ECONOMICALLY IMPORTANT PRODUCTS OF BEEKEEPING INDUSTRY AND FARMERS` AWARENESS ABOUT BEEHIVE PRODUCTS IN SHIMLA HILLS OF HIMACHAL PRADESH, INDIA

ABSTRACT

Insect pollinators are responsible for pollination of most the fruit crops and they are performing it well. Pollinator mediated cross-pollination is needed for better production of fruit crops. Many insects such as honey bees, bumble bees, wasps, hover flies, butterflies and beetles are important pollinators but honey bees are the most significant and efficient pollinators of fruit crops. Honey bees are economically very important because they not only help in pollination but provide other valuable products like honey, beeswax, propolis, royal jelly, bee venom and pollen.

A survey was conducted to know the farmers` awareness about beehive products in Shimla hills of Himachal Pradesh. It was found that the farmers had knowledge about different insect pollinators visiting various fruit crops. They were practicing beekeeping not only for managed crop pollination but for producing honey also. Only 67% of them were getting extra income by extracting honey from bee colonies. There was very little awareness among the farmers about other beehive products like beeswax, propolis, royal jelly, bee venom and pollens as well as regarding their use as industries, food, medicine, cosmetics and apitherapy. The climate and the conditions of Himachal Pradesh are not favourable for beekeeping. The lack of experts, financial support, labour, transport, honey market, knowledge of diseases and occurrence of winter snow fall at higher altitudes were demoralizing the farmers to make beekeeping as whole time profession. The renovation in all aspects of apiculture and application of improved beekeeping technologies not only benefit beekeepers but also farmers and general public in pollinating their crops, gaining extra income and maintaining biodiversity.

Key Words: - Honey Bees, Pollination, Honey, Farmers' Awareness, Beehive Products, Himachal Pradesh

INTRODUCTION

Insect pollinators are vital for the sustainability of crop ecosystems. The pollinator diversity is important for stabilizing crop pollination and its yield. It has been estimated that over 80% of angiosperm plants rely on insect pollinators. Many insects such as honey bees, wasps, flies, butterflies, moths and beetles are main pollinators of many fruit crops [1][2]. "Among insects, honey bees are more effective pollinators than other insects because, unlike other insects, they are social and collect nectar and pollen not only to satisfy their own needs but to feed their young. They are perfect pollinators because of their body hairs, flower constancy, floral fidelity and many species can be reared and managed for pollination" [3]. "Further, honey bees can be domesticated, marketed and transported from place to place" [4].

The vibrant role played by honey bees in pollinating large number of crops is under estimated in developing countries. The income from bee pollinated crops is many times higher than the value of honey and beeswax production [5]. "Pollination by honey bees is one the most effective and cheapest method of increasing the crop yield, improves fruit and seed quality by hybrid vigour"

[6][7]. “Honey bees are highly social insects which have fascinated the human since prehistoric times. Commercial beekeeping is perhaps the only industry exploiting domesticated bees for enhancing crop productivity and producing honey, wax and several other products of medicinal use” [8]. “There is ever increasing demand for food security during present conditions of climate change, land use, habitat transformation and expanding human population. Proper pollination can improve the quality and quantity of many crops” [9]. “According to market price, pollination by animals improves the global crop output. However, greater production also leads to an increased demand of pollination services” [10] [11].

“Although, the soil and the climate of Himachal Himalaya is suitable for planting different types fruit crops and orchardists are also putting their intensive efforts, yet the yield and quality of fruits is reducing due to inadequate pollination” [2]. “Lack of awareness among farmers, professionals and extension workers at policy and planning levels is main problem in promoting managed pollination. Raising awareness at all levels about the importance of managed crop pollination through beekeeping and other pollinators is the first step as a part of development efforts” [12] [13]. Saville and Upadhaya [14] stressed on the importance of traditional log hives, baiting hive method to capture swarms, swarm management, honey harvesting and processing, winter colony management and traditional methods of disease control of bee colonies for pollination services.

MATERIALS AND METHODS

A field survey was conducted through a questionnaire at different localities in Shimla hills of Himachal Pradesh. Primary data was collected by simple random sampling method from 400 farmers and they were questioned about different aspects like knowledge of bee pollination, beehive products and various problems faced by them in beekeeping at different localities in Shimla hills of Himachal Pradesh**.** The secondary data was collected from reference books, research papers and the agencies such as Directorate of Horticulture, Government of Himachal Pradesh, Central Bee Research and Training Institute (CBRTI), Pune and Khadi and Village Industries Commission (KVIC).

RESULTS AND DISCUSSION

Apiculture is considered as an eco-friendly source of direct (hive products) and indirect income (pollination). The main purpose of beekeeping in Shimla hills of Himachal Pradesh is pollination of fruit crops. Some farmers here get the beehive products like honey, beeswax, pollen, propolis, royal jelly, bee venom and bee bread in addition to pollination. In the present investigation, we intended to find out the knowledge of farmers about pollination and beehive products along with various problems faced by them.

1. ECONOMICALLY IMPORTANT PRODUCTS OF HONEY BEES

1.1 HONEY

Flower nectar is a solution of sugars and other minor constituents that bees collect and concentrate into honey. It is a sweet, viscous fluid, produced by honey bees. It is collected as nectar from nectarines at base of flowers. It may also be collected from nectar secreted by plant parts other than flowers called extra floral nectarines, fruit juice, cane juice etc. Depending upon the source of sweet liquid and also the plant species in case of floral and extra floral nectar, the quality of honey varies. On this basis, the honey can be classified as floral honey or honeydew honey.

“Honey is extracted and prepared for market by different methods. The honey from *Apis dorsata* combs is squeezed and it is ought to contain more pollen grains and even the juices of some brood

and the honey is normally called squeezed honey. The honey from combs of *Apis cerana* and *Apis mellifera* is extracted with the help of honey extractors, so it is extracted honey. These honeys may remain in liquid form or may crystallize and, hence, can be presented to consumers as liquid honey or granulated honey. There are some other preparations for marketing honey which are not common in India. Small combs can be made to be raised and sealed honey in these combs is marketed as such as comb honey. Small pieces of combs are suspended in liquid honey packing and the preparation is marketed as chunk honey" [15].

1.1.1 Composition of honey: "Chemical composition of honey is very complex. Honey mainly contains sugars but acids, minerals, vitamins, enzymes and antibiotic substances are also present in small amounts. The solids in honeys vary with the floral source. Honey is also known as a supersaturated sugar solution. Natural honey is composed of 38.5% fructose, 31% glucose, 12.9% other sugars (i.e. 82.4% carbohydrates), 17.1% water, 0.5% protein, organic acids, multi-minerals, amino acids, vitamins, phenols and a myriad of other minor compounds" [16].

"Sucrose in honey varies between 0 and 5%. A reducing disaccharide maltose is also present 3-10%. Maltose may not be present initially, but the quantity increases with storage and this is due to conversion of other sugars by the action of enzymes and acids. Analytical methods have also shown the presence of many other common sugars such as isomaltose, trehalose, genitiobiose, maltulose, panose, turanose etc occurring in lesser quantity. These complex sugars account for 1-2% only. Mineral complex of honey is very wide consisting of potassium, calcium, sodium, magnesium, phosphorus, manganese, copper, silica, sulphur, silicon and iron. All these account for up to 1% of solids in honey. Different vitamins are present in honey are: thiamine (B1), riboflavin (B2), nicotinic acid (B3), vitamin K, biotin (B7), folic acid (B9), pyridoxine (B6), ascorbic acid (Vitamin C), pantothenic acid (B5) and carotene (Vitamin A)". There is loss of vitamins during storage" [15]. "Honey constituents with health benefits include phenolic acids, ascorbic acid, flavonoids, proteins, carotenoids and enzymes like glucose oxidase and catalase" [16].

1.1.2 Uses of Honey

The different types of uses of honey [15] [17] are listed as follows:

Food supplement- Use of honey as food continues because of its natural flavor, taste and its natural preservative properties. Honey is used directly in cooking and as an ingredient of other regular food items such as baked products. Hotels, health clubs and restaurants serve honey on table as bread spread, in salads or in their special food and drink preparations.

Medicine or tonic- In many parts of the world, honey is used as a medicine or tonic and as a special treat for children. Modern medicine is increasingly using honey for a variety of treatments. It is used as laxative, blood purifier, fever, ulcers, burns, used in cold, cough and diabetes.

Cash crop- Fresh local honey is always more highly valued than imported honey. Many beekeepers sell their product directly to consumers. Honey is often used as an exchange commodity in villages, especially in remote areas or areas isolated by war or sanctions. Honey is a stable commodity with a long shelf life. If harvested carefully, it will remain wholesome for many years.

An export crop- As standards of living rise, honey consumption increases. Most industrialized countries import honey to meet demand. This requirement can provide developing countries with a useful source of foreign exchange from honey exports. The countries with the highest honey exports are Mexico, China and Argentina. Because beekeeping does not use land, production of honey for export need not conflict with growing crops for local consumption.

Industrial importance – Almost 10-12% of total production of honey is used in industry. This is largely due to the fact that honey is costly and therefore adds significantly to the cost of production. Forest honey is usually preferred in the industries because of its low cost. It is used for making honey tea, coffee, honey biscuits, honey wine and baking.

Ancillary products – Use of honey in mass production and fast food industry has recently been increasing. Some products that use honey are processed food like cereals, ready-to-eat mixes, health foods and baby foods and dairy products like yogurts, creams, sweet-meats, fudges and ice creams.

Confectionery – During the past decade or so, honey is used in confectionery like candies, sweets, toffees, and chocolates.

In bakery – Small amount of honey is used in bakery products like breads, biscuits, cakes and cookies. It is used as a sweetener and flavouring agent in the preparation of pancakes, pastries, pies and puddings.

Honey as preservatives- This emerging industry has good potential to use honey both as a preservatives and as a flavouring medium. The fruit products industry that includes manufacture of jams, jellies, canned fruits, syrups, squashes, sauces and ketchups is just beginning to use honey in its products.

Pharmaceuticals- Much of the honey used in industry is for manufacture of medicines like cough drops, lozenges or syrup, tonics and other medicinal formulations. Interestingly, forest honey contributed to only 22% of the honey used in Pharmaceuticals companies. Dental creams and antiseptic eye lotions are newly developed products of this industry using honey.

Cosmetics- Honey has a mild action on skin, but at the same time protects it from infection and nourishes it. Because of these properties it is in use in facials, shampoos and other cosmetics. Consumption in this sector was negligible. With the recent perceptible shift towards herbal preparation honey is increasingly used for manufacture of skin-care and hair-care products as a natural therapeutic and medicinal ingredient.

Antioxidant- Antioxidants are substances which protect the body from damage caused by free radicals. Free radicals are very reactive chemicals which react with and change other molecules next to them. Maurya *et al*. [18] investigated, "the antioxidative properties of honey from different flora and reported that honey serve as a good source of natural antioxidant and hence, it is free radical scavengers that either reduce the formation of or neutralize free radicals. Honey is a healthy foodstuff for human health and nutrition".

Religious ceremonies– "It has high place in the world. Honey remained mainly as an essential food in religious ceremonies at the time of birth, marriage and death, as well as an item offered to the gods during worship. Social and cultural customs in all religious groups include use of honey. Christian's use to make cakes on Christmas, Quran has special chapter for honey, Hindus use it as a holly thing" [18].

Stamina booster- Athletics use it with the milk to increase their stamina.

Growth enhancer- It is used in plant growth and root cuttings.

Culture medium- In the laboratory, honey is used to grow bacterial culture.

Other industrial uses- Significant quantities of forest honey are used in incense sticks manufacture, perfumery, tobacco curing and cigarette manufacture.

1.2. BEESWAX

It is important byproduct of bee keeping industries. It is true wax secreted by four pairs of specialized glands on the ventral side of the abdomen (sternites 4-7) of about 2-week older worker

bees. They secrete flakes of a soft, malleable material called beeswax that bees use to build the comb where honey is stored and larvae are reared. Bee's wax in elementary origin is whitish in colour and later becomes darker. In India, wax is obtained from rock bee (*Apis dorsata).* The wax has a relatively low melting point so it is easy to extract and purify with heat.

1.2.1 Composition of beeswax: "Pure beeswax consists of at least 284 different compounds. All of them have not been completely identified but over 111 are volatile" [19]. "At least 48 compounds were found to contribute the aroma of beeswax. Quantitatively, the major compounds are saturated and unsaturated mono-esters, di-esters, hydroxyl-polyesters, saturated and unsaturated hydrocarbons and free acids. There are 21 major compounds constituting 56% of wax, each compound making up more than 1% of the pure unfractionated wax. The other 44% of various minor compounds probably contribute for characteristics of beeswax like plasticity and low melting point" [19].

"compound making up more than 1% of the pure unfractionated wax. The other 44% of various minor compounds probably contribute for beeswax's characteristic plasticity and low melting point" [19].

1.2.2 Uses of Beeswax

The different types of uses of beeswax [15] [17] are listed as follows:

Candles- Beeswax is mainly consumed by candle industry and bee industry for preparing comb foundation sheets. Bee wax candles are preferred in most Eastern Orthodox churches because they burn cleanly, with little or no wax dripping down the sides and little visible smoke.

Cosmetics – Wax is also an important constituent of cosmetics like cold creams, lipsticks and rouges because it adheres better to skin.

Pharmacy – Pharmaceutical and perfume industries are also major or wax. It is also used in ointments, capsules, pill coatings and deodorants.

Furniture and inks- Wax is used for preparing shoe polish, furniture etc. because it acts as water proofing. Its minor use is made in adhesives, chewing gums and inks etc.

Cheese coating- It is also used as a coating for cheese, to protect the food as it ages. While some cheese makers have replaced it with plastic, many still use beeswax in order to avoid unpleasant odour that results from plastic.

1.3. BEE VENOM

Bee venom is a clear, odourless, watery liquid. It is produced by two glands associated with the sting apparatus of worker bees. Sting is evolved from ovipositors and is involved in hive defence and foraging.

1.3.1 Composition of bee venom: "About 88% of venom is water. The glucose, fructose and phospholipid contents of bee venom and bee blood are same. At least 18 components, including various proteins, enzymes (Phospholipase, Hyaluronidase, Phosphomonoesterase, Lysophospholipase and B -glucosidase) and peptides (Melittin, Pamine, Mast Cell Degranulating (MCD) Peptide, Protease inhibitor, Secapin, Procamine, Adolapin, Tertiapin) and various small peptides and amines (Histamine, Dopamine and Noradrenalin) have been found in venom" [20].

1.3.2 Uses Bee Venom

The different types of uses of bee venom [15] [17] are listed as follows:

Skin diseases – Bees can be made to sting the patients who have diseases and the venom can be used as medicines for subcutaneous infections. The treatment of diseases with bee venom is called as apitherapy.

Treatment of rheumatism- Bee venom has long been used in traditional medicine for the treatment of various kinds of rheumatism.

Other diseases- Its use in cure of the diseases, like chronic pain, epilepsy, rhinosinusitis, polyneuritis, neuralgia, migraine, multiple sclerosis, asthma and tropical ulcers.

Ointments- They can be prepared by thoroughly homogenizing bee venom with white Vaseline, petrolatum or melted animal fat and salicylic acid, in the ratio of 1:10:1, acid can be used to make the skin soft and increases penetration.

Blood Pressure- It has stimulating effect on heart muscles. It decreases cholesterol level and also lowers blood pressure.

1.4. PROPOLIS (BEE GLUE)

"Propolis is a mixture of the beeswax and the resins collected by honey bees from plants. During the collection of resin, it mixed with some saliva and wax. The colour ranges from yellow to dark brown. Propolis is used to line the hive cavities, brood combs, sealing of cracks in hive, reduce the size of hive entrances and sealing the brood cells. At temperature of 25 to 45ºC, it is a soft and very sticky substance but it will become liquid at 60 to 70ºC, but for some samples the melting point may be as high as 100ºC" [15].

1.4.1 Composition of propolis: "The main constituents of propolis are resin (50%), wax (30%), essential oils (10%), pollen (5%) and other organic compounds (5%). Phenolic compounds, esters, terpenes, flavonoids, beta-steroids, aromatic aldehydes and alcohols are also the important organic compounds present in propolis" [16]. "Twelve different flavonoids, namely, pinocembrin, rutin, acacetin, chrysin, luteolin, myricetin, kaempferol, apigenin, naringenin, catechin, galangin and quercetin; two phenolic acids, caffeic acid and cinnamic acid; and one stilbene derivative called resveratrol have been detected in propolis extracts by capillary zone electrophoresis" [21]. "Propolis also contains important vitamins, such as vitamins B1, B2, B6, C and E and useful minerals such as magnesium (Mg), calcium (Ca), sodium (Na), potassium (K), copper (Cu), zinc (Zn), iron (Fe) and manganese (Mn). Propolis also has a few enzymes, such as succinic dehydrogenase, adenosine triphosphatase, glucose-6-phosphatase and acid phosphatase" [22].

1.4.2 Uses of Propolis

The different types of uses of propolis [15] [17] are listed as follows:

Ointments- As propolis is a natural effective antibiotic, it is useful in preparing ointments for healing cuts, wounds and abscesses in cattle. Mixed with vaseline, it smoothens burns [23]**.** The Greeks, Romans and Egyptians already knew that propolis heals skin abscesses.

Sealant- It is used by bees for sticking frames, sealing cracks and crevices. It has been incorporated in special varnishes [23].

Cosmetics- It is used in cosmetics for rejuvenation and fairness of skin.

Health supplement- Propolis is sold as supplement in health shops too in the form of capsules, tablets and in liquids.

Its antifungal, antibacterial, antiviral, anti-inflammatory, anti-acne and antioxidant properties provide many benefits of its applications in medicines, dermatological and cosmetic treatment.

1.5. ROYAL JELLY (BEE MILK)

Royal jelly is a special liquid food which is rich in proteins, hormones, vitamins, organic acids, lipids, carbohydrates and minerals, secreted by the hypo-pharyngeal gland of young worker bees having the age of 6-12 days. Royal jelly is whitish in colour with yellow tinge having pungent phenolic odour and sour flavor. It is partially soluble in water and having pH 3.6 to 4.2.

1.5.1 Composition of royal jelly: Royal jelly consists of water (50%–60%), proteins (18%), carbohydrates (15%), lipids (3%–6%), mineral salts (1.5%) and vitamins [24]. Royalactin is the most important protein present in royal jelly and it is composed of approximately 185 organic compounds. Fatty acid, proteins, acetylcholine, adenosine monophosphate (AMP) N1 oxide, adenosine, polyphenols and hormones such as testosterone, progesterone, prolactin and estradiol are other useful bioactive components present in royal jelly [16]. It also contains 10-hydroxy-2-decenoic acid (HAD), which has immunomodulatory properties. The major mineral salts of K, Ca, Na, Fe, Zn, Cu and Mn [15].

1.5.2 Uses of Royal Jelly

The different types of uses of royal jelly [15] [17] are listed as follows:

Energy booster- "The spectacular fertility and long life-span of the queen fed on royal jelly, has suggestively led people to believe that royal jelly may produce similar effects in humans too. People have experienced it as a general tonic and stimulant improving general well-being, resistance to fatigue, learning capacity and memory, appetite and general health improvement" [15].

Immunity booster – It improves immune response and general body functions.

Pharmaceutical – Royal jelly is used as ingredient in medicinal products. It is usually mixed with medicines, tonics and beverages.

Food supplement- A mixture of royal jelly in honey (1-3% royal jelly) is probably the most common way in which royal jelly is used as a food ingredient. Royal jelly is a nutritious food for human beings also as it increases vigour and vitality.

Cosmetics – Probably the largest use of royal jelly is in cosmetics and dermatological preparations.

1.6. POLLEN

Workers collect pollen from the plants. It is used for feeding the larvae. The nurse bees refine the pollen in to beebread or royal jelly for feeding the larvae or young bees. Pollen is used for human consumption because it has 25 proteins and 18 amino acids. After harvest from bee colonies, pollen loads are carefully air-dried or fresh- frozen for preservation and packed in air tight glass bottles. Pollen is also sold as tablets and capsules mixed with honey.

1.6.1 Composition of honey: "The major components are proteins, amino acid, lipids and sugars. The minor components are more diverse including flavonoids, carotenoids, minerals, vitamins, terpenes, nucleic acids and nucleosides, enzymes and growth regulators. All essential amino acids are found in pollen" [15].

1.6.2 Uses of Pollen

The different types of uses of pollen [15] [17] are listed as follows:

Food supplement – The pollen is used as food and food supplement. Tribal people eat the comb's pollen while harvesting honey.

Medicinal use – It is used in medicine for treatment of diseases like chronic prostatitis, bleeding stomach ulcers, respiratory infections and allergy reactions.

Energy booster – Bee collected pollen is used in the cures or improvement in athletic performance, digestive assimilation, rejuvenation, vitality, appetite, hemoglobin and sexual powers.

Cosmetics – Pollen is used in some cosmetic preparations for rejuvenating and nourishing the skin.

1.7. BEE BREAD

Bee bread is a source of protein produced by honey bees for the larvae and young ones. A mixture of pollen, lactic ferments and honey is prepared and sealed within the cells of hive that turns onto beebread roughly about after three months of fermentation.

1.7.1 Composition of bee bread: "Like most other bee products, this by-product, too, contains vitamins, enzymes, minerals, lactic acid and amino acids, among other things. Bee bread stored carefully at room temperature tends to retain its beneficial properties for a very long time" [17].

1.7.2 Uses of Bee Bread

The different types of uses of bee bread [15] [17] are listed as follows:

Food supplement- A very good source of energy, bee bread has detoxifying properties along with the ability to increase hemoglobin.

Immune booster- It is used as immune booster recommended for children and people with mineral and selenium deficiencies.

Fat reducer – It reduces appetite, helps in weight management and regulates cholesterol and triglycerides.

Medicine- Bee bread is known for treating liver disorders, intestinal problems and constipation.

2. FARMERS' AWARENESS ABOUT BEEHIVE PRODUCTS

The farmers of different localities in Shimla hills were surveyed on various parameters to assess their awareness about bee pollination and beehive products**.**

2.1. Beekeeping as a Pursuit

Majority of farmers (91.10%) are practising beekeeping as a part time job whereas only 8.90% farmers are practising it as full time job (Table- 1, S. No. 1).

2.2. Motives for Rearing of Honey bees

Farmers were engaged in beekeeping since many years. Only 13.20% farmers are professional beekeepers practicing apiculture throughout the year. Some of the farmers practiced it in spring, in summer and both spring & summer seasons. farmers rearing the bees throughout the year were giving more than one season for this (Table- 1, S. No. 2).

2.3. Farmers' Awareness on Pollination

Analysis of data on farmers` awareness on pollination revealed that 80% farmers were aware about the introduction of honey bee hives in orchards at the time of flowering period helped in increasing the fruit set and yield. But they have learned it recently and this information was disseminated to them through some other persons (70%) and by government agencies (30%). Most of the farmers (80%) knew that their crops were not naturally pollinated by wind or insects due to changing weather conditions (Table- 1, S. No. 3).

2.4. Information on Beekeeping

Orchardists were rearing *Apis cerana* (40.50%) and *Apis mellifera* (55.50%) bees and only 04% had both species of bees. However, 52.10% orchardists preferred native *Apis cerana* and 38% preferred exotic *Apis mellifera,* whereas 09.90% preferred to use both the species bees for pollination (Table- 1, S. No. 4).

2.5. Number, Strength and Placement of Bee Colonies

Data revealed that majority of the farmers (65.90) were aware about the number of bee colonies required per hectare for pollination of temperate fruit crops. Most of them (87.70%) also knew that bee hives with better strength have better results. 65.70% farmers knew about the time of

placement or colonies in their orchards. However, some orchardists (45.10%) shifted the colonies from one place to another during flowering period (Table- 1, S. No. 5). Farmers need to be trained and get awareness about the benefits of beekeeping and role of honeybees on pollination of fruits, vegetables and cereals [25].

2.6. Farmers' Awareness of Bee Flora

Only half of the farmers (55%) and knowledge regarding the local bee flora. They had different types of bee plants on their own land, such as mustard, pear, apple, almond, kiwi, plum, peach, rose and bottle brush. Only 47% orchardists agreed that there was sufficient availability of bee flora in local areas. According to most of the farmers (70%) the plants nearer to hives have better produce than distant ones. Most of orchardists had plants nearby their houses. Farmers of different villages have different conceptions of honey flow period (Table- 1, S. No. 6).

2.7. Information Regarding Types, Constituents and Value of Honey

Most of the farmers (66.80%) earned extra income from honey besides using honey bees for pollination. Most of the farmers (61%) preferred brown honey. About half of the orchardists (56.50%) had knowledge about the constituents of honey and 89.20% knew about the value of honey. 66.10% respondents preferred to use honey made up of more plant sources (Table- 1, S. No. 7).

2.8. Processing and Storage of Honey

Maximum farmers (81.20%) processed the honey by themselves. About 84% farmers stored the honey in glass containers (Table- 1, S. No. 8).

2.9. Information on Other Bee Hive Products

Less than half of the farmers (44.90%) have knowledge about the bee hive products other than honey. They had the knowledge beeswax and used it for various purposes (Table- 1, S. No. 9).

2.10. Marketing of Honey

Collection of honey was made available at different intervals. Most of the persons (61.40%) were satisfied with the collection interval. Majority of farmers (66.30%) were not satisfied with the transport arrangements in their regions. Many farmers (79.90%) were facing marketing problem of different kinds. Nearly 50% farmers consider low price of honey as main problem in beekeeping and majority of them (84.60%) sold their honey to private parties for more than one reasons (Table- 1, S. No. 10).

Table 1: FARMERS' AWARENESS ABOUT HONEYBEES AND BEEHIVE PRODUCTS

S. No.	Farmer's Awareness	Variables	Responses			
			Yes (%)	No (%)	DNK (%)	Total (%)
1.	Beekeeping as a Pursuit	Full time	08.90	-	-	100
		Part time	91.10	-	-	
2.	Motives for Rearing of Honey bees	Pollination purpose	65.30	-	-	100
		Professional beekeeper	13.20	-	-	
		Part time honey producer	13.20	-	-	
		For honey production and pollination (both)	06.80	-	-	
		Experimenting apiculture	01.50	-	-	

3.	**Farmers' Awareness on Pollination**	**a) Knowledge about honeybee pollination**	80	11	09	**100**
		b) Source of pollination knowledge				**100**
		Government officials	30	-	-	
		Other persons	70	-	-	
		c) Yield by artificial pollination				**100**
		Increase	75	-	-	
		Decrease	25	-	-	
4.	**Information on Beekeeping**	**a) Types of bees reared**				**100**
		Apis mellifera	55.50	-	-	
		Apis cerana	40.50	-	-	
		Both Species	04.00	-	-	
		b) Preferred bee species			-	**100**
		Apis mellifera	52.10	-	-	
		Apis cerana	38.00	-	-	
		Both Species	09.90	-	-	
5.	**Number, Strength and Placement of Bee Colonies in the Orchards**	**a) Number of honeybee colonies/ha required for pollination**	65.90	25.40	08.70	**100**
		b) Better results of healthy colonies	87.70	08.50	3.80	**100**
		c) Knowledge about placement of colonies in orchards	65.70	26.20	08.20	**100**
		d) Shifting of colonies to another site	45.10	34.70	10.20	**100**
6.	**Farmers' Awareness of Bee Flora**	**a) Knowledge about bee flora**	55	35	10	**100**
		b) Sufficient bee flora	47	19	34	**100**
		c) Flora nearer to hive has better yield thane rear one	70	19	11	**100**
7.	**Information Regarding Types, Value and Constituents of Honey**	**a) Honey as extra income source**	66.80	29.60	03.60	**100**
		b) Preference for the type of honey	36.60	61.20	02.20	**100**
		c) Awareness about honey constituents	56.50	42.30	01.20	**100**
		d) Awareness about nutritional value of honey	89.20	09.70	01.10	**100**

		e) Preference for one or more source honey				**100**
		One source	33.90	-	-	
		More source	66.10	-	-	
8.	**Processing and Storage of Honey**	**a) Honey Processing**				**100**
		Manual	81.20	-	-	
		Honey processor	14.30	-	-	
		Not processed	04.50	-	-	
		b) Storage				**100**
		Glass containers	84.10	-	-	
		Steel containers	09.40	-	-	
		Drums	02.20	-	-	
		Plastic bags	04.30	-	-	
9.	**Information on Other Bee Hive Products**	**a) Knowledge about other beehive products**	44.90	51.70	03.40	**100**
		b) Knowledge about use of beeswax				**100**
		Creams	05.60	-	-	
		Sheets	16.30	-	-	
		Polishes	04.30	-	-	
		Candles	35.70	-	-	
		Thread strength	07.80	-	-	
		Sell	02.20	-	-	
		Comb foundation	28.10	-	-	
10.	**Marketing of Honey**	**a) Satisfaction with honey collection intervals**	61.40	35.30	03.30	**100**
		b)Marketing problems	79.90	11.10	09.00	**100**
		c) Satisfaction with transport arrangements	30.00	66.30	03.70	**100**
		d) Types of problems				**100**
		Less price for honey	49.90	-	-	
		Market was away	08.70	-	-	
		Time consuming	11.30	-	-	
		Long processor	02.30	-	-	
		Winter snow falls	07.80	-	-	
		Need of genuine support price	03.30	-	-	
		Need of guidance	10.60	-	-	
		No marketing facility	06.20	-	-	
		e) Selling honey to private parties	84.60	14.40	01.00	**100**

		f) Preference of selling honey to private parties				**100**
		Easily available	54.30	-	-	
		Advance payment	06.70	-	-	
		High incentive	09.80	-	-	
		Better rates	21.20	-	-	
		Economic regions	03.90	-	-	
		Money of transportation saved	04.10	-	-	

Conclusion

The purpose of beekeeping in Shimla hills of Himachal Pradesh is pollination of fruit crops. Honey bees increase the yield of all fruit crops by cross pollination. They produce a range of economically important substances like honey, beeswax, pollen, propolis, venom and bee bread. Beekeeping and honey bee management in Himachal Pradesh is in infancy. Most of the farmers here practiced beekeeping as a part time job but the commercial beekeepers stressed on the role of honey bees as honey producers than pollinators of horticultural crops. Most of the farmers earned extra income from honey and other bee products besides using them for pollination purposes. They had knowledge regarding different aspects of honey such as its composition, nutritional value, storage containers, processing, marketing problems etc. But only a few farmers were aware of other hive products like beeswax, bee venom, propolis, royal jelly and pollen and their uses as medicine, cosmetics, pharmaceuticals, apitherapy and industry. The beekeepers' awareness, financial assistance and improved beekeeping technologies are required in this region. It will not only benefit beekeepers but other farmers and general public also in pollinating crops, gaining extra income and maintaining biodiversity.

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