.09	8.99
2014	2.00	-60.71
2015	1.95	-2.50
2016	2.00	2.56
2017	2.00	0.00
2018	2.00	0.00
2019	2.80	40.00
2020*	2.20	-21.43
CAGR (In percent)	2.86	

Source: Karnataka State Department of Horticulture

From the table we can see that from 2010-11 to 2012-13 honey production in the state decreased drastically. Whereas it is constant from 2013-14 to 2016-17 but, a slight increase in production was observed during 2018-19.

Bee keeping or Apiculture

The word ‘apiculture’ comes from the Latin word ‘apis’ meaning bee. So, apiculture or beekeeping is the care and management of honey bees for the production of honey and wax. In this method, bees are bred commercially in apiaries, an area where a lot of beehives can be placed. Usually, apiaries are set up in areas where there are sufficient bee pastures – such as areas that have flowering plants. It is an art and skill of maintaining the bees in modem movable frames for hobby or fascination and for pollination services. Beekeeping has an edge over the other ago-based subsidiary enterprises as it involves low initial expenditure and does not need an elaborate infrastructure. Honey is the only food that includes all the substances necessary to sustain life, including enzymes, vitamins, minerals, and water. Today, apiculture plays a valuable part in rural livelihoods worldwide. Honeybees are special gift to mankind because beekeeping can be done for both their pollination services and their cherished products such as honey, bee wax, Propolis, bee venom, etc. These products have their widespread use in different small and large scale industries in India.

Beekeeping is an important activity that supplements and compliments agriculture and provides nutritional and economic security to rural communities worldwide. Even landless people can take up beekeeping as a profession. Beekeeping helps in generating additional income and is an integral part of integrated farming system. In addition to the revenue obtained from honey and other bee products, pollination activities of honey bees are important which contribute to the increased crop yield to an extent of 20-80 per cent in most of the cultivated crops through cross pollination. Beekeeping aids in increased agricultural productivity, has role in employment generation, rural development and nutritional security and is crucial in maintaining biodiversity and provides environmental sustainability. Thus beekeeping provides multiple advantages.

India is a country which inhabits four major honey bee species; two domesticated species, viz. *Apiscerana* (Indian or Asian honey bee) and *A. mellifera* (European honey bee) and two wild species, viz. *A. dorsata* (rock honey bee) and *A. florea* (dwarf honey bee). Beekeepers in many of the Indian States including Tamil Nadu, Kerala, Karnataka, Andhra Pradesh, Telengana, Odisha and North Eastern States, cultivate *A. cerana,* Indian honey bee and are dependent on it for their livelihood. The honey obtained from *A. cerana* constitutes hardly 5 to 10% of total honey produced in India.

Among the four species, *A. mellifera* is an introduced species to India. *A. melliferaligustica*known as the Italian bee was introduced into India in the 20th century when the beekeeping industry with the native bee, *A. cerana* was badly hit because of the outbreak of tracheal mite, *Acarapiswoodi* and Thai sacbrood virus during 1965-1986. Presently beekeeping with *A. mellifera* is more in North India because of the rich flora viz., Mustard, Sunflower, Eucalyptus, Safflower, etc. They produce 50 to 60 kg of honey per colony per year. About 70-75% of the honey produced in India is from *A. mellifera*. Placing a few hives in the vicinity of the cropped area helps in large number of honey bees working in a society and accomplishing crop pollination sufficient to produce seeds and fruits that man consumes in his daily life.

A.dorsata, rock bee contributes to approximately 20% of the total honey produced in India, even though there is no clear official estimate available. The quantity of honey that is taken from little honey bees *A. florea* is negligible. However all the honey bee species are important pollinators and need to be conserved.

Honey has a long history of human consumption, and is most commonly consumed in its unprocessed state (i.e. liquid, crystallized or in the comb). It is taken as medicine, eaten as food, or incorporated as an additive in a variety of food and beverages. India has been known as 'land of honey.' Since centuries, honey is used to treat a variety of ailments through a wide range of applications. In India beekeeping has been mainly forest based. Thus, the raw material for production of honey is available free from nature. Bee hives neither demand additional land space nor do they compete with agriculture or animal husbandry for any input. The beekeeper needs only to spare a few hours in a week to look after his bee colonies. Beekeeping is therefore ideally suited as a part-time occupation. Beekeeping constitutes a resource of sustainable income generation to the rural and tribal farmers. It provides them valuable nutrition in the form of honey, protein rich pollen and brood. Bee products also constitute important ingredients of folk and traditional medicine. Honey has so far been consumed mainly as a medicine and for religious purposes. A small quantity has been used in kitchen as an ingredient of pickles, jams and preserves. With the increasing production in recent years, there is an increasing trend to use honey in food. This is obviously the case with the affluent segments of the population. Forest honey is used in pharmaceutical, food, confectionery, bakery and cosmetic industries.

Table1: Honey bee species in India

Sl. No	Common name	Scientific name	Honey yeild per year per hive (kg)
1.	Indian bee	*Apis cerena*	8-10
2.	European bee	*Apis mellifera*	25-30
3.	Rock bee	*Apis dorsata*	30-35
4.	Little bee	*Apis florae*	<1
5.	Himalayan bee	*Apis laboriosa*	40-45

Source: AICRP on Honey Bee, 2018

From the above table when see that there are mainly five species in India i.e *Apiscerena* with an yield of 8 -10 kg per year per hive, followed by *Apismellifera* with an yield of 25-30 kg, and then *Apisdorsata* with yield of 30-35 kg, *Apis flora*e less than one kg of yield and finally *Apisloborisa* producing highest honey yield i.e 40- 45kgs.

IMPORTANCE OF BEEKEEPING IN AGRICULTURE

As we all know that bees play a vital role in agriculture. They pollinate crops, increase yield, and give rise to a lucrative honey industry. Over one third of food we eat relies on pollination by bees.

Table 2: Effect of Bee pollination on Yield of Crops

Crop	Increase in fruit set (%)	Increase in frui t weight (%)	Increase in fruit size (length diameter) (%)
Apple	10	33	15.10
Peach	22	44	29.23
Plum	13	39	11.14
Citrus	24	35	9.35 Premature fruit drop decreased by 46 %,increased juice by 68% and sugar contents in juice by 39%
Straw berry	112	48	Misshapen fruit decreased by 50%

Source: FAO beekeeping, 2019

The above table represents that effect of bee pollination on yield of crops.As we can see from the table that in all most all crops,there is an increase in percentage of fruit set,fruit weight and also fruit size due to pollination by bees. For example; In case of citrus fruit set increased by 24 per cent,fruit weight by 35 per cent and fruit size by 9.35 per cent and also there is a decrease in premature fruit drop by 46 per cent, increase in juice content by 68 per cent and sugar content by 39 per cent.

Honey bees as Pollinators

Through pollination honey bees enhances crop yield by 11 to 79 per cent and it also accounts for 80 per cent of pollination service done by insects and also honey bees must visit between 100 to 1500 flowers in order to fill their stomachs.

Why pollinators are important?

Pollination is the transfer of pollen, containing the male gamete of a plant, from the anthers where it is produced to the receptive stigma, the female part of the same or another plant of the same species. This process results in fertilization, and sexual reproduction of the plant to produce seeds. Most ancient plants were pollinated by wind. Grasses, conifers, and

many deciduous trees are still wind-pollinated. Most flowering plants, however, utilize living organisms to aid in this transfer. Birds and bats can pollinate a limited number of plants, but the vast majority of plants are pollinated by insects. Some wasps, flies, beetles, ants, butterflies and moths pollinate various flowers, but bees are responsible for the vast majority of pollination.

Honey bees perform more than 80 percent of pollination of many of our cultivated crops.

More than 100 important crops are pollinated by honey bees. This includes many of the fruits and vegetables that we eat, but also a number of important crops such as nuts, herbs, spices oilseed crops, forage for dairy and beef cattle, as well as medicinal and numerous ornamental plants. Even plants that are not grown for their fruits require pollination in order to propagate them by seed. Honey bees add an estimated $15 billion to the U.S. economy each year in increased crop yields**.**

Many species of pollinators have been in decline recently. Why?

European honey bees were brought to North America by colonists in the 1600s. As many of these bees escaped into the wild, the feral populations began to displace some of the estimated 4000 native bee species. These feral honey bees provided pollination for the growing agricultural industry across the county through the 20th century. In the 1990s two species of parasitic mites were accidentally introduced from Asia. The tracheal mite and varroa mite caused severe declines in honey bee populations within a few years. These parasitic mites were controlled on managed bees largely with chemical pesticides, substantially increasing the costs of large beekeeping operations.

During the same time, populations of feral honey bees dramatically declined.

Fewer natural pollinators, combined with increased agricultural production have resulted in an increased need for contracted pollination services. Honey bee hives are placed on trucks each spring and moved from their winter homes to areas of agricultural production in order to provide adequate numbers of pollinators when crops are in bloom. This movement of honey bee hives is thought to be associated with the spread of honey bee diseases and other hive pests.

Table 3: Per cent increase in crop yield due to bee pollination

Sl. No.	Crops	Per cent increase in crop yield
1	Sunflower	45-50
2	Mustard	45-50
3	Cotton	25-50
4	Tomato	25-30
5	**Pumpkin**	**100**
6	Cucumber	25-30
7	Watermelon	80-90
8	Grapes	25-30
9	Lime species	50-55
10	Apple	50-60
11	Clove	50-60
12	**Cardamom**	**100**

Source: AICRP on Honey Bees and Pollinators,2018

Here, is the table representing percent increase in crop yield due to bee pollination. Some of the crops are sunflower, mustard, cotton and tomato etc. In case of pumpkin and cardamom 100 per cent increase in crop yield due to bee pollination.

Table 4: Value of Honey bee pollination

Country	Value of honey bee pollination (in US$)
USA	14.6 billion
Canada	1.2 billion
Europe	3.0 billion
New Zealand	2.3 billion
Australia	5.2 billion
India	3.2 billion

Source: FAOSTAT, 2020

From the above table we see that USA ranks first in valve of honey bee pollination i.e 14.6 billion, followed by other countries like Canada, Europe, New Zealand and Australia where as India stands sixths position with 3.2 billion.

BEE PRODUCTS

- Honey
- Royal jelly

- Bee wax
- Propolis
- Bee venom
- Bee Pollen

Honey

Honey is commonly referred as golden liquid because of its unrivalled properties along with colour resemblance. Honey is composed primarily of fructose and glucose but also contains fructo-oligosaccharides and many amino acids, vitamins, minerals and enzymes. Composition of honey varies based on the nectar it was made.

Decapping of the sealed wax layer of honey combs is done using a sharp, thin and long knife or decapping knife. Extracting the honey from honey combs is done with the help of honey extractor (works on the principle of centrifugal force) in the case of Indian and Italian bees and squeezing of honey combs in the case of rock bees, little bees and stingless bees. Processing of honey is done to prevent granulation and fermentation. In India, most of the apiaries, process the honey by traditional method of indirect heating in which a vessel containing honey is heated by placing it in another vessel containing hot water, so that the honey gets its required heat from the hot water. The yeast cells present in honey are killed while heating / processing making honey less susceptible to ferment. For large scale processing of honey, honey processing units are used.

According to the recent study by IMARC Group, titled “Indian Honey Market: Industry Trends, Share, Size, Growth, Opportunity and Forecast 2019-2024”, the Indian honey market reached a value of INR 15,579 Million in 2018, registering a CAGR of almost 11% during 2012-2018. Most industrialized countries import honey to meet demand. This requirement can provide developing countries with a useful source of foreign exchange from

honey exports.

Benefits of consuming pure honey;

- Helps in allergies and infections.
- Great for the digestive health.
- Boost the immune system.
- For Wounds and cuts.
- Cures obesity and helps in losing weight.
- Enhance skin and hair.
- Good for brain health

Royal jelly

Royal jelly is a secretion of hypopharyngeal glands and mandibular glands of nurse bees in a ratio of 1:1. Royal jelly plays a vital role in caste differentiation of honey bees. Queen bee is fed with this nutritious royal jelly throughout its life time, while the drone and worker bees are fed for short time (2/3 days in their immature stages). As a result of the complex composition of royal jelly (lipids, proteins, mineral salts, vitamins, enzymes, oligo-elements and natural antibiotics), it is also said to have specific vital factors that act as biocatalysts in cell regeneration processes within the human body.

Production of royal jelly is related to rearing of queen bees and so the technology for royal jelly production is similar to that for mass queen rearing. It is because the queen larvae can't consume the royal jelly at a rate at which it is supplied to them and there is always surplus of it surrounding the larvae which can be extracted at the cost of the queen larvae. Royal jelly has a low shelf life and so it must be kept in refrigerator (0o C to 5o C). Since royal jelly is an emulsified product and not cellular tissue, freezing presents no particular problem and common household freezers can be used. It can be kept in a freezer for about 6 months.

Royal jelly is sold at very high prices in international market as dry powder in capsules or as formulation with honey. Commercial production of royal jelly is restricted to *A.mellifera*in India and that too by a very few beekeepers. Lack of awareness about the demand for the products and its production technologies are the reasons for its low production in India.

Royal jelly is a secretion of hypopharyngeal glands and mandibular glands to nurse bees. Royal jelly plays a vital role in caste differentiation of honey bees.The worldwide market for Royal Jelly is expected to grow at a CAGR of roughly 2.9% over the next five years, will reach 100 million US$ in 2024, from 81 million US$ in 2019, according to FAO.It includes improved health, increased body mass, enhanced fertility and additional longevity.

Cosmetics containing royal jelly are said to have anti-aging qualities. On an average, it requires 1003-day old cells to produce 500gm of royal jelly and sold @ Rs 25, 000/kg.World consumption, most of the world's royal jelly is consumed in China with much of the balance exported to Japan. Japan is the world's largest royal jelly importer with consumption 1,000 tonnes in 2018 (AgEconPlus estimate).

Table 5: Changes in wholesale price of royal jelly ($/kg)

Year	Price
1964	180 to 400
1993	30 to 80
2012	20 to 40
2018	30 to 60
2021	70 to 80

Source: FAO beekeeping, 2019

Bee wax

Bees produce wax from the wax secreting glands and they use this wax for construction of comb, in which their immature stages live and they also store pollen and honey in the hexagonal cells of the comb which is made up of beeswax. Pure fresh form of beeswax is white in color but later turns into yellow as a result of the presence of pollen and other substances. And so brown or yellow coloured beeswax is available in the market. Wax is secreted by 14-18 days old worker bees. And to produce one part of wax, bees has to

consume about 4-7 times as much honey. Beeswax has resistance to the action of acids and is also insoluble in water and cold alcohol. But wax can be dissolved partially in boiling alcohol, and completely in chloroform, in carbon disulfide, and in the essence of hot turpentine.

The beeswax is used in several industries such as cosmetic, electric and textile industry, church candles, carbon paper, metal castings and mouldings and shoe polish. Apart from these, it can also be used in beekeeping industry for preparation of comb foundation sheet. Beeswax is also used in food processing industry for coating metal containers internally against the effects of acids from fruit juices and honey.

Beeswax is the bee product that is produced in large quantities next to honey in India. The market price of beeswax is Rs.400 to 700 per kg.

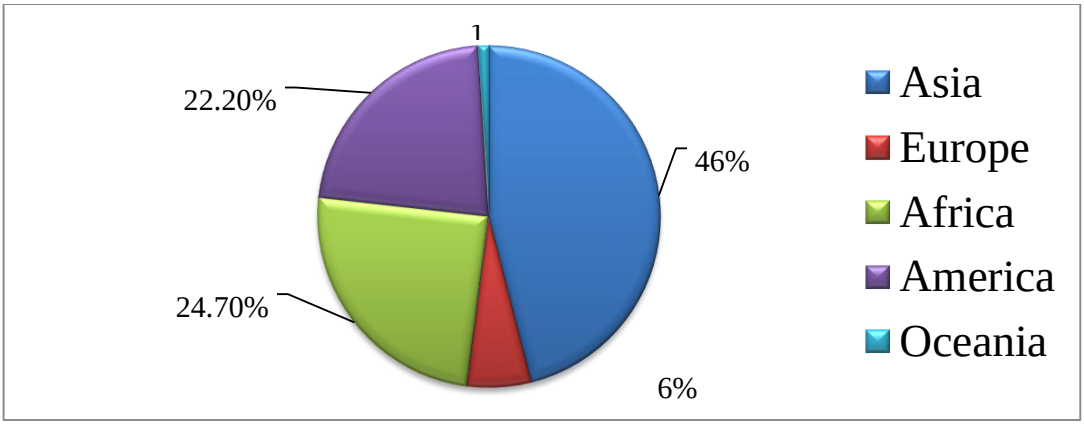


Fig. 1: Market share of bee wax by different regions in world

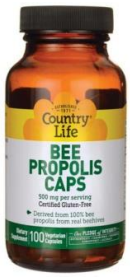
Source: FAO stat, 2019

Propolis

The word propolis has Greek origin, ‘pro’ meaning ‘in defense of’ and ‘polis’ meaning ‘city’, i.e. defense of beehives. It is produced by Italian and stingless bees and not seen in Indian bee, rock bee and little bee. Honey bees use propolis for sealing the cracks and crevices and unwanted holes in the hive; for spreading around the hive entrance as repellent to the intruders like ants. It is collected by bees from tree resins, flower-buds, and other vegetal tissues. At the time of collection, bees mix their wax and collected resins to make propolis.

Propolis has different compounds such as esters, fatty acids, carbohydrates terpenoids, vitamins, and inorganicsubstances and has numerous therapeutic properties, such as antibacterial, anti-inflammatory, healing, anesthetic, anticariogenic, antifungal, antiprotozoan and antiviral activities. It can be collected by scrapping off the hive parts or by using the propolizing plastic screens, which are placed on the top bars of the hive.

About 300g of propolis can be obtained from one colony per year and sold @ Rs 500/kg. Propolis has been suggested to have a role in treating certain cancers as well (National Center for Biotechnology Information).



Bee venom

Bee venom also known as Apitoxin contains more than 40 biologically and pharmacologically active compound. It is injected by honey bees using their sting to defend themselves from the intruders. Quantity of bee venom produced by worker bees varies between 100 to 150 micrograms. About 50 mg venom can be obtained per colony and sold @ Rs1000/g. The main venom producer in the USA has produced only about 3 kg of dry venom during the last 30 year.

Bee Pollen

Pollen collected by honey bee and carried back to the hive is called bee pollen. Bee pollen is the chief source of protein, lipids, amino acids, minerals, vitamins etc. in the honey bee diet. Pollen is also considered as a complete food for human beings. It is used in apitherapeutic treatments as it is said to have properties such as antifungal, antimicrobial, antiviral, anti-inflammatory, immune stimulating, and local analgesic and also facilitates the burn wound healing.

Pollen is carried back to the hive on the third pair of legs of the honey bee, which are specially modified for this purpose. Only a tiny amount can be carried back to the colony at each trip (around 10 mgs per load) and bees in a hive need about 20 kilograms for their annual development. It is clear that this constitutes a remarkable feat of social co-ordination by the bees - in fact this takes 2 million pollencollecting trips for the colony every year.Pollen is mixed with enzymes and nectar in a way that allows it to be stored by the bees for a considerable time.

It's important to avoid confusing bee pollen with natural honey, honeycomb, bee venom, or royal jelly. These products do not contain bee pollen although there are combination products that contain one or more of these substances. Bee pollen is sold in market for prices ranging from Rs. 2,000 to 20,000 per kg depending on the crop from which it is collected by bees.

Economics of beekeeping

Apiculture or Beekeeping is the art and science of collecting, processing honeybee colonies of desired species having them in specified and standard boxes, installing at appropriate sites, managing optimum number of colonies scientifically round the year and harnessing both direct and indirect benefits of the activities. As such a degree or high qualification is not essential in order to work in this profession. Apiarists can be developed and trained to handle the enterprise. There is vast potential and scope from diversification in Apiculture i.e. besides honey its offers scope for production and marketing of other bee products like bee pollen, bee propels, bee way bee venom and Royal selling. Honeybees can also be managed as and when required for pollination of field and Horticultural crops and for hybrid seed production in vegetables and other bee pollination crops technologies for the production of different products i.e. Royal jelly, bee pollen, bee porpoise, bee venom, Queen bees, package bees etc. now available in India Thakur 2008.

Table 11: Economics of Beekeeping.

Sl. No.	Details of items	Amount in Rs.
1	Cost of 10 number of bee hives per box	2000×80= 1,60,000
2	Cost of 80 bee box	80×400= 32,000
3	Cost of Apiery equipments	8,000
4	Cost of honey unit and uncapping tray	15.500
5	Bee wax sheet1 kg	400

Source: VeerSainandJitenderNain,2017

In Haryana state, commercial bee keepers are keeping *ApismelliferaL.* Bee whose queen is highly prolific and laying about 1500-2000 eggs per day during honey flow season. Therefore the colonies always remain in good strength. At present Haryana state is one of the leading state in India in honey production in the year 2004-05 there were only 28,000 colonies from which about 275mt of honey (years 2015-16) about 3,05,000 bee colonies from which about 4100mt honey in produced annually. Haryana has vast resources of bee flora, there is a great scope for further expansion of beekeeping in the state. In Haryana, where land holding is less than 0.75ha beekeeping can provide better food, balanced nutrition and employment to small and marginal farmers. It can also provide persons with full employment and extra income. A honeybee the unemployed and underemployed is member of the genus Apis, primarily distinguished by the production and storage of honey and the construction of perennial,colonial nests from wax.

Currently only 7 species of honeybee are recognized the bestknown honey bee species *Apismellifera.L.*(western honey bee) which has domesticated for honey production and crop pollination. Honey bees present only a small fraction of roughly 20,000 known species of bees. But only members of the genial Apis aretrue honey bees. Two species of honey bee *Apismellifera L.* And*apisceranaindica F.* (Indian Honey bee) are often maintained fed and transported by beekeepers. Modern beehives also enable beekeepers to transport bees, moving from field to field as the crop needs pollinating and allowing the beekeeper to charge for the pollination services. They provide, revising the historical role of the self employed beekeeper and favouring large scale commercialoperationstable2.

Table 12: Economics of Honey production and returns.

Sl. No.	Details of items	Amount in Rs.
1	Honey production 80Rs.×40kg	3200Rs/Box
2	For 80 boxes=80×3200	2,56,000
3	Labour (skilled) cost 5000×12	60,000
4	Unskilled labour cost3500×12	42,000
5	Migration charges	20,000
6	Feed charges annual	10,000

7	Total	1,32,000*1
8	New25box×700each	17,500
9	Net profit	1,49,500*2

Source: VeerSainandJitenderNain, 2017

Bee Keeping Industry

Beekeeping is an ideal activity which provides supplementary income to a large number of rural, hilly and tribal production and also for horticulturists, agriculturists, hobbyist etc. because of the rich flora available in abundance in the country. Any beginner who wants to start beekeeping should known some of the aspects of beehives, tools, locations where honey bees can be kept with its.

Total of 60,000+42,000+20,000+10,000=1, 32,000

Total of 1, 32,000+17,500=1, 49,500

Return expenses=Honey production-Net profit

272000-149500=1, 22,500Rs/-

Bee's increase (25×1800) =45,000Rs/-

Net profit annual=1, 67,500Rs

The Honey Market

The honey market in India was worth INR 15,579 Million in 2018, registering a CAGR of 10.9 per cent during 2012-18. The market is further projected to reach a value of INR 28,057 Million by 2024, at a CAGR of 10.2 per cent during 2019-24.The branded honey market is growing at a compound annual growth rate (CAGR) of 10 per cent, with a current market size of Rs 700 crores. India produces 7,000 million tons of honey, out of which 50 per cent is exported annually. Beekeeping was one of India's oldest practices. This makes India one of the world's most prominent honey markets, generating intense competition in terms of innovation and quality. In addition, the demand for honey in India is growing due to rising customer preference for natural and healthier alternatives to artificial sweeteners, greater awareness of the benefits of honey, as well as the growing popularity of various honey flavours. In addition, due to its proven antibacterial, anti-microbial, and anti-inflammatory properties, honey is anticipated to gain popularity in food and non-food applications throughout the world. The Government has encouraged the growth of honey in India by providing funding for the creation of businesses through marketing, R&D, innovation as well as exports. Such programs assist producers by providing consulting and mentoring services,

general and industry-specific training, and providing subsidized goods and organize workshops and seminars.

On the basis of distribution channel, the India honey market can be divided into the following:

- Business to Consumer
- General Trade
- Modern Trade Facilities
- E-Commerce
- Business to Business
- Food and Beverage
- Pharmaceuticals
- Cosmetics

On the basis of sector, the India honey market can be divided into:

- Organized
- Unorganized

The major states for the industry included in the regional market are as follows:

- Maharashtra
- Tamil Nadu
- Karnataka
- Punjab
- Rajasthan

Market Analysis

Due to the high floral diversity and the availability of a variety of bee forages, the honey industry provides lucrative opportunities for producers to produce a variety of honey flavours such as tulsi, ajwain, eucalyptus, and Jamun. That, along with the increasing popularity of online retail stores in the region, is driving the growth of the India honey market. In addition, the Government of India is offering training programs and advisory and mentoring services to educate farmers on the latest apiculture practices, thereby stimulating

the production of honey in the country. For example, the Government has introduced the 'Production of Beekeeping to Increase Crop Yield,' a scheme that helps coordinate training and awareness-raising programs for beekeepers and promotes the establishment of honey processing plants. A wide variety of honey products are presently available in India that are used in the food and beverage, cosmetics, as well as pharmaceutical industries. Scientific evidence of the medicinal use of honey and its rising importance as a quality ingredient in nutraceuticals also serves as a powerful driver for the India honey market.

Table 13: Top Brand wise prices of different honey in India.

Brand names	Cost Per Kg(Rs)
Dabur	**450**
Hitkari Honey	**510**
Beez Honey	**500**
Himalaya Honey	**499**
Little Bee organic Honey	**760**
Dyu Honey	**805**
Zandu pure Honey	**440**
24 Mantra Honey	**600**
Patanjali Honey	**350**
BaidyanathMadhu	**410**

From above table we can infer that Dyu honey is highest price of 800 Rs per kg and Patanjali honey is having 260 Rs per kg.

What are the major Market Drivers???

- ❖ Raising Disposable Incomes.
- ❖ Increasing Population.
- ❖ Rising Application in Food Industry.
- ❖ Raising popularity of online retail stores.
- ❖ Availability of a wide Variety of Honey Products.
- ❖ Honey's Health benefits.

Assistance by Government under different schemes

Table 14: Schemes of beekeeping development 2018-19

Sl. No.	Scheme	Allocation (Rs in crores)
1.	Mission for Integrated Development of Horticulture (Central Sector)	70.12
2.	Integrated Development of Commercial Bee-Keeping (RKVY)	292.00
3.	Madhuvana and Bee keeping development (State Sector)	200.00
4.	Bee keeping Development (District Sector)	226.62

Source: KVIC ministry of MSME GOI

There are different schemes for developments of bee keeping are Mission for Integrated Development of Horticulture under central sector with allocation of 70.12 crores. Under RashtriyaKrishiVikasYojana (RKVY) Integrated Development of Commercial Bee-keeping scheme has been introduced with allocation of 292.00 crores. 200 crores has been allocated for Madhuvana and Bee keeping development under state sector and under district Bee Keeping Development with allocation of 226.62 crores.

Table 15: Programmes by Mission for Integrated Development of Horticulture (NHM)

Sl. No.	Programme	Cost (Rs.)	Assistance
1.	Production of Nucleus stock (Public sector)	20.00 lakhs	20.00 lakhs (100%)
2.	Production of bee colonies by bee breeder	10.00 lakhs	4.00 lakhs (40%)
3.	Assistance for purchase of bee hives and colonies	Rs.4,000/unit	Rs.1,600/unit (40%)
4.	Assistance for purchase of bee keeping equipments	Rs.20,000/Unit	Rs.8,000/unit (40%)

Source: NHM website

During 2018 some of the programmes has been introduced by Mission for Integrated Development of Horticulture (NHM) are production of Nucleus stock for public sector with 20.00 lakhs of cost and 100 per cent assistance is provided for this scheme. Next is production of bee colonies by bee breeder with 40 per cent of assistance out of 10 lakhs of cost. And other two programmes are assistance for purchase of bee hives and colonies and assistance for purchase of bee keeping equipments.

Table 16: State Apiculture Development Schemes

Sl.no	Programme	Cost (Rs.)	Assistance
1	Bee keeping training Programme	700 / Beneficiary	100%
2	Assistance for purchase of Bee Box, Colony and Stand	4500/Unit	Rs.3375/Unit(75% -G)Rs.4050 (90% SC-ST)
3	Assistance for establishment of Madhuvanas.	1.00 lakh	Rs.0.50 lakh (50%)

Source: KVIC ministry of MSME GOI

Under state government some of the programmes have been introduced like Bee Keeping training programme, where 100 per cent assistance is given to this programme. Assistance for purchase of Bee Box, Colony and Stand ,where as in this promgramme 75 per cent assistance for general and 90 per cent assistance for SC-ST and 50 per cent assistance is provided to the Assistance for establishment of Madhuvanas.

HONEY MISSION

Local employment for migrant workers has been created by Khadi and Village Industries Commission (KVIC) through its flagship Honey Mission programme. Khadi and Village Industries Commission (KVIC) through its flagship Honey Mission programme has taken an enormous leap towards 'Atmanirbhar Bharat' by generating local employment for migrant workers.Minister of State for MSME, Pratap Chandra Sarangi distributed 700 bee boxes to 70 migrant workers of Saharanpur and Bulandshahr districts of Uttar Pradesh on 25 August, 2020. Due to COVID-19, they had returned to their hometown from Karnataka, Maharashtra, and Gujarat. Not only this KVIC has provided training on bee-keeping and also gave necessary tool kit and bee boxes so that they can carry out their bee-keeping activities. Mr.Sarangi also stated that it will contribute to increasing the production of honey which is the main aim of the Honey Mission. It will also generate employment for the migrant workers at their doorsteps and make them self-reliant. According to the Ministry, KVIC has distributed 1, 35,000 bee boxes so far in Jammu and Kashmir, Himachal Pradesh, Punjab, Uttar Pradesh, Bihar, Arunachal Pradesh, Assam and Tripura. This has benefitted around 13,500 people across the country.

About Honey Mission

It was launched in 2017 by KVIC with the purpose of creating employment for the Adivasis, farmers, unemployed youth, and women by roping them in bee-keeping and it will also increase India's Honey production.Under the rural development programme in India, beekeeping is an important, sustainable, integral Forest, social forest and agricultural supporting activity. It provides nutritional, economic, and ecological balance while providing employment and income. Beekeeping as the very low investment and skills Industry has the potential to offers direct employment to lakhs of people especially hill dwellers, tribal and unemployed youthand farmers.

Beekeeping has been carried out across several generations in India. It plays a crucial role in the livelihoods of the rural communities in four major dimensions namely;

–It helps in generating an inc

– It provides food and medicine.

– It supports agricultural activities through cross-pollination and increase in yield of crops.

– It contributes immensely to forest conservation.

– It provides supplementary income to farmers or Tribals etc.

Prime Minister NarendraModi viewed these opportunities and advised the authorities to explore the possibilities to create employment in Tribal regions and Left-Wing Effected (LWE) areas, backward districts of the country and announced to take up mass honey production as Sweet Kranti (Sweet Revolution) in the lines of "ShwateKranti" (White Revolution) in Mission mode.

How the mission will help in generating employment?

According to V.K Saxena, the Chairman of KVIC, beekeeping will not only increase India's honey production but it will also increase the income of the beekeepers. He also told that products like pollen, bee wax, royal jelly, propolis, and bee venom are also marketable products and so it will also be a profitable proposition for the locals. In Panjokera, KVICs training centre, the bee boxes were distributed.

What does KVIC provide beekeepers under Honey Mission?

– For the examination of honeybee colonies, practical training is provided.

– Acquaintance with apicultural equipments.

– Extraction of Honey and purification of wax.

– Methods to identify and manage bee enemies and diseases.

– Management of bee colonies in seasons like spring, summer, monsoon, autumn and winter seasons.

Besides providing them certificates of trained bee-keepers, the KVIC experts also delved upon honey bee species, colony organisation, division of labour and life cycle of honey bees, management of honey bee colonies during different seasons.For honey production, Western Uttar Pradesh has been chosen as one of the most favourable markets because the entire region has an abundance of flora that also includes a variety of crops. Among the world's top five honey producers India is one among them.

About Khadi and Village Industries Commission (KVIC)

The Khadi and Village Industries Commission (KVIC) is a statutory body established by an Act of Parliament (No. 61 of 1956). It took over the work of former All India Khadi and Village Industries Board in April 1957.

– Under the Ministry of Micro, Small and Medium Enterprises (MSME), it is an apex organisation.

– At the national level, it is a nodal implementation agency of Prime Minister Employment Generation Programme (PMEGP).

At last, KVIC also set a world record on World Honey-Bee Day on 21 May, 2018 by distributing maximum number of bee-boxes in a single day. KVIC Chairman ShriVinai Kumar Saxena distributed 1,000 bee-boxes among 100 people belonging to the Mishing Assamese tribe within the Kaziranga forest, thereby setting a new world record.

Table 17: Funds earmarked under honey mission in India (2017-18 to 2020-21)

Sl.No.	Year	Funds earmarked (Rs. In lakh)
1.	2017-18	600
2.	2018-19	6,335
3.	2019-20	1,300
4.	2020-21	6,300
	TOTAL	**14,535**

Source, RajyaSabhaunstarred question no,658

From the above table we see that the total of 14,535 lakhs of funds earmarked under honey mission in India.

Table 18: Different products produced under Honey Mission 2018

Sl. No	Name of product	Production (in tones)	Value (in crores)
1.	Honey	3320.0	36.52
2.	Wax	22.00	0.66
3.	Pollen	19.00	0.76
4.	Royal jelly	4.0	4.0
5.	Bee venom	0.0001	0.50
6.	Propolis	0.60	0.06
	Total		**42.50**

Source: Honey mission, 2018

From the above table we can see that the total of 14.50 crores target is achieved by Honey Mission during 2018. Among different products the major contribution is from honey i.e 36.52 crores.

National Beekeeping & Honey Mission (NBHM) aims to achieve the goal of 'Sweet Revolution' as part of Atmanirbhar Bharat Abhiyaan

Keeping in view the importance of beekeeping as part of the Integrated Farming System in the country, government approved the allocation for Rs. 500 crore for National Beekeeping & Honey Mission (NBHM) for three years (2020-21 to 2022-23). The mission was announced as part of the AtmaNirbhar Bharat scheme. NBHM aims for the overall promotion & development of scientific beekeeping in the country to achieve the goal of 'Sweet Revolution' which is being implemented through National Bee Board (NBB).

The main objective of NBHM is to promote holistic growth of beekeeping industry for income & employment generation for farm and non-farm households, to enhance agriculture/ horticulture production, developing infrastructural facilities, including setting up of Integrated Beekeeping Development Centre (IBDC)s/CoE, honey testing labs, bee disease diagnostic labs, custom hiring centres, Api-therapy centres, nucleus stock, bee breeders, etc. and empowerment of women through beekeeping.

Besides, the scheme also aims to create awareness about scientific bee keeping under Mini Mission-I, post-harvest management of beekeeping, beehive products, including collection, processing, storage, marketing, value addition, etc. under Mini Mission-II and Research & Technology generation in beekeeping under Mini Mission-III. Rs 150.00 Crores has been allotted to NBHM for 2020-21.

11 projects of Rs. 2560 lakhs have been sanctioned under NBHM for Awareness & Capacity building in scientific beekeeping, empowerment of Women through beekeeping, technology demonstrations on impact of Honeybees on yield enhancement & quality improvements of agriculture/horticulture produce. It also aims to make farmers aware about the distribution of specialized Beekeeping equipments for production of high value products, viz. Royal Jelly, Bee Venom, Comb Honey, etc, and also about the studies on exploring potential of High Altitude Honey, production of special honey in Kannauj & Hathrus Dists. of UP and use of mustard honey to cure colon cancer during the year 2020-21.

Main achievements:

Two World Class State of the Art Honey Testing Labs, one at NDDB, Anand, Gujarat & one IIHR, Bengaluru, Karnataka, have been approved/ set up. Lab at Anand has been accredited by NABL and has been inaugurated by Union Minister of Agriculture & Famers Welfare, Govt. of India on 24th July, 2020. Now Lab has started testing of Honey samples for all the parameters notified by FSSAI; 10,000 Beekeepers/Beekeeping & Honey Societies/Firms/Companies with 16.00lakhs honeybee colonies have been registered with NBB. Proposal for developing Traceability Source of Honey and other Beehive Products approved and work initiated/ started. This will help in controlling the adulteration in honey & other beehive products. Farmers/ beekeepers have been trained in scientific beekeeping including production of high value beehive products, viz.; Bee Pollen, Propolis, Royal Jelly, Bee Venom, etc. 5 FPOs of Beekeeper/honey producers in the States of Bihar, Uttar Pradesh, Madhya Pradesh, Rajasthan & West Bengal have been formed and launched by Minister of Agri. & FW on 26.11.2020.Honey production has increased from 76,150 MTs (2013-14) to 1, 20,000 MTs (2019-20) which is 57.58 % increase. Export of honey has increased from 28,378.42 MTs (2013-14) to 59536.74MTs (2019-20) which is 109.80 % increase. 16 Integrated Beekeeping Development Centres (IBDCs) as role model of beekeeping have been commissioned, one each in the States of Haryana, Delhi, Bihar, Punjab, Madhya Pradesh,

Uttar Pradesh, Manipur, Uttarakhand, Jammu & Kashmir, Tamil Nadu, Karnataka, Himachal Pradesh, West Bengal, Tripura, Andhra Pradesh and Arunachal Pradesh.

Awareness created about role of honeybees/beekeeping in pollination support of various crops and adoption of scientific beekeeping.

National Bee Board

The Ministry of Agriculture, Govt. of India launched a Central Sector Scheme titled 'Development of Beekeeping for Improving Crop Productivity' during the VIII plan (1994-95). The scheme had various components covering R&D, production & distribution of honey bee colonies, organizing trainings and awareness programmes and support for setting up honey processing plant, etc. A Beekeeping Development Board also functioned under the Chairpersonship of Secretary (A & C) to coordinate the Beekeeping activities. The Scheme was approved for continuation during the IX Plan. However, the scheme got subsumed under the Macro Management Scheme, with effect from October, 2000. The Department facilitated efforts by providing seed money through Small Farmers' Agri-Business Consortium (SFAC) for enabling the private sector to join hands in forming the National Bee Board as a Registered Society under Societies Registration Act, XXI of 1860 on 19th July, 2000 & promoted by the Small Farmers' Agri-Business Consortium (SFAC). In May 2005, Beekeeping has been included as a supplemental activity under National Horticulture Mission (NHM) for promoting cross pollination of Horticultural Crops.

In view of the tremendous scope for increasing productivity due to cross pollination and increase in income through Apiculture, it was proposed to revive Beekeeping activity in the country, exponentially by pooling the resources of the Department of Agriculture and Cooperation with other organization, including private sector. Accordingly, the National Bee Board (NBB) was reconstituted in June, 2006. The main objective of the National Bee Board (NBB) is overall development of Beekeeping by promoting Scientific Beekeeping in India to increase the productivity of crops through pollination and increase the Honey production for increasing the income of the Beekeepers/ Farmers.

The main features of reconstituted Board (NBB), after amendments approved in AGM held on 21/10/2008, are as under: Secretary (A & C) is the Ex-Office Chairman of the Board (NBB). Additional Secretary, Incharge of Horticulture, Department of Agriculture & Cooperation, Ministry of Agriculture, Govt. of India is the Ex-Officio Vice-Chairman of the

Board and Ex- Officio Chairman of the Managing Committee of the National Bee Board. Joint Secretary (NHM), Department of Agriculture & Cooperation, Ministry of Agriculture, Govt. of India is the Ex-Officio Member Secretary of the Board and Managing Committee of the National Bee Board. AS & FA, DAC, GOI, Horticulture Commissioner, DAC, Managing Director (MD), SFAC, ADG (PP), ICAR, CEO, KVIC are the regular Members from Govt. of India and Two members, viz; Chairman, APEDA and Dr. R.P. Phadke, Retd. Director, Central Bee Research & Training Institute (CBRTI), are also nominated by the Govt. of India. The eight members are elected Members of the Managing Committee. These eight members are elected from various categories of the Society of the Board as per the following details. Two Members from Founder and Corporate Members (at least one from Founder Members). One Member from Beekeeping & Honey Societies. Four Members from Individual Beekeepers and Scientists & Development workers. One Member from Bee Equipment Manufacturers and Wholesalers /Traders/ Packers of Bee Products.

Executive Director is the Principal Executive Officer of the Board. Managing Committee of National Bee Board consists of 18 Members (10 from Govt. of India & 8 from the Registered Members of the Society of the Board) apart from the Executive Director, who is the Ex-Officio Member of the Managing Committee. In normal course the Elected Members of the Managing Committee shall hold office for a period of 3 years. Any eligible Registered Beekeeper can apply for the membership of the Board as per the rules prescribed for the same.

This website belongs to Department of Agriculture and Cooperation, Ministry of Agriculture and Farmers Welfare.

All India Coordinated Project on Honeybee and Pollinators

In recognition of the potential role of honey bees and other pollinators enhancing the agricultural production and productivity, National Commission on Agriculture during 1976 recommended the starting of a project entitled “All India Coordinated Project on Honeybee Research & Training”, which was launched by the Indian Council of Agricultural Research in 1980-81. The coordinating centers of the Project started functioning at different locations under the Project Coordinating unit located at the then Central Bee Research Institute (CBRI), Pune, presently designated as Central Bee Research & Training Institute (CBRTI), Pune with an objective to coordinate, counsel and monitor the activity of cooperating centres. The PC unit at CBRTI, Pune continued to function from 1980-81 to 1987 and then shifted to CCS, HAU, Hisar, Haryana where it functioned from 1987-88 to October 2013. A

new centre was added in the VIII plan at Kerala Agricultural University, Trivandrum. Besides the honey bees, there are many non Apis bees, insects and animals which contribute to potential yield enhancement of several cross pollinated crops. Realizing this fact the current project has been up scaled during the XIth plan period (2008-2012) with a new name as All India Coordinated Research Project on Honey bees and Pollinators in July, 2007. By end of the XIth plan period AICRP on honeybees and pollinators is functions with the following 16 centres other than the Project Coordinating unit.

Now the Project Coordinating Unit is functioning at Division of Entomology, IARI, Pusa, New Delhi from November, 2013 with new aspiration and drive to coordinate location specific research on pollinators. Now the project has 18 regular coordinating centers and 6 voluntary centers with sanctioned strength of 26 scientists to undertake the research work over a larger agro-ecological area than before.

Mandate

- The aim of the Project is the Conservation and Sustainable Use of Pollinators (CSUP) is to promote co-ordinated action across the country:
- Assessing the economic value of pollination and the economic impact of the decline of pollination services to Indian agriculture
- Promote wider use of pollinators, as essential input for cross pollinated crops, to enhance / maintain agricultural productivity
- Monitor pollinator decline, its causes and its impact on pollination services;
- Address the lack of taxonomic information on pollinators;
- Promote conservation and restoration of pollinators for the sake of sustainability of agriculture in India

Objectives

- Development/enhancement of standardize tools and techniques to assess and monitor status of pollinators;
- Establishment and/or updating of databases on pollinators, their host plants, bio-geography, nesting requirements, etc;
- Development of demonstration sites to test/illustrate/validate "pollinator-friendly" best management practices;
- Further development of taxonomic information and capacities;

- Promoting co-operation and sharing of best practices and lessons learned.

Extension activities

- Total 40000 stakeholders were trained since inception of the project.
- Monthly Beekeeping message to registered bee keepers based on information technology was developed by AICRP center of OUAT, Bhubaneswar.
- The information is disseminated through mobile (voice message) to the Beekeepers of the state in collaboration with Reliance Foundation, Bhubaneswar.
- AICRP (HB&P) also engaged in organizing training programmes for the tribal's on scientific bee keeping. To date 27 such training programmes have been organized benefiting 1554 tribal's in different parts of the country.
- MadhuSandesh- mobile advisory service to bee keepers -a pilot project in collaboration with KVK, Baramathi and Crop life Asia limited launched by AICRP (HB& P) to save the bees from pesticide poisoning.

AICRP on Honey Bee and Pollinators, UAS, Bangalore

The University of Agricultural Sciences (UAS) is one of the oldest varsities in India. It was established in 1964 at GKVK, (then) Bangalore, Karnataka. Serving the farming community through research, teaching and extension activities has been its motto. Another big leap in the promotion of apiculture in the State was when, for the first time in India, a separate Department of Apiculture was set up in UAS in December 1996. In 2009, the Indian Council of Agricultural Research (ICAR) established the All India Coordinated Research Project (AICRP) on 'Honey Bees and Pollinators at the UAS to promote research activities. The project got financial assistance from ICAR to implement the Tribal Sub-Plan (TSP) project for the welfare of tribal's engaged in beekeeping

Dr KT Vijayakumar, who is working as a scientist and a principal investigator at the UAS, has taken several initiatives aimed at improving the lives of tribals. He worked with the Soliga tribal families from Chamarajanagar district, Siddis of Uttara Kannada district (NAIP project) and Nayaka community (ST) of Turakur district. Before this intervention, these tribals used to collect honey from wild colonies by killing bees and squeezing the

honeycombs. Because of this unscientific practice, they were not only destroying bee colonies but also unknowingly tampering with the quality of honey.

Extracting honey without killing bees. This would keep the hives safe and the quality of honey intact. More than 500 Apis cerana colonies, beehives, smokers, honey extractors and other equipment were distributed for rearing domestic honey bees. In the last four years, they have conducted 12 training programmes on scientific beekeeping in tribal areas. The AICRP project created awareness on the importance Honey clusters were made and linked with marketing facilities of wild honey bees. Beekeepers were trained for sustainable to maximise the use and reach of honey and wax products. In harvest of honey so that bees aren't harmed and given a couple Tumkur, tribal's collected 10 quintals of wild honey, 50 kg of training programmes on sustainable honey harvesting about apiary honey and two quintals of beeswax.

Research Studies

1. Farmer's Knowledge and Perception on Importance of Pollinators and Pollination in Crop production of Kolar and Chikkaballapur districts in Karnataka state

Sindhu, 2021

Objectives:

1. To assess the knowledge and perception level of farmers on importance of pollinators and pollination.
2. To study the personal, socio-economic, psychological characteristics of farmers.
3. To know the association between personal, socio-economic, psychological characteristics and their knowledge and perception about pollinators and pollination.
4. To ascertain the problems and seek their suggestions about conservation of pollinators and pollination to enhance the productivity of crops.

Methodology:

- Kolar and Chikkaballapur districts of Karnataka had been identified as a locale of present research study.
- 120 farmers were selected from 12 diversified villages of two potential taluks.
- Ex-post facto" research design was employed for this present investigation.

- The data analysis was carried by means of suitable statistical tools such as Frequency, percentage; mean, standard deviation and chi-square are given below.

Results:

Table 1: Overall Knowledge of farmers towards importance of pollinators and pollination

(n=120)

Knowledge level	Category	Respondents					
		Smallfarmers (n_1=60)		Bigfarmers (n_2=60)		Total farmers(n=120)	
		f	%	f	%	f	%
Mean:18.44SD:3.53	Poor(<16.67)	17	28.33	17	28.33	34	28.33
	Average (16.67-20.20)	28	46.67	27	45.00	55	45.83
	Better(>20.20)	15	25.00	16	26.67	31	25.84
	Total	60	100	60	100	120	100

f - Frequency, % - per cent

Table 2: Overall perception of farmers towards importance of pollinators and pollination

(n=120)

Perception level	Category	Respondents					
		Smallfarmers (n_1=60)		Bigfarmers (n_2 = 60)		Total no. offarmers (n=120)	
		f	%	f	%	f	%
Mean:69.52 SD:8.48	Poor(<61.03)	20	33.33	18	30.00	38	31.67
	Good(61.03-78.01)	25	41.67	27	45.00	52	43.33
	Better(>78.01)	15	25.00	15	25.00	30	25.00
	Total	60	100	60	100	120	100

f - Frequency, % - per cent

Findings of the study:

The study implicated that the knowledge and perception level of the farmers on importance of pollination and pollinators is low to medium level. The need of protecting the

pollinators is rising to be the most significant concern, as it is important to establish and execute rational and global policies that enable and promote activities to safeguard and manage pollinators. Suitable national policies are needed in order to provide an efficient enabling environment to support activities by farmers, land managers, beekeepers. Pollination concerns are often an incising issue, and policies should be designed to consolidate pollinator and pollination considerations not only into the conditions of sustainable agricultural adaptation, but also over many diversifying sectors (for example forestry and health).

Addressing connection between pollinator's and human health, nutritious diets, pesticide exposure and the provision of ecosystem services and functions, beyond food production. Acknowledging pollinators as part of holistic farming systems, an important agricultural input and an essential part of the ecosystem maintenance and its integrity. Administering environment-based solutions and strengthen positive interactions (e.g. on-farm diversification, integrated pest management, restoration to increase landscape connectivity, ecological intensification).

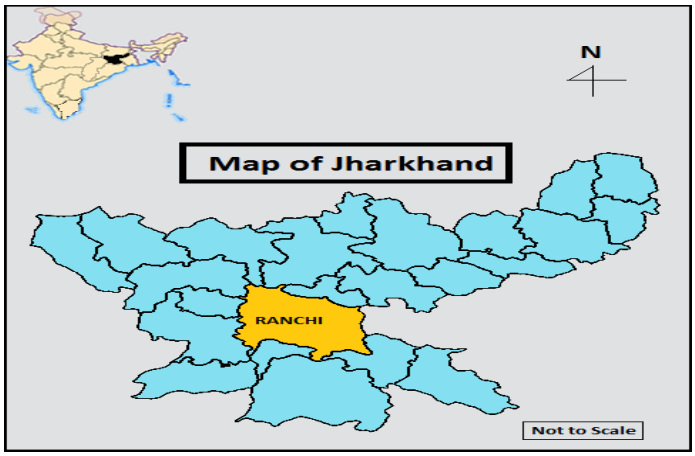
2. Potentiality of beekeeping in doubling farmers' income in Jharkhand: a way to sweet Revolution

Khanra and Mukherjee, 2018

Objective: To know the potentiality of bee keeping in doubling farmer's income.

Methodology:

- **Locale of the study**: Ranchi district of Jharkhand
- A total of 47 beekeepers were randomly selected those who get their inputs and information from the KVIC and Ramakrishna Mission, Divyayan KVK.
- The primary data for the present study was collected using structured schedule.
- Rank Based Quotient (RBQ) technique was applied to rank various parameters of interest.



RESULTS

Table-1 Cost of producing honey per 100 hives

Particulars	Cost (Rs)
Bee box	49927.71
Wax sheet	11396.25
Feeding	35472.76
Medicine	1107.139
Labour	12756.6
Transportation	33903.45
Maintenance	8109
Total input-	152673
Harvesting	255.3
Processing	180.45
Preservation	20977.62
Packaging	3914.3
Total-	177900.67

Table-2 Income from honey/100 hives

Sale	Average quantity (quintal)	Average Price (Rs/kg)	Income (Rs)
Wholesale	27.69	114.15	316081.35
Retail	1.67	280.00	46760.00
Total			362841.35
Net income	Total income – Total cost = Rs (362841– 178000) = Rs 184841		

Table-3 Quality parameters of the customers

Quality Parameters	R.B.Q.	Overall Rank
Colour	77.02	I
Taste	72.34	II
Density	65.53	III
Organic	55.32	IV
Price	29.79	V

Table-4 Constraints faced by the beekeepers

Constraints	R.B.Q.	Overall Rank
Overall Marketing of honey and honey products	69.79	I
Disease infestation in colonies	68.09	II
Land availability for keeping the bee boxes and foraging	61.70	III
Chemical treatment	53.19	IV
Transportation for forward and backward linkages	48.09	V

2. Perception towards adoption and constraints in beekeeping

Singh and Singh, 2019

Objective:

- To assess the perception of the people toward adoption of beekeeping and possible constraint in this regard.

Methodology:

1. Saina Nehwal Institute of Agricultural Technology, Training & Education, Directorate of Extension Education, Chaudhary Charan Singh Haryana Agricultural University, Hisar conducted eight training programmes (3-5 days duration) on bee keeping for farmers, women and unemployed youth in which a total of 272 trainees participated from different districts of Haryana and adjoining states.
2. To see the perception of trainees towards adoption of beekeeping as an enterprise and constraints in this activity, an evaluation of these programmes was conducted.
3. The data were tabulated and analyzed in terms of frequency and percentage using computer software MS Excel.

Results:

Table 1: Socio-economic profile of trainees (n= 272)

Sr. No.	Particulars	Frequency	Percentage
1.	**Gender**		
	Male	256	94.1
	Female	16	5.9
2.	**Age**		
	Young (18-35 yrs)	220	80.9
	Middle (36-50 yrs)	44	16.2
	Old age (>50 yrs)	8	2.9
4.	**Education**		
	Up to Primary	16	5.9
	Up to Matriculation	72	26.5
	Senior Secondary	104	38.2
	Diploma holder	16	5.9
	Graduation	48	17.6
	Post Graduate	16	5.9
6.	**Occupation**		
	Agriculture	160	58.8
	Labor	12	4.4
	Self employed	12	4.4
	Govt. Job	4	1.5
	Others (Retiree, student etc.)	84	30.9
7.	**Land holding**		
	Landless	52	19.1
	Marginal (<1 ha)	68	25.0
	Small (1-2 ha)	116	42.6
	Medium (2-10 ha)	32	11.8
	Large (>10 ha)	4	1.5
8.	**Annual Income**		
	Low (< 1 lac)	88	29.4
	Medium (1-2 lacs)	148	54.4
	High (> 2 lacs)	44	16.2

Table 2: Perception towards adoption and constraints in beekeeping

Particulars	Frequency	Percentage
Perception towards adoption		
Adopter	260	95.6
Non-adopter	12	4.4
Constraints in beekeeping		
Social constraints		
Objection from neighbor	168	61.8
No family support	44	16.2
No interest in beekeeping	4	1.5
Theft of bee hives	140	51.5
Physical constraints		
Labor intensive activity	40	14.7
Fear from bees	108	39.7
Allergy from bee sting	44	16.2
No land for keeping bee hives	124	45.6
Economic constraints		
Lack of money to start business	184	67.6
More recurring expenditure	16	5.9
Sale of honey at appropriate rate	160	58.8
Less income than expenditure	12	4.4
Technical constraints		
Insufficient training	20	7.4
Lack of complete knowledge	56	20.6
Difficult occupation	32	11.8
Bee management in dearth period	196	72.1

Major Constraints in Beekeeping:

The major constraints confronting the development of beekeeping are summarized as under:

(i) Some major concerns are a lack of:

- Scientific data on choice of Honeybee species for commercial beekeeping and for promoting cross pollination;
- Infrastructure for producing genetically superior queen bee for supply to beekeepers;
- Technical knowledge for efficient management of bee colonies for higher honey yield;
- infrastructure at grass root level and national level for promoting beekeeping;

- Awareness about yield increase in crops by beekeeping through pollination; understanding between farmers & beekeepers.
- Laboratories for disease prevention, control and analysis. Eco-friendly control measures for serious problems- Parasitic mites (Varroa, Acarapis etc.), fungi (Nosema, Acosphaera), bacteria (Paenibacillus, Melissococcus), Viruses (Sacbrood virus), etc. are required.
- Indigenous technologies for production of quality honey & other high value products from beekeeping: Bee pollen, Royal jelly, Propolis, Bees wax, Bee venom, Comb honey, etc. including migration/ transpiration technologies for honeybees.
- Institutional support for beekeeping in terms of bank loans, etc;
- Proper pricing policy for honey and those engaged in packaging, processing and storing honey;
- Consumer awareness of honey and its products; And
- Convergence of various developmental programmes.

(ii) Poor quality control for production of honey and quality control labs.

(iii) Beekeeping not on the priority list of states. The State Bee Boards/Missions/ Technical

Centres/IBCDs (Integrated Beekeeping Development Centres) and the like need to be established.

(iv) Various hindrances in migration, transportation of honeybee colonies.

(v) Forest Laws/Acts, etc.- charging a fee for allowing bee colonies in forest is a disincentive. The laws are also restrictive of the beekeepers/traders/processors of honey.

(vi) Less emphasis for production of other bee products such as beeswax, pollen, propolis, bee venom and royal jelly.

(vii) The behaviour and life cycle of honeybees depend completely on climatic and floristic conditions, which vary from place to place. Flowering of plants and secretion of nectar and production of pollen – sole food of honeybees, influenced by climatic conditions.

(viii) Insufficient database on beekeeping activities.

(ix) Mono-cropping culture in large parts – not good for bee promotion.

(x) Indiscriminate use of insecticides, pesticides, weedicides etc.

(xi) Lack of coordination between/among bee breeders, entomologist & plant breeders, such as to help to evolve scientific beekeeping practices based on good agriculture and management practices, following both crops and honeybees centred approach.

(xii) Heat-waves and & unforeseen changes in climatic conditions.

Conclusion:

Beekeeping being intertwined with flora is naturally integrated with crop production. It has a symbiotic relation with agriculture. The crops benefit from bees on account of pollination and the latter benefit from crop for their food, the nectar. The value of honeybee as a pollinator, that contributes to enhanced yield in crops is being recognised. Further, honey and various other products of beehive are being increasingly recognised world over as health foods. Hence, the farmers and

landless agricultural labour have an opportunity in adopting beekeeping as an enterprise and generate for themselves additional jobs and income. India being home to different species of honeybees offers wider scope for beekeeping. The diversity of flora and multiple products apart from honey create a conducive environment for establishing an enterprise for both domestic and export markets.

Honey bees provide a variety of products (Honey, wax, pollen, royal jelly etc) and services (pollination) to Human society and Ecosystem. Across the world the bees support millions of livelihoods while also enriching the ecosystem and provide better health benefits to the consumer. Although, traditional beekeeping has come a long way but there are certain implications that must be addressed in regional as well as national social-economic changes and nutritional security. Apiculture sector needs well-functioning markets to drive growth, employment and economic prosperity in rural areas of the country and to provide efficiency in the marketing system, sound technical investment are required for beekeeping entrepreneurship development.

Discussion

1. Sweet Revolution first started in which state and what are the components?

Ans: Jharkhand is the first state to promote sweet revolution in India.

Components of Sweet Revolution:

1. Plan approval

• Rs. 100 crores administrative approval for the year 2018-19. Under this scheme more than 12000 farmers will be benefitted.

• Rs 10 crores has been allocated.

• Under the scheme 1207 beneficiaries will be benefitted in the first phase.

• District wise targets have already been prepared.

2. Selection of farmers

The farmers will be selected through the Chief Minister small and micro industries Board

3. Training of farmers

• Farmers will be trained for beekeeping and production through our training centers.

• Apart from this Birsa Agricultural University, Krishi Vigyan Kendra, will be trained through other Notified Agencies.

4. Unit distribution

• Each unit will be given a unit

• Each unit will have 20 bee colony, 20 honey boxes and one honey extract machine.

• Government will give 80% subsidy and share of beneficiary will be only 20%

• Each farmer will be given Rs. 80000 / – against a total unit cost of Rs. 100000 / – and farmers will have to contribute only Rs. 20000 / -.

5. Processing / Production / Marketing Support:

• The Jharkhand government will help farmers in the field of honey processing and marketing.

• There are 7 processing units of different agencies in the state and they will help the farmers in the processing of raw honey

• The state government will connect farmers with APEDA, Government of India especially for honey exports.

2. How to protect pollinators/Honey bees from pesticides?

Ans: 1. Apply pesticides in the evening

Many pesticides are extremely toxic to honey bees and other beneficial insects. Honey bees are attracted to blooming flowers of all types. If at all possible do not spray blooms directly with pesticides. If the bloom needs to be sprayed, apply the pesticides in the evening hours. Honey bees forage during daylight hours when the temperatures are above 55-60°F. As the sun begins to set, they return to their hives for the evening. Thus, spraying pesticides in the evening hours can greatly reduce honey bee mortality because the bees are not in the fields.

2. Choose the appropriate formulation

The appropriate choice of formulation is another way to avoid honey bee pesticide kills. Pesticides come in different formulations: dusts (D), wettable powders (WP), soluble powders (SP), emulsifiable concentrates (EC), solutions (LS), and granulars (G). Solutions, emulsifiable

concentrates, and granulars are the best formulations to use. Solutions and emulsifiable concentrates dry quickly and do not leave a powdery residue unlike the dusts and wettable powders. Granulars are similar to dusts but are larger in particle size. They are applied into the soil or broadcast on the surface of the ground. They are seldom used on blooming plants and are essentially non-hazardous to bees. On the other hand, dusts and wettable powders will adhere to the thousands of tiny hairs found on the body surface of the honey bee. These dust particles are then transferred back to the hive and stored along with the pollen. This can cause an entire colony to collapse if the pollen is fed to the queen or the brood.

3. Use less toxic, rapidly degradable pesticides

Using less toxic pesticides that degrade rapidly is also important in reducing honey bee mortality (See Table of Insecticides and Miticides for pesticide toxicity and residual time). Many of the newer pesticides being marketed today have a faster residual time which is the time required to reduce the activity of the chemical to safer levels for bee activity. When these pesticides are sprayed in the fields, it takes only a few hours for them to degrade as opposed to a few days or weeks.

4. Alter application method

The method of application can also change the risk of pesticide poisoning. Aerial applications have the highest potential risk for causing bee kills. Most bee kills occur when the pesticide drifts or moves from the target area into the apiary or onto crops attractive to the bees. The outcome of drift can be catastrophic. Spraying during windy days greatly increases the risk of drift. Using granular formulations, soil treatments or equipment that confines the spray to the intended target can help reduce the risk of drift from pesticides.

5. Establish apiaries in safe locations

The location of your apiary is probably the most important factor in eliminating the risk of pesticide poisoning. The farther colonies are away from fields or orchards that are treated with pesticides, the better chance the bees have against pesticide poisoning. Establish apiaries at least 4 miles from crops being treated with toxic materials and subjected to drift. However, if your apiary is already located in an agricultural area where pesticide use is high, moving your bees may be the best insurance against future pesticide kills since preventing honey bees from foraging on pesticide-contaminated flowers is almost impossible.

3. How can we differentiate natural honey and adulterated honey?

Ans: The Thumb test: Apply a small amount of honey on your thumb, check if it is spilling like any other liquid, if it does then your honey is not authentic. Honey is supposed to be thick and it doesn't drip.

Water Test: In a glass of water, put a spoon of honey, if your honey is dissolving in water then its fake. Pure honey has a thick texture that will settle at the bottom of a cup or a glass.

Vinegar Test: Mix a few drops of honey into vinegar water, if the mixture starts to foam, then your honey is fake.

The Heat Test: Honey remains unburned. To try the heat test, dip a matchstick in honey and light it. If it burns, then your honey is adulterated.

We can, in fact, spot the difference with the naked eye too. Pure honey has a distinct sweet aroma to it, and raw honey when consumed leaves a tingling feeling in your throat.

4. If Honey Bees vanished from the earth, then what are its effects?

Ans: As far as important species go, they are top of the list. They are critical pollinators: they pollinate 70 of the around 100 crop species that feed 90% of the world. Honey bees are responsible for $30 billion a year in crops. That's only the start. We may lose all the plants that bees pollinate, all of the animals that eat those plants and so on up the food chain. Which means a world without bees could struggle to sustain the global human population of 7 billion. Our supermarkets would have half the amount of fruit and vegetables. It gets worse. We are losing bees at an alarming rate. Possible reasons include the loss of flower meadows, the crab-like varroa mite that feasts on their blood, climate change, and use of pesticides

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