TRANSFORMING HARYANA -PROGRESSING HARYANA

Working Group Report on Promotion of Honey Beekeeping in Haryana

HARYANA KISAN AYOG

Government of Haryana

Working Group Report
on
Promotion of Honey Beekeeping
in Haryana

2017

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Anaj Mandi, Sector-20, Panchkula - 134116

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Working Group Report on "Promotion of Honey Beekeeping in Haryana"
Published by : **Haryana Kisan Ayog**

Number of copies published : 1000
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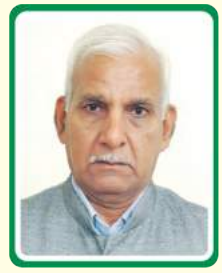

FOREWORD

Honey bee keeping provides excellent source of employment for the rural landless youths and enhances income of farmers. Due to its low cost and higher returns, the beekeeping is projected as an important subsidiary or even major occupation as compared to other agro-based industries. It also enhances the productivity levels of agricultural, horticultural and fodder crops through pollination services. Haryana, Punjab, U.P., Bengal and Bihar are the major beekeeping states in the country.

Haryana is one of the leading States in honey production. The State represents one of the most important beekeeping areas in India as it has varying agro-climatic conditions and crop diversity in different zones. Several cropping pattern due to different soil types, irrigation facilities, temperature, and relative humidity and the agro-climatic conditions prevailing in the state are also quite favorable for beekeeping. In Haryana where land holding is less than 0.75 ha, beekeeping can provide better food, balanced nutrition and additional income to small and marginal farmers. The rural artisans such as carpenters, black smith and manufactures of other beekeeping equipments may also get additional income due to further expansion of beekeeping in the state.

Bee keepers are harvesting good volume of honey but they are largely selling it as raw and have not come forward to get their honey processed. Some progressive beekeepers need to be trained to extract royal Jelly, bee venom and prepare other products like wax, pollen etc for optimum harvest of bee hives as there is great scope for marketing the bee hive products in the NCR keeping in view the demand and states strategic location.

The Haryana Kisan Ayog constituted a working Group of experts on 'Promotion of Honey Beekeeping in Haryana' consisting Dr. V.K. Mattu as Chairman, Dr. S.K. Garg, Dr. C.J. Juneja and Dr. Jaspal Singh as Members, besides Dr. Gajender Singh as Nodal Officer. The expert group deserves all the appreciation for their sincere efforts in finalization of this Working Group report. I am confident that this report will turn a new leaf and 'Way Forward' to promotion of honeybee keeping in Haryana as a beneficial farming occupation.

I congratulate Dr. R.S. Dalal, Member-Secretary, Haryana Kisan Ayog and Dr. V.K. Mattu, Chairman and the members of Working Group for bringing out this valuable report. I am sure that this publication will be highly useful to administrators, planners, policy maker's beekeepers and entrepreneurs/traders specifically for those having interest in Apiculture.

(Ramesh Kumar Yadava)

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PREFACE

Apiculture (Beekeeping) as a non-land based income-generating activity is now becoming an important component of present day strategies for development of sustainable agriculture. This report of the Working Group on "Promotion of Honey Beekeeping in Haryana" is intended to serve as a guide to policy makers, planners, administrators, rural developers and agriculture, horticulture and forestry experts to make them aware of the importance of beekeeping in providing extra food, cash income, nutritional benefits, pollination of crops, employment and improvement of environmental health. It deals with the scientific and practical aspects of beekeeping with exotic species of honeybees, *Apis mellifera L.* in this region, that is suitable for beekeepers, extension workers and researchers.

The different natural hive products such as honey, pollen, royal jelly, bee venom and propolis not only broaden the food base of poor rural communities, but can also help in solving the problem of Protein-Energy-Malnutrition (PEM) caused by an overall shortage of calories and proteins in their diet. Honey along with other hive products has also been used for centuries all over the world for medical and pharmacological purposes. Thus beekeeping technology which is low in investment, appropriate in scale and operations, safe and affordable, can provide both food and nutritional security to the rural communities.

Yet another dimension of the beekeeping is the role it can play in the development of rural women because the work is not heavy, allows time flexibility, provides gainful employment close to home and financial independence to housewives. A few successful women entrepreneurs engaged in modern beekeeping in this region provide a good example for others to follow.

This report is an attempt to deliberate upon all the aspects of beekeeping/apiculture as set forth in terms of reference for the working group. The report has assessed the present status of beekeeping and its stakeholders in Haryana, identified the opportunities as well as challenges for further growth and provided appropriate technological, developmental and policy options for the future growth and development of the State. The report in particular has examined in details the farmer's perspective of beekeeping/pollination as well as economic development of this sector and has made recommendations for not only providing solutions to their concerns but also implementing policy options for horticulture and other departments of the State Government to bring a qualitative and quantitative change in the state of functioning of the beekeeping sector.

The State of Haryana is possibly the most suitable part of the country to start initiating efforts to establish a centre of excellence for apiculture. It should act as a coordinating agency and provide general liaison between different parts of this region, between aid agencies and Government and thus help in the original planning of this state.

The programs, projects and the policy level recommendation together, if implemented, in the indicated time frame in a mission mode, will ensure a status of a front line standing for the farmers of the State, simultaneously increase the economic standing of the beekeepers, potentiate the primary sector growth in this region and thus well establish the state of Haryana as a role model for bee keeping/apicultural growth and development in the country. It is hoped that this report will arouse considerable interest in Government, non-government and funding agencies for their continuing commitment to beekeeping development programmes.

This report would not have been possible without the unflinching support of the Haryana Kisan Ayog secretariat particularly its Member Secretary Dr.R.S.Dalal, who spared no efforts to facilitate the deliberations, visits, meetings and interaction with official institutions and different aid agencies.

(Vinod K Mattu)

ACKNOWLEDGMENTS

Words are inadequate to express our gratitude to Padma Bhushan Dr. R.S. Paroda, former Chairman, Haryana Kisan Ayog for his visionary approach in identifying beekeeping as one of the key sector for rural prosperity and nutritional security by way of enhancing the production of agricultural and horticultural crops through the role of bees in seed setting. / pollination. Constitution of an independent Working Group for the promotion of honey beekeeping in the State of Haryana is a timely step, shows his commitment towards the welfare of the farming community in the State. The study of this dimension and preparation of a comprehensive report would not have been possible without the invaluable support and valuable suggestions of Dr. Ramesh Kumar Yadava, Chairman Haryana Kisan Ayog.

We would also like to thank Dr. A.S. Saini, Director General Horticulture, Sh. D.K. Bahera IAS, Director of Agriculture, and Farmer Welfare, Dr B.S. Sehrawat Mission Director, HSHDA, Dr. R.K. Thakur, Project Coordinator AICRP, New Delhi, Prof. Dr. S.S. Siwach Director Research CCS HAU Hisar, Prof. S.K. Sharma and Prof. Yogesh Kumar Department of Entomology CCS HAU Hisar for their kind input at various steps in the smooth functioning of the working group.

The working group takes immense pleasure in thanking Sh Jagjit Singh Kapoor, proprietor Kashmir Apiary Doraha (Ludhiana Punjab), progressive honey beekeepers and entrepreneurs, stakeholders from Haryana and Punjab who shared their success stories and / or participated in various interactive meetings and workshops held at Panchkula, Karnal and at other places of the State etc.

An honourable mention goes to the senior officers of the Department of Agriculture & Farmer Welfare, Horticulture, Bankers, Industry representatives and Experts from various fields for their valuable inputs and sharing their experiences whenever needed. Working Group would also like to thank Late Dr S.P. Singh (former chairman of the working group) for his contributions in laying the foundation of this working group by way of his sincere and experienced advice.

Our special thanks and appreciation go to Dr. R.S. Dalal, Member Secretary, and the team of Haryana Kisan Ayog for their excellent cooperation, effective and prompt organization of all meetings with State beekeepers and other stakeholders and Govt officials, and also for providing necessary logistic support and necessary help in the preparation of this important report on promotion of honey beekeeping in the State of Haryana.

Dr. Vinod K. Mattu

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EXECUTIVE SUMMARY

Apiculture is an exclusive non-land based activity which does not compete with other farming systems for resources. It also helps in the conservation of forest and grassland ecosystems because honey bees are one of the most efficient pollinators. Inputs for apiculture are mostly simple and locally available. Yet another significant, but not widely recognized role, is that honey bees enhance the productivity of agricultural, horticultural and fodder crops because of effective cross pollination. It has been estimated that the value of honey bees as pollinators is about 18-20 times more than their value as producers of honey and other hive products.

Bees and beekeeping also provide free ecosystem services in the form of crop pollination, thereby helping in the conservation of forest and grassland ecosystems. The role of beekeeping in improving the subsistence economy of farmers cannot be overlooked as it has been linked with the socio-economic, cultural, religious and natural heritage of communities living in rural India. Therefore, it is becoming an important component of present day strategies for sustainable development and organic farming programmes.

Honeybees and honey find special mention in the Indian epics and bee hunting for honey dates back to some 2000 to 2500 years. Presently only four species of honey bees i.e., Rock honey bee, *Apis dorsata F.;* little honey bee, *Apis florea L.;* Indian honey bee, *Apis cerana F.* and European honey bee, *Apis mellifera L.* are being considered as important component for honey production and pollination of various crops in India. Today most of the countries practise bee keeping with the European honeybee, *A. mellifera* which surpasses the Indian honeybee, *A. cerana* in almost all the traits.

Beekeeping is an excellent source of employment for the rural unemployed youth. It enhances income of farmers and the landless beekeepers. A number of small scale industries depend upon bees and bee products. Honey and other hive products find use in several industries which are under pharmaceuticals, beeswax industries, bee venom, royal jelly, bee nurseries, bee equipment, hives etc.

At present there are about 2.0 million bee colonies in India, with an estimated annual production of around 80,000 metric tonnes of honey (including honey from wild honey bees). India has a potential to keep about 120 million bee colonies that can provide self employment to over 12 million rural and tribal families. In terms of production, these bee colonies can produce over 1.2 million tonnes of honey and about 15,000 tonnes of beeswax.

1. Status and Prospects of Beekeeping

The Haryana State presents two distinct zones for beekeeping:

i) North zone:

North zone where relatively lower temperature (up to 44°C) and higher humidity (above 30%) are witnessed during dearth period.

ii) South west zone:

Here high temperature (around 48°C) and low humidity (15% or less) prevail during summer months.

The different cropping patterns due to different soil types, irrigation facilities, temperature, relative humidity and the agro-climatic conditions prevailing in the state are quite favourable for beekeeping with *Apis mellifera*.

In Haryana state, commercial beekeepers rear *A. mellifera* bees whose queen is highly prolific and lays about 1,500-2,000 eggs per day during honey flow season. Therefore, the colonies always remain in good strength. To maintain their strength during dearth period, these colonies are regularly migrated in those areas where plenty of bee floras are available in that season. In North zone of Haryana, eucalyptus, toria, pigeon pea, sunflower, berseem etc. are grown in plenty, whereas, in South west zone, the crops like mustard, acacia, *ber,* bajra and cotton are grown in large areas.

There is still vast potential and scope of diversification of beekeeping in Haryana. Besides honey, it offers scope for production and marketing of other bee hive products like beeswax, pollen, propolis, royal jelly and bee venom. In addition, sale of package bee, the rearing and sale of pedigree queens offers a tremendous scope as entrepreneurship activity. Renting out bee colonies for pollination is also another source of income to beekeepers. Apart from direct employment to beekeepers, there is a dire need for good artisans, hive manufacturers, apicultural equipment and machinery manufacturers, transport system for migration of colonies, traders, product quality experts, packers, sellers, raw material dealers, etc. and allied industries. This industry has, so far, remained unexplored and thus offers tremendous scope.

2. Management of Honey Bee Colonies for Higher Productivity

Productivity of honey bee colonies is dependent on availability of bee flora, congenial weather conditions and their management. Management of honey bee colonies both during the major honey flow season and off-season is important for obtaining higher honey production. Beekeeping equipment is also a very important component of scientific beekeeping, so its quality and proper use will also boost colony performance. Most important factors affecting the productivity of bee colonies in Haryana are: Use of standard equipment; Selection of colonies; Maintaining strong colonies; Use of queen excluder; Selective division; Marking and isolation of infected/infested colonies; Proper and timely migration; Preventing swarms; Hiving of alien swarms; Checking robbing; Mating of quality queens with drones; Off-season colony management; Quality honey production and Avoidance of open feeding.

3. Hive Technologies for Products

The technologies for the production of different hive products are now available in India but required to be standardized at the farmer's field. The implementation and commercialization of these products is essential to enhance the income of the beekeepers in Haryana state.

Today, honey is being used as a food and food ingredient. As food, it can be used in baked products like cake, biscuits, breads, confectionary products, candy, jams, spreads and milk products. Products of honey fermentation includes honey vinegar, honey beer and alcoholic beverages. Honey is being used in tobacco industry to improve and preserve tobaccos aroma. In addition, honey is also being used in cosmetic products such as lotion, ointments, creams, shampoos, soap, toothpaste, deodorants, facial masks, make up, lipsticks, perfumes, etc..

Among the important hive products of Haryana, honey is at present the only cash form which is harvested from the bee hive. Honey extraction and its processing is done by both the traditional and modern methods. In Haryana, there are only four medium scale processing plants at Murthal (1), Ambala (1) and Yamunanagar (2) and four small scale honey processing plants at Karnal (1), Sonepat (1), Hisar (1) and Rohtak (1). Haryana Agro Industries Corporation (HAIC), Ltd. is a registered society which has its R&D centre at Murthal (Sonepat). This centre has a Honey Processing Unit having the capacity of processing one MT daily. It has signed an agreement with HAFED (Haryana Government Federation) to market honey, which is to be procured and processed by this centre with the brand name "Haryana Madhu". This centre is also processing honey of the farmers @ Rs. 5/kg but the response is very poor. The State Government should explore the possibility of processing farmer's honey at subsidized rates and steps should be taken to put in use the non-functional processing plants. Further, the Honey processing policy is required to be formulated and more processing plants needs to be established in Haryana.

Currently there is a major thrust on value addition of Honey and other bee products. The value addition technologies developed by the Government organization viz., Punjab Agricultural University (PAU), Ludhiana, Central Food and Technology Research Institute (CFTRI), Mysore, Central Bee Research and Training Institute (CBRTI) Pune and private industries (especially of M/s Kashmir Apiaries Exports) have already started helping beekeepers and bee industry in harvesting rich dividends. Kashmir Apiaries Export and Little Bee Impex, (Doraha, Ludhiana) are obtaining honey from bees foraging on Coriander, Litchi, Sunflower, Multi flowers, Shivalik, Jamun and Organic / Forest etc. These are some of the other types of crops from which honey is obtained. Some value added products of these firms are Honey 'n' Lemon, Honey 'n' Ginger, Honey 'n' Cinnamon, Honey 'n' Tulsi. Several types of honey and fruit spreads, Honey 'n' Nuts, Honey 'n' Dry fruits, Honey based tea; Honey based sauces / syrups / shakes are being produced and sold.

The industry has, so far remained unexplored in Haryana and offers tremendous scope for growth. Commercial beekeepers can be extended support to take up such value addition product activities to enable them to increase employment generation on the one hand and ensure better remunerative price to the beekeepers engaged in production of honey on the other. In this regard, infrastructure facilities are required to be created for the preparation of various value addition products of honey in the State. Besides honey, in Haryana, there is also a need for the commercialization of other hive products like beeswax, royal jelly, bee venom, propolis, pollens etc. which have multipurpose uses with a lot of scope on foreign exchange earnings through their export. However, such products are yet to appear in this state because of a lack of technical know-how.

4. Crop Pollination and Conservation of Pollinators

At present, in Haryana state, *A. mellifera* is playing an important role in increasing the productivity of vegetables, oilseed crops, fruits, fodder and other miscellaneous crops. It is estimated that increase in various crops ranges from 252 to 1505 metric tonnes due to bee pollination alone. But in recent years, pollinator population is on decline in Haryana state as in other parts of the Indian subcontinent due to a number of factors like: excessive and indiscriminate use of chemical pesticides; land use changes, monoculturing and deforestation; conventional methods of honey extraction from wild bee colonies; minimal

efforts for conservation of the native pollinators; agricultural intensification and promotion of honey bee friendly high yielding composite and hybrid varieties; global warming/climate change; introduction of exotic vegetables; destruction of natural pasture lands; unawareness among the farmers and general public about significant role played by pollinators including honeybees; natural calamities and perpetual forest fires and Lack of promotional policies.

One of the major problems faced by beekeepers in Haryana is different type of pests attacking various agricultural and horticultural crops and in order to protect the crops, various types of pesticides are being used in different agro-climatic zones of the state. Thus, the use of insecticides during the crop blooming period is of major concern. Application of insecticides on bee floral crops like *Brassica juncea, Brassica napus, Brassica rapa, Sesamum indicum, Trifolium alexandrinum, Helianthus annuus,* fruit and vegetable crops during their blooming periods may cause major loss to pollinators. This may lead to large scale mortality of honeybees as well as of other pollinators, thereby, resulting in reduction in productivity of honeybee colonies as well as of crops because of dwindled population of foraging pollinators.

Therefore, following strategies needs to be adopted for the conservation of honeybees and other pollinators in Haryana State, :- Use of broad spectrum pesticides should be avoided; only selective and relatively environmental friendly (REF) pesticides should be used wherever necessary; Recommended dose and concentration of pesticides should be used; Pesticidal application should be avoided during the blooming period of crops; It is useful to keep bee colonies as far away from the pesticides treated fields as possible; Pesticidal applications if possible, should be done in early morning or during late evening hours; There is a need to create awareness among farmers and orchardists regarding pesticide application schedules and insecticidal poisoning of pollinators; Greater stress should be laid on integrated pest management programmes so as to minimize the use of poisonous chemicals; Floral diversity should be conserved and maintained to encourage the wild pollinators; There is a need to develop a technique for mass rearing of insect pollinators and survey of their natural nesting sites; Like other agro-inputs, managed pollination should be included in programmes of agriculture and horticulture departments; Adoption of pollinator-friendly management practices; Green accounting; Pollinator awareness programmes should be launched among farmers and general public and enhanced integration of pollination issues should be weaked into sectorial policies, including agriculture and environment.

In Haryana, many factors influence toxicity of insecticides to pollinators, like stage of the crop; time of insecticide application; nature of the pesticide; type of formulation etc.. In order to combat the effect of toxic chemicals, various measures have been recommended in the present report so as to minimize pesticidal toxicity to pollinators including honeybees. By adopting the above measures, farmers as well as the beekeepers in their areas will be able to maintain higher population of honeybees and other pollinators in the field as well as in the hives. This will benefit the farmers in terms of higher production of seed or fruit as well as higher honey production. This process will further encourage other beekeepers and farmers to have close linkages to achieve this mutually beneficial bonding. Therefore, there is an urgent need to check the harmful effect of pesticides through legislation or improved pest control programmes.

In Haryana state, about 250 plant species have been identified as bee forage from which bees collect nectar and pollen for their growth and development. Of the total bee flora, 29 species are source of nectar, 21 species pollen and 200 species are source of both pollen and nectar. According to the relative utility of the bee flora, the plant species have been grouped into four categories. Nine plant species included in the major category are very rich source of nectar, pollen or both. Their acreage is quite high in the state. Of these, major sources are mustard, eucalyptus, berseem, sunflower, bajra, cotton, pigeon pea, acacia and neem. Multiple honey extraction is possible in the state where these sources are available in succession. Twenty plant species comprising the medium utility bee flora are rich source of nectar, pollen or both and have abundant occurrence in the state. These sources are mainly utilized for maintaining the colony strength throughout the year. The minor and poor utility category bee flora contain 45 and 95 plant species, respectively. These plant species are either poor / very poor source of nectar and pollen or their intensity is very rare. These sources are comparatively of lesser importance to honey bees and are useful only as subsistence food sources.

Decline in bee flora due to deforestation and cleaning of waste lands for extensive agriculture has been one of the serious setbacks for Haryana beekeeping. Propagation and mass plantings of bee flora through aforestation should be done on the principle of planting flora having multiple uses, since it is not practically possible to plant melliferous plants for honey bees alone. These plantations can be undertaken along highways, railway lines as well as in waste lands with the help of some central agencies. People can be encouraged to take up plantation of bee flora under social forestry, agroforestry and apiforestry schemes.

5. Honey bee Pests, Predators, Diseases and their Management

The most important enemies of honey bees in Haryana include parasitic mites, waxmoths, predatory wasps, beetles, ants and birds. Most important mites affecting bee colonies are Tropilaelaps clareae and Varroa destructor. Besides parasitic mites, other important pests and predators attacking A. mellifera colonies in Haryana include waxmoths like Galleria mellonella and Achoria grisella; predatory wasps like *Vespa magnifica, V. auraria, V. basalis* etc. and Predatory birds like Green bee-eater, King crow etc.. Among the important diseases, European foulbrood, Nosema, Sac brood etc. are affecting bee colonies in Haryana State.

For managing the menace of bee diseases and enemies in Haryana, there is an urgent need to adopt following strategies scientific solutions by researchers. Develop non-chemical methods for disease and pest management; Refine chemical measures; Quantify impact of unscientific practices on colony productivity; Aid in identification; Updated information on pest and disease management; Demonstration of accurate methodology for pest and disease management; Awareness about losses incurred because of wrong practices adopted by beekeepers; Proper identification of bee diseases and enemies; Check causes of spread of diseases and pests; Exchange of combs among healthy and infected colonies; Open feeding; Robbing among the colonies in an apiary; Robbing among the colonies of adjacent apiaries; Drifting of the bees among the colonies; Use of contaminated equipment; Capturing and hiving alien swarms; Purchase and sale of colonies; Prefer non-chemical measures and Adopt recommended practices only.

6. Marketing and Economics of Beekeeping

For improving profitability of beekeeping in Haryana, two very important aspects namely marketing of honey and economics of beekeeping have to be developed. At present Haryana beekeepers are producing large quantity of honey by rearing *Apis mellifera* and almost all of the honey is sold in wholesale market. These beekeepers generally do not put much effort in retail marketing of honey. Most of the beekeepers just remember how many buckets of honey they have sold in the season, but do not maintain the record of expenditure and income from their beekeeping enterprise.

To have better marketing of honey, there is a need to make beekeepers aware of the importance of honey bottling, labeling, presentation, promotion and maintenance of quality of honey. Various aspects of honey marketing in Haryana that need serious attention are: balance in wholesale and retail marketing; expansion of products list by value addition; advertisement and promotion of brands for New market; contractual retailing of honey by involving unemployed rural youth, urban market; attractive gift packing; attractive bottles; attractive display of honey on roadside; festivals and melas; promotion through print media and audio-visual heads.

So far no systematic studies on the economics of beekeeping have been carried out in Haryana to project the immense importance of this enterprise. In this report, the economics of beekeeping based on the data supplied by different bee scientists of the region have been worked out. Such an analysis will be helpful to develop broad guidelines to initiate further action to develop beekeeping as an enterprise for different target groups at various technological levels.

7. Constraint Analysis in Beekeeping Industry

Apiculture could not get its due recognition in educational institutions and at Government level; lack of adequate laboratory facilities for diagnosis, prevention and control of pests and diseases of honey bees and their management; deforestation and depletion of floral resources; difficulties in the migration of honey bee colonies; lack of quality nucleus stock of *Apis mellifera;* lack of infrastructure at the grassroots as well as National level for producing large volumes of genetically superior queen bees for supply to beekeepers; lack of facilities for imparting practical training in scientific beekeeping to the farmers/beekeepers; lack of technical knowledge for efficient management of honeybee colonies for high honey yield; poor quality control for production of honey and other beehive products; more emphasis for production of honey as compared to other beehive products lack of institutional support for beekeeping in terms of bank loans, etc.; lack of marketing facilities and proper pricing policy for honey and other beehive products; indiscriminate use of insecticides, pesticides and weedicides, etc.; adverse weather conditions and pollution of water and air; lack of consumer awareness about honey and its products; lack of accurate scientific database i.e. contradictory figures about potential, present status and future prospects of the beekeeping industry in Haryana and lack of adequate research facilities for beekeeping.

8. Beekeeping Trainings, Extension and Research

Beekeeping in Haryana is being practiced for several years and has been a source of income for thousands of families in Haryana. Beekeeping has developed a lot with the tremendous efforts of scientists, extension officers and workers and ofcourse beekeepers

in Haryana. But still there is a great scope for further development of beekeeping in newer areas which are still untapped/inexplored beekeeping. Faster growth of beekeeping can be achieved only through development of sound bee management techniques and their proper dissemination to the beekeepers. For effective and proper dissemination of apicultural technologies throughout the state, there is an urgent need to develop extensive training centers with well trained extension personnel. Some of the strategies that can help farmers, beekeepers and extension workers are, establishment/strengthening of training units at district and State level: trainers' trainings; basic and advanced trainings; beekeeping workshops beekeeping exhibition gallery; model apiaries; organising honey festivals; felicitation of innovative and successful beekeepers; and telephonic & on-farm consultancy etc..

9. Research and Development Activities

Apicultural research includes both basic and applied aspects. Basic research can pave a pathway for formulating the possible means to plan for the applied research and the extensions machineries will be educated on outcome of the applied research for efficient transfer of beekeeping technology for utilization by the ultimate users. At present, apicultural research at National as well as state level is suffering due to a number of reasons enlisted in the present report. Therefore, there is an urgent need to motivate young researchers to carry the further research on various aspects of beekeeping especially bee breeding, bee management, bee forage, capacity building, bioprospecting, biotechnological aspects etc. which will help in promoting beekeeping industry in Haryana in the long run.

To address the issues and concerns of the beekeepers, farmers, extension workers, researchers, beekeeping professionals and the stakeholders, a series of suggestions have been made for undertaking R & D programmes for enhanced honey production and productivity of different agricultural and horticultural crops. The major thrust areas have been identified and a road map of strategies and action plan to be implemented has been suggested as follows:

- Multiplication and distribution of bee colonies
- Commercialization of the beekeeping industry
- Adoption of scientific beekeeping
- Streamlining migratory beekeeping practices
- Organic beekeeping
- Establishment of honeybee parks
- Processing, packaging and marketing of honey
- Establishment of honey testing and disease diagnostic laboratories
- Apitherapy: a new alternate system of Indian medicine
- Judicious use of pesticides
- Artificial insemination of honeybees
- Administrative reforms
- Management of financial resources
- Coordination amongst beekeeping and R & D organizations

- Upgrading beekeeping extension and HRD component
- Bridging knowledge – practice gap
- Special independent status for beekeeping industry
- Role of women in beekeeping
- Recognition of beekeeping in educational institutions
- Capacity building
- Upgrading beekeeping scientific database and statistics

10. Overview

Scientific and technical action plan, projects and policy level recommendations together are summarized and presented. If implemented, in a judicious manner in a proper time frame work, they will ensure a status of a front line standing for the beekeepers and farmers of the state, as also increase the economic standing of the apiculturists, potentiate the primary sector growth in the GDP and establish the state of Haryana as a model State for beekeeping research and development in the country. Critical parameters for such growth process have been enumerated and their quantitative and qualitative role identified in the current developmental scenario. All these efforts can help in bringing a 'sweet revolution' in the State of Haryana in very near future.

POLICY BACKGROUND

INTRODUCTION

Beekeeping is destined to play a crucial role in the present context of commercialization of agriculture and liberalization of Indian economy. Bees and beekeeping also provide free ecosystem services in the form of crop pollination thereby helping in conservation of forest and grassland ecosystems. The role of beekeeping in improving the subsistence economy of farmers cannot be overlooked as it has always been linked with the socio-economic, cultural, religious and natural heritage of communities living in rural India. Therefore, it is fast becoming an important component of present day strategies for sustainable development and organic farming programmes.

The potential for beekeeping in India is yet to be realized and according to a rough estimate, the present practicing beekeeping is a mere 10 per cent of the total potential. It is also well documented that there is a significant untapped diversity of scientific and practical knowledge available with in the country. Several aspects have been studied in much detail but this knowledge has not been widely disseminated. In general, a little is known about the overall status of research, training and extension systems, primarily because of a lack of coordination amongst the various implementing agencies and lack of database on different aspects, especially organic beekeeping. Pollination and its practical application are still knowledge for insiders only and a broad level outreach of this aspect is lacking. There is, thus, an obvious need for reorienting policies and programs in the country for revitalizing the beekeeping industry thereby resulting in a paradigm shift towards more productive and sustainable apiculture.

As per the estimates given by different sources/organizations, presently there are about 2.0 million bee colonies of native *Apis cerana F.* and exotic *Apis mellifera L.* kept in traditional and modern beehives in India producing above 80,000 metric tonnes of honey. About 25,000-27,000 metric tonnes of honey is exported to more than 42 countries valued at about one thousand crores of rupees. Beekeeping covers more than 5,000 villages and provides full/part time employment to more than 3,00,000 persons in Haryana, at present there are more than 2,50,000 bee colonies producing more than 3,000 metric tonnes of honey. Keeping in view, the beekeeping potential of Haryana, the state could sustain more than 4.0 lacs bee colonies of *A. mellifera* resulting in the production of more than 15,000 metric tonnes of honey annually. This will help in generating employment to more than 4,000 unemployed youths in state. In order to achieve the targets in state of Haryana, it is imperative to quantify the current status of beekeeping industry in the state for its sustainable growth. Moreover, a comprehensive survey of honey production, processing and marketing in different eco-geographic regions of the state is needed.

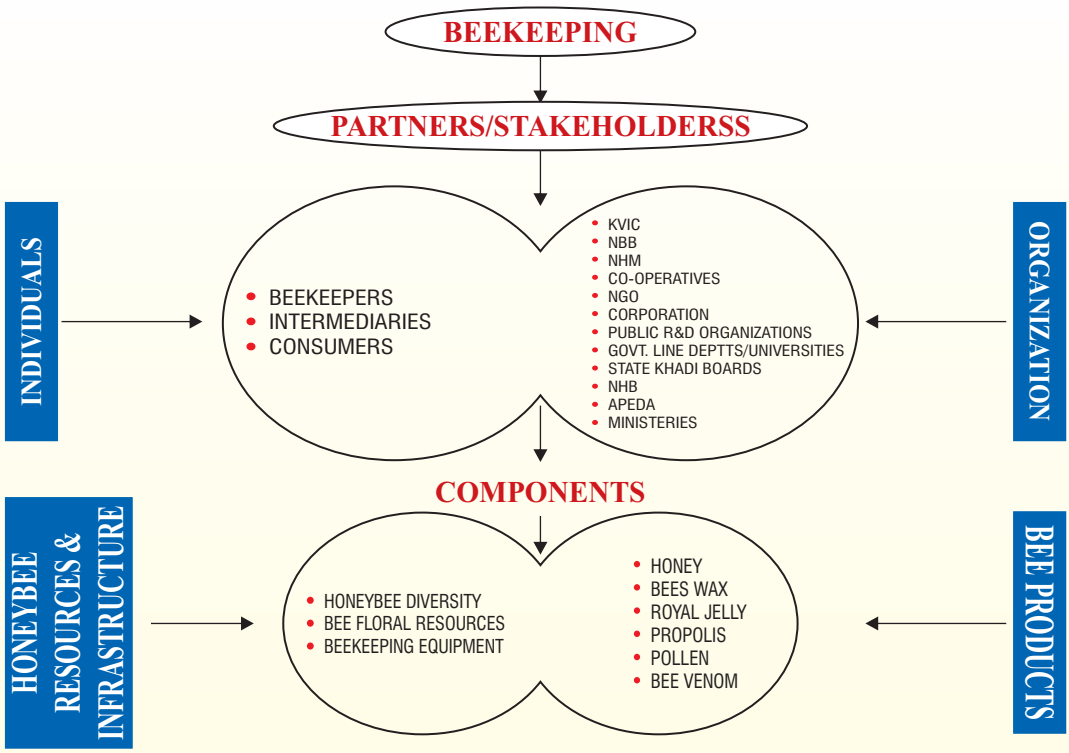
ATTRIBUTES OF BEEKEEPING

- Provides food and cash income
- Does not require ownership of land
- Provides opportunities for small, medium, and large-scale farming situations
- Provides gainful employment close to home

- Promotes co-operation within family and society
- Can be adopted as a spare time, part time, and full time occupation
- Requires a little investment and infrastructure
- The technology is simple
- Helps local craftsman to earn extra wages
- Hive products are low volume-high value and do not require special storage facilities
- Diversifies the economic base
- Earns foreign exchange
- Enhances productivity level of agricultural, horticultural and fodder seed crops
- Helps in overcoming the problems of malnutrition and human health in rural areas
- Helps in conservation of bio-diversity in general
- Solves social and environmental problems
- Provides effective linkages to other farming systems

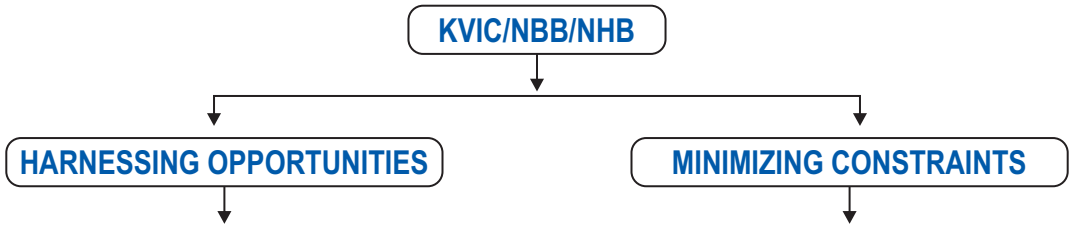
PARTNERS / STAKEHOLDERS AND COMPONENTS OF BEEKEEPING INDUSTRY

Beekeeping industry in India / Haryana can be defined as a cascade of innovative technological and business agenda aimed toward an "Ever Sweet Revolution". It should be aimed at the revitalization of honeybee resources and bee product management systems. This would result in a paradigm shift towards more productive and sustainable beekeeping in India/Haryana. Partners/stakeholders and various components of beekeeping industry are given in the following flow chart:



SWOT ANALYSIS OF HARYANA BEEKEEPING INDUSTRY

Beekeeping industry in Haryana should cover the "Entire scope of Honeybee Resource, Bee Product and Beekeeping Practices and their Interface with business / Economic Systems and Environmental Integrity". Efforts should be made to harness the opportunity and minimizing and constraints. These are listed as follow



- Honey Bee Diversity
- Vast Honey Plant Resources
- Varied Climate/Bee Plora
- Commercialization/Export Potential
- Research, Development and Infrastructure Support
- Attractive Domestic/ Foreign Market
- Linkage with Off-farm Employment
- Wealth of Indigenous Technology and Skill
- Resource and Market Oriented Diversification
- High Pay off/low Volume
- Low Degree of Perishability
- Non-competing and Non-extractive Resource user

- Slow Pace Bee Colony Production and of Multiplication
- Poor Yield per Colony Stagnation/Decline
- Honey Not Considered as a Natural / Primary Food
- Inadequate Quality Control
- Knowledge – Practice Gap
- Vulnerability to Biotic and Abiotic Stresses
- Inadequate Forward Linkages
- Indirect Gains in way of Pollination not Projected
- Inconsistent Pricing Policy
- Genetic Erosion/Species Extinction / in Breeding
- Poor Extension Infrastructure and HRD Component

CHAPTER

1

STATUS AND PROSPECTS OF BEEKEEPING, FARMERS PERCEPTION AND POLLINATION

During eighties, European honeybee, *Apis mellifera* was well established in Punjab and adjoining States of Himachal Pradesh and Haryana. In the last more than three decades following the release of this species into the Haryana fields, beekeeping in the State has progressed very fast. This agro-based enterprise is highly suitable as a subsidiary occupation for landless and marginal farmers. Beekeeping in the State has become an important agricultural allied industry for supplementing farmers' income and for self-employment of the youth.

Honey bees have been offering service to the society through ensured pollination in various agricultural and horticultural crops as well as by providing honey and a variety of beehive products. It is being increasingly realized that bees could be less expensive input for promoting sustainable and eco-friendly agriculture and enhancing crop productivity. According to agricultural scientists, value of additional yield obtained by pollination service rendered by honey bees is about 15-20 times more than the value of all the hive products put together. By adopting diversification in apiculture, a commercial beekeeper can enhance his income manifold.

With the passage of time, certain bee diseases and Varroa mite, which were not present in the state earlier, have appeared in the Northern India. This menace coupled with crashing down of raw honey rates, hike in price of beekeeping equipment and certain other administrative problems has adverse bearing on the development of beekeeping in the State. Strengthening of apiculture research, education, extension and human resource development for dissemination of apicultural technology to beekeepers and farmers is required very urgently in Haryana. In addition, there is a need to critically examine the various issues confronting promotion of beekeeping in the State and to find solutions to the problems faced by beekeepers, the farmers and the processing industry.

Species of Honey Bees

Mainly four species of honey bees are available in India namely, the little honey bee, *Apis florae* F., the rock honey bee, *Apis dorsata* F., the Indian honey bee, *Apis cerana* F. and Italian honey bee, *Apis mellifera* L. The former two species are not amenable to human handling and, therefore, fall under the category of wild insect pollinators. Since no human control can be exercised on them for augmenting their population on a particular crop or locality, they are not considered useful for planned pollination. The latter two species are hive bees and can be kept in wooden hives. These species are quite industrious

and are amenable to human handling easily. They can be shifted to different places in required number whenever needed. Both the species show remarkable similarity in pollination behavior and constitute an ideal instrument for planned pollination. However, out of these two species, *A. mellifera* beekeeping is mainly concentrated in the state of Haryana.

Beekeeping Zones

The Haryana State presents two distinct zones for beekeeping:

i) **North zone:**

North zone is comprised of districts like Panchkula, Ambala, Yamunanagar, Kurukshetra, Karnal, Kaithal and Panipat, where relatively lower temperature (up to 44ºC) and higher humidity (above 30%) are witnessed during dearth/period.

ii) **South west zone:**

Districts like Sirsa, Fatehabad, Hisar, Bhiwani, Dadri, Rewari, Mahendergarh, Faridabad, Palwal, Gurugram, Nuh, Rohtak, Jhajjar, Jind and Sonepat constitute the south west zone. Here high temperature (around 48ºC) and low humidity (15% or less) prevails during summer months.

The different cropping pattern due to different soil types, irrigation facilities, temperature, relative humidity and the agro-climatic conditions prevailing in the State are quiet favourable for beekeeping with *Apis mellifera*. In the State, winters are not so severe that may hamper the bee brood rearing and food collection activities. Thus, there is no problem of over wintering to *Apis mellifera*. Although the summers are quite severe, but this species has the potential to regulate its temperature and works under such ruthless conditions, provided some suitable arrangements of shade and water be made in the apiary. During monsoon, the food availability becomes scanty and a dearth period is experienced but it can be overcome through artificial feeding on sugar syrup as nectar substitute and soya sugar patties as pollen substitute.

Migratory Beekeeping

In Haryana State, commercial beekeepers are keeping *Apis mellifera* bees whose queen is highly prolific and lays about 1,500-2,000 eggs per day during honey flow season. Therefore, the colonies always remain in good strength. To maintain their strength during dearth period, these colonies are regularly migrated in those areas where plenty of bee flora are available in that season. In Haryana, there are two main zones i.e. North and South West Zone. In North zone, eucalyptus, toria, pigeon pea, sunflower, berseem etc. are grown in plenty, whereas, in South west zone, the crops like mustard, acacia, *ber*, bajra and cotton are grown in large areas.

Most of the beekeepers migrate their colonies from September to November in North zone and from December to February in South west zone to exploit the different bee flora available there. Again from March to June, bee colonies are migrated in North zone to take advantage of berseem and sunflower bloom. During July and August, bee colonies are fed sugar syrup and pollen substitute to overcome the dearth period in the state.

Beekeeping and Honey Production Scenario

About 50 million bee colonies, mostly, *Apis mellifera* are maintained all over the world. The world production of honey is estimated at about 14 lakh metric tons. There are

15 countries in the world which account for about 90 per cent of the world honey production. China is the largest producer, 4,50,000 tones (40%) and exporter (35%) of honey of the world followed by US, Argentina, Ukraine. Mexico supplying 20 per cent, whereas, Argentina supplying 15 to 20 per cent.

In India, there are about 2.0 million bee colonies with estimated annual production of around 80,000 metric tonnes of honey including honey from wild honey bees. It occupies fifth position in terms of total honey production in the world. The average yield of honey from domesticated bees is quiet low. In India, two types of honey *viz*., apiary honey (domesticated bees) and squeezed honey (wild bees) is produced. About 25,000-27,000 tonnes of honey is exported to more than 42 countries valued of Rs. 1,000 crores. The major markets for Indian honey are Germany, USA, UK, Japan, France, Italy and Spain. There are 45,000 species of plants and shrubs, which comprise seven per cent of the world's flora. Only 10 per cent of the existing potential has been utilized so far. India has a potential to keep about 120 million bee colonies that can provide self employment to over 12 million rural and tribal families. In terms of production, these bee colonies can produce over 1.2 million tonnes of honey and about 15,000 tonnes of beeswax.

In India, Punjab, Haryana, Uttar Pradesh, Bihar and West Bengal are the major honey producing States. In our country, honey is not being used in the form of food and its per capita per year consumption is only about 8.40 gms. But in other countries where it is considered as a food, for example, in Germany, per capita honey consumption is 1.800 Kg. In the world, on an average, its per capita consumption is 200 gms. Whereas in Asia, Japan has the highest per capita honey consumption which is about 600 gms.

In Haryana, during the year 2004-05 there were only 28,000 bee colonies of *Apis mellifera* from which about 275 MT of honey was extracted. Now, the number of bee colonies during the year 2012-13 has increased to 2,50,000 from which about 3,000 MT of honey is produced annually.

Potential and Future Projections of Beekeeping

Keeping in view the availability of bee flora continuously for eight months from October to September, Haryana State could sustain about 4.0 lakh bee colonies of *Apis mellifera*. Further, it is possible to extract about 15,000 MT honey from these colonies annually. Besides this, there is vast scope of employment generation of about 4,000 unemployed youth in the State. In addition to this, additional job of 100 men days can be created for about 10,000 persons in a year. The rural artisans such as carpenter, black smith and other beekeeping equipment manufacturers will also get additional source of income. This shows that there is tremendous scope of bee keeping in the State with *Apis mellifera* bees.

Check list for the Selection of Bee Breeders

Various State Government agencies without scientific norms and criteria have arbitrarily designated many beekeepers as “Bee Breeders” to provide high quality colonies to the beekeepers in the State. They altogether lack technical competency and there is an urgent need to rework the selection procedure. Based on scientific criteria, competent beekeepers should be selected afresh. Some of the points have been indicated in the checklist prepared for the selection of bee breeders.

Sr. No.	Points to be checked for the selection of Bee breeder	Yes/No
1.	Has the Beekeeper undergone at least one training course in 'Scientific bee keeping" at Horticulture Training Institute, Uchani, Karnal; HAIC, Murthal; CCS Haryana Agriculture University, Hisar or at a Krishi Vigyan Kendra (KVK), National Bee Board (NBB), New Delhi (Training certificate is required to be submitted by the bee keeper)	
2.	Does the Bee keeper have a minimum of 5 years' experience in handling or management of bee colonies? (Experience certificate is required to be submitted by the beekeeper)	
3.	Does the Beekeeper have minimum of 500 bee colonies of Apis mellifera?	
4.	If yes, whether the above mentioned 500 bee colonies are registered with the State Government or National Bee Board (NBB), New Delhi (Registration certificate given by the State Government or NBB, New Delhi is required to be submitted by the bee keeper)	
5.	i) Are the bee colonies healthy i.e. disease as well as pests free? ii) Does the bee keeper have sufficient technical knowledge as well as infrastructure facilities for the multiplication of nucleus bee colonies. (In this regard, whether a committee duly approved by the competent authority has interviewed and visited Apiary unit of the bee keeper and given their recommendations to the concerned authority for consideration and providing financial assistance to the bee keeper)	
6.	Has the bee keeper availed any financial assistance earlier for the same purpose? (If yes, he can't be considered again. If no, an affidavit is required to be submitted by the bee keeper)	
7.	Has the bee keeper given an Affidavit that after availing financial assistance, he will produce a minimum of 2,000 nucleus bee colonies of Apis mellifera per year for its supply to other bee keepers / new farmers as and when required at a price fixed by the Directorate of Horticulture from time to time?	
8.	If beekeeper is selected as bee breeder, he is to submit a Bank Draft of Rs. 50,000/- with the nodal agency as security amount before the supply of bee colonies to the farmers.	

Role of National Bee Board (NBB) for Development of Beekeeping

The main objective of the National Bee Board is overall development of beekeeping by promoting scientific beekeeping in India to increase the productivity of crop through pollination and increase the production of honey and other bee hive products to enhance the income of the beekeepers / farmers.

The major initiatives / measures taken by National Bee Board for development of scientific beekeeping in a sustainable manner are as under:

i) NBB has been carrying out various capacity building programmes including seminars, trainings, exposure visits, etc. on beekeeping under NHM scheme.

ii) A detailed programme on pollination support through beekeeping under NHM scheme has been prepared by NBB and communicated to all concerned States/organizations.

iii) Various publications on beekeeping, viz; publication of Souvenirs in all the seminars conducted by NBB and a quarterly magazine "BEE WORLD" are published by NBB.

iv) It may be mentioned that the import of Indian Honey by the European Union (EU) was banned for the reasons of reporting of presence of antibiotics and lead in honey in test reports conducted under Residue Monitoring Plan (RMP) of Export Inspection Council (EIC) and the traceability of the source of honey had not been in place. To address the issue of traceability of the source of honey, the NBB has been authorized as the National Agency for registering the bee keepers and allot them a number so that exporters and buyers of honey can collect / buy honey with the reference of the registration number allotted by NBB to the bee keeper / society / company / firm practicing bee keeping. This is an ongoing process, to bring within the fold of NBB all the beekeepers in the country. In Haryana, so far 564 entities having 1,04,875 ten frames bee colonies (hives) have been registered with NBB. The number of beekeepers registered in different categories as on May, 2015 is indicated in the Table 1.1.

v) A strong recommendation was made by NBB to the Department of Agriculture and Cooperation, Govt. of India to incorporate financial assistance for distribution of bee hives, bee colonies and bee keeping equipments, etc. to the beekeepers under NHM scheme. The cost norms and pattern of assistance under National Horticulture Mission (NHM) relating to beekeeping.

Table 1.1 : State wise details of beekeepers registered with National Bee Board in different categories up to May, 2015

Sr. No.	Name of State	Individual Beekeepers		Beekeepers Societies		Companies		Firms		Self Help Froup		Total	
		Entities registered	Bee colonies	Entities registered	Bee colonies	Entities registered	Bee colonies	Entities registered	Bee colonies	Entities registered	Bee colonies	Entities registered	Bee colonies
1.	Andhra Pradesh	30	2060									30	2060
2.	Assam	1	100									1	100
3.	Bihar	572	98823									572	98823
4.	Chhattisgarh			1	500							1	500
5.	Delhi	6	3810	1	80	3	550	1	500			11	9940
6.	Goa	4	200									4	200
7.	Gujarat	13	840			1	90					14	930
8.	Haryana	564	95225	1	1700	2	1050	4	6900			571	104875
9.	Himachal Pradesh	131	19240	2	20							133	19260
10.	Jammu & Kashmir	83	7699									7	699
11.	Jharkhand	2	750									2	750
12.	Kerala			1	85					1	200	1	85
13.	Madhya Pradesh	95	14427	1	500							96	14927
14.	Maharashtra	29	2950	1	100	1	500					32	3750
15.	Nagaland	232	4265									232	4265
16.	Odisha	27	835									27	835
17.	Punjab	797	353953			4	60000	8	3200			809	217153
18.	Rajasthan	258	54141	3	259			7	6500			268	60891
19.	Tamil Nadu	1	50									1	50
20.	Uttarakhand	259	34637	2	2515			2	3000			263	40152
21.	Uttar Pradesh	1584	211065	18	3260	3	5600	7	7300	1	50	1613	227275
22.	West Bengal	603	54700									603	54700
	TOTAL	**5291**	**759770**	**31**	**9010**	**14**	**72790**	**29**	**27400**	**2**	**250**	**5367**	**869220**

Scope of Diversification of Beekeeping

There is vast potential and scope of diversification of beekeeping in Haryana. Besides honey, it offers scope for production and marketing of other bee hive products like bees wax, pollen, propolis, royal jelly and bee venom. In addition, sale of packaged bee, the rearing and sale of pedigree queens offers a tremendous scope as entrepreneurship activity. Renting out bee colonies for pollination can also be another source of income to the beekeepers. Apart from direct employment to the beekeepers, there would be need for good artisans, hive manufacturers, apicultural equipment and machinery manufacturers, transport system for migration of colonies, traders, product quality experts, packers, sellers, raw material dealers, etc. and allied industries. This industry has, so far, remained unexplored and offers tremendous scope.

According to an estimate, based on the current price status of inputs, an apiary unit of 100 bee colonies put under diversification plan can earn a profit of about Rs. 7.0 lakh per year.

Farmers' Perception of Beekeeping and Pollination

Farmers' perception of beekeeping and pollination in Haryana was made through meetings with farmers, beekeepers, government officers and agricultural extension workers. To identify pollination-related management practices and productivity problems, these beekeepers were classified into different categories based on various socio-economic parameters such as family structure, caste, age, education, size of land holding, land use patterns etc.

The data prepared for the present study is primary as well as of secondary nature. The secondary data was collected from different agencies like Directorate of Agriculture and Directorate of Industries Govt. of Haryana and Khadi and Village Industries Commission (KVIC). Elaborate interactions were made with the district and state level officials of beekeeping department of Govt. of Haryana.

Primary data was collected with the help of a questionnaire prepared for the purpose. In order to finalise the questionnaire, a rough draft was prepared initially and a pre-use survey was conducted to judge the relevance and applicability of the collected questionnaire. The questionnaire was modified after correcting some weaknesses and a final questionnaire was prepared related to socio-economic conditions of the apiculturists. Primary data was collected after discussing the questionnaire with various apiculturists and farmers in different parts of the state based on their personal interviews.

Farmers perception about beekeeping and pollination practices in Haryana are summarized as follows :

Agro-Climatic Conditions, Landholdings and Household Economy

Regarding agriculture and household economy of different farmers/beekeepers from different areas of Haryana showed that land holding per acre varied from place to place and most of the farmers opted for both food and cash crop production, and areas under cultivation of different crops also showed great variation, (Fig. 1.1, 1.2, 1.3, 1.4) according to needs of farmers.

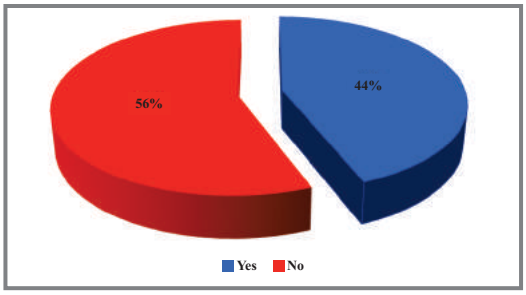


Fig. 1.1 : Farmers knowledge about climatic pattern of the area.

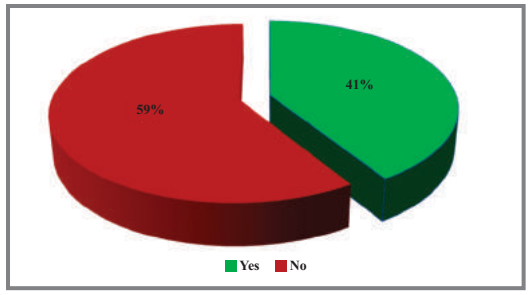


Fig. 1.2 : Effect of climate change on crop productivity

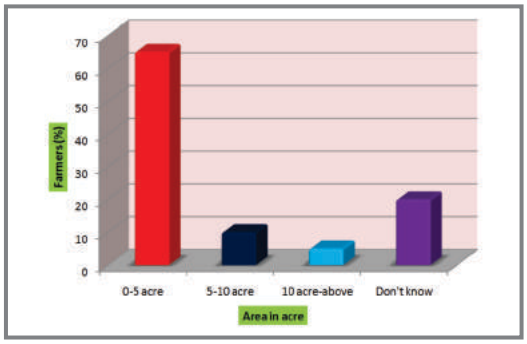


Fig. 1.3 : Landholding size of surveyed farmers.

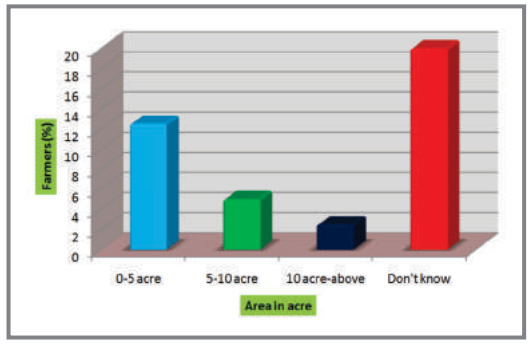


Fig. 1.4 : Area under cultivation

General Beekeeping

Most of the beekeepers reared European bees in their apiaries and had more than 150 bee-colonies in their respective apiaries, although some were having lower number. Many beekeepers told that, they practiced beekeeping as a part-time profession, after getting training from government agencies or private organizations. Most of the beekeepers intended to go for commercial beekeeping and were quite satisfied with the location of their apiaries. Season of beekeeping also varied from spring, summer to autumn. Beekeepers in Haryana had sufficient knowledge regarding the agencies supplying bee-colonies and bee equipments and most of the beekeepers were not allergic to honeybee stings (Fig. 1.5, 1.6, 1.7, 1.8, 1.9, 1.10, 1.11, 1.12). Most of the beekeepers were not quite aware about the effects of climatic change on beekeeping, honey production and crop productivity.

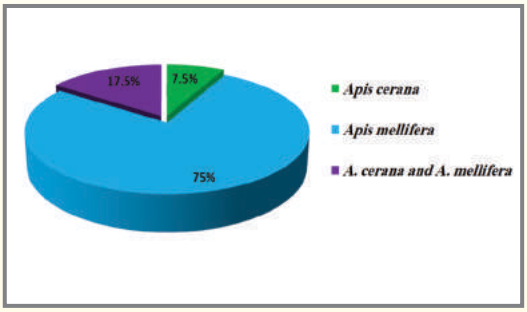


Fig. 1.5 : Preference for different types of honeybees.

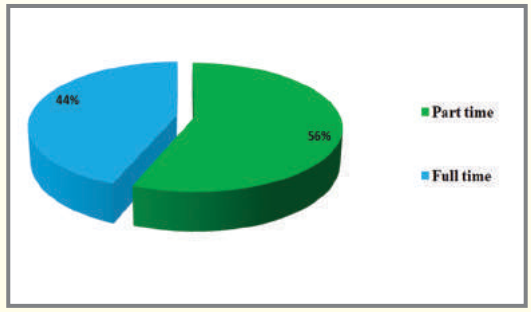


Fig. 1.6 : Apiculture as part time or full time job.

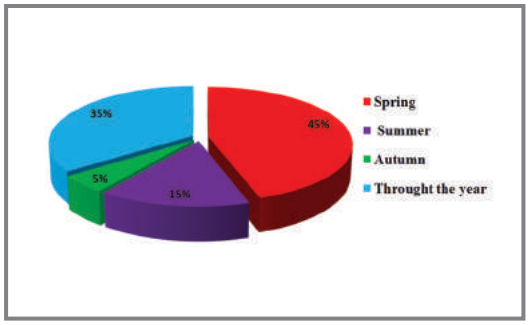


Fig. 1.7 : Preference of seasons for practicing apiculture.

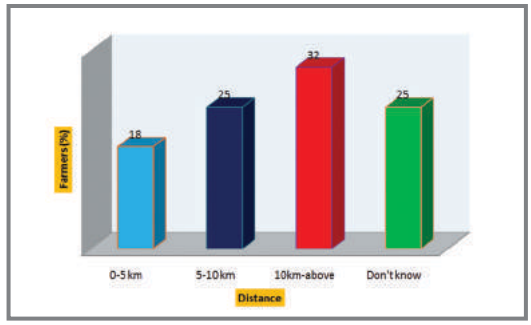


Fig. 1.8 : Distance of apiary from the house.

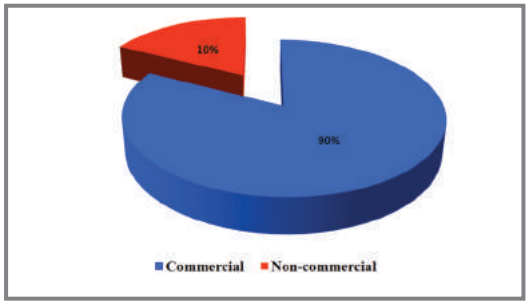


Fig. 1.9 : Commercial beekeeping.

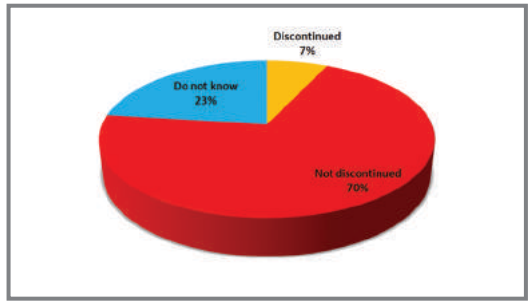


Fig. 1.10 : Discontinuation of apiculture practice.

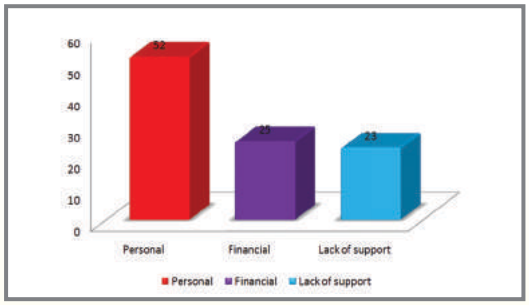


Fig. 1.11 : Reasons for leaving apiculture practice.

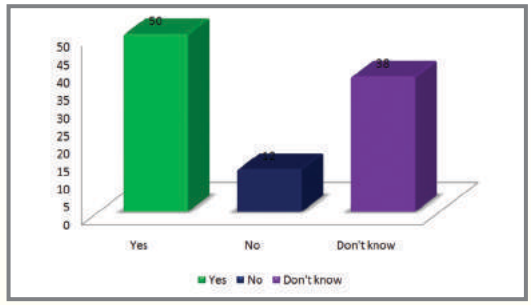


Fig. 1.12 : Use of standard equipment in apiculture.

Natural Insect Pollinators and Crop Pollination

Most of them were aware that, honey bee and other insect species were helpful in the pollination of different agricultural crops. They were also, having knowledge regarding wild bee-flora but most of them were not sure that the wild bees are sufficient for crop production. They were quite aware of the fact that number of insect pollinators are decreasing every year. They were of the view, that excessive use of pesticides was one of the major reasons, for sharp decline of pollinators.

Most of the farmers were aware about the role of honeybees in augmenting a crop production, and this was mainly based on their personal observations. Moreover, they were of the view that introduction of bee-colonies at the time of flowering could augment their crop production. Most of the farmers from different regions of Haryana, were fully aware about minimum number of bee-colonies, required per hectare for pollination of different

crops; and they also had some knowledge that strong colonies of honeybees, gave better results. However, they were not aware, that colonies of Apis mellifera should be shifted according to the change in availability of bee-flora in different plants. Most of the farmers told/informed that they used honeybee colonies for both, honey production as well as for crop pollination. There was lack of awareness; regarding the proper placement of hives, singly or in groups, in different fields. Moreover, the farmers' didn't know that artificial attractants or syrups can help bees in attracting towards flowers (Fig. 1.13, 1.14, 1.15, 1.16, 1.17).

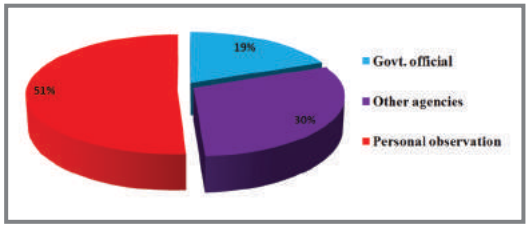


Fig. 1.13 : Source of knowledge of pollination

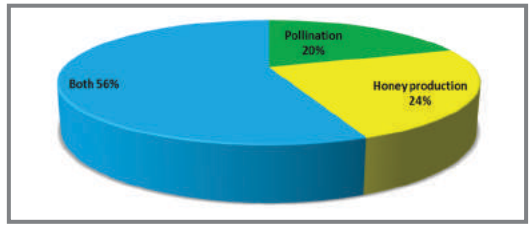


Fig. 1.14 : Preference of honeybees for pollination or for honey production.

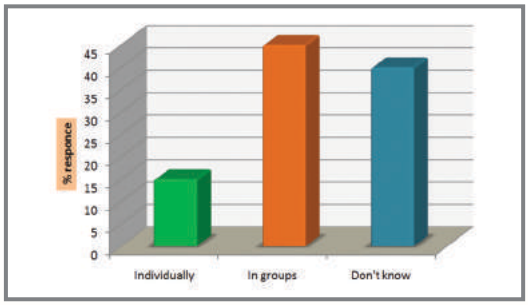


Fig. 1.15 : Knowledge regarding placement of bee hives.

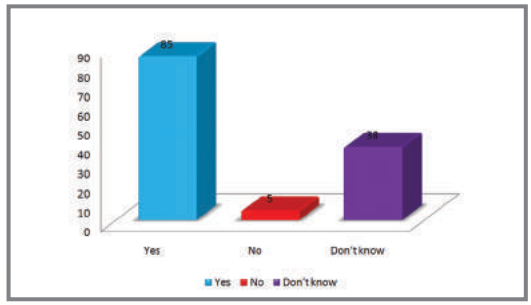


Fig. 1.16 : Observation of insects on flowers in fields.

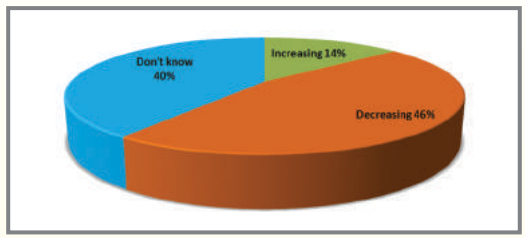


Fig. 1.17 : Fluctuation in number of natural insects.

Bee Flora

Farmers' knowledge regarding bee flora present in different agro climate zones of Haryana, revealed that majority of the farmers were quite aware about different floral resources present in their respective areas. However, they were not sure about bee flora present in their areas. They were quite aware about the fact that flora resources nearest to hives have better yield, than distant ones. They had the observations, that most of the useful bee-floral resources were present on the edge of the fields, than the nearby residential areas (Fig. 1.18, 1.19).

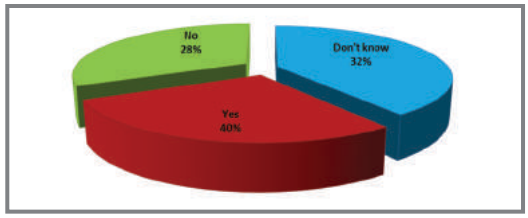


Fig. 1.18 : Awareness about bee flora.

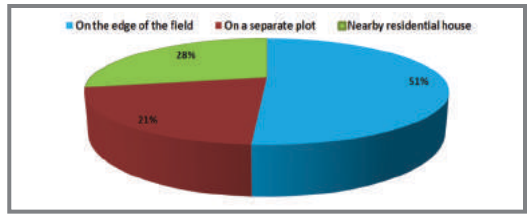


Fig. 1.19 : Distribution of bee flora.

Beekeeping and Pesticides

Farmers are fully aware of the fact that, different types of pesticides being used by them are killing different type of pollinators, including honeybees. Most common formulation of pesticides used, were in the form of wettable powders as compared to, spray or dust. They used pesticides, mostly in the morning hours and during non-flowering period of agricultural crops. Most of the farmers, were not aware that, they are making excessive and indiscriminate use of pesticides in their fields. Most common remedial measures, used by them for protection of bees, from pesticidal sprays, were cov ering the hives, closing the main entrance of hives or putting mud at the mouth of the bee hives (Fig. 1.20, 1.21).

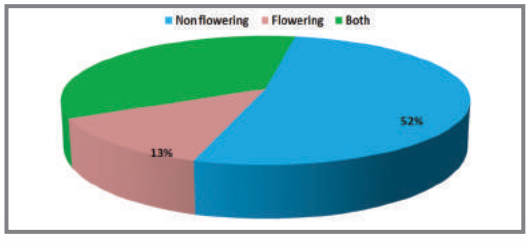


Fig. 1.20 : Preference for period of spray of pesticide.

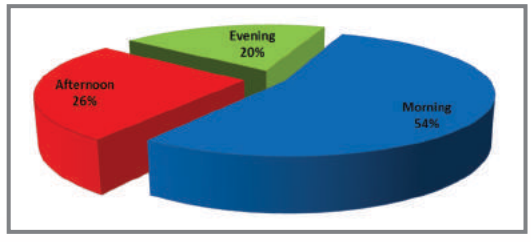


Fig. 1.21 : Preference for time of spray of pesticide.

Bee Management Practices

Farmers were having sufficient knowledge about handling of bee hives and they preferred to do it themselves, rather than employing others. Majority of the farmers, multiplied bee-colonies either once or twice in a year and various equipment used for handling of bees were; gloves, smokers, bee-veil, bee-brush etc. most of the farmers told, that they preferred to migrate the bee-colonies; according to the availability of bee flora and most commonly used modes to transportation was mini trucks, but they were not fully satisfied with the process as well as transportation regarding migratory beekeeping (Fig. 1.22, 1.23).

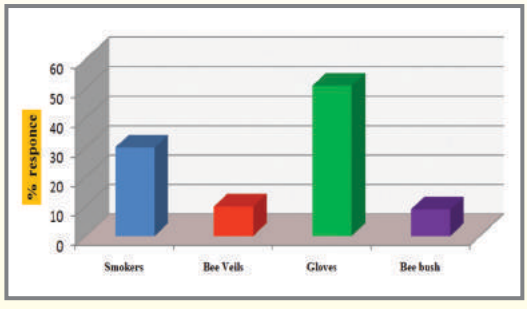


Fig. 1.22 : Equipments used for handling honeybees.

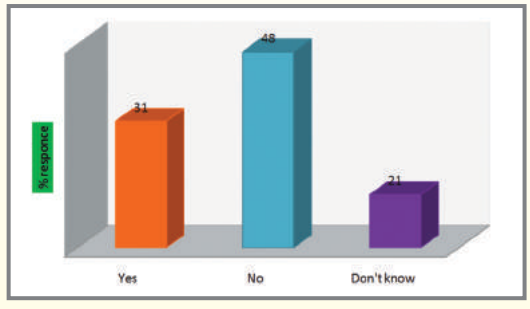


Fig. 1.23 : Satisfied with migratory beekeeping.

Hive Products

Most of the farmers were having sufficient knowledge regarding different hive products; for example; Honey bees' wax, pollen etc. Majority of them used bees' wax for manufacturing candles, comb foundation sheets and various types of creams etc.

Regarding honey, majority of bee keepers preferred watery-white and brown coloured honey and they were fully aware about nutritional value of honey, although they did not have any knowledge about constituents present in honey. They knew that bees collect honey from single or multiple floral resources and it was a source of extra income for them.

Regarding storage and processing of honey, most of the beekeepers in Haryana, used manual methods; and they preferred to store honey in glass containers as compared to drums and steel containers.

Most of the beekeepers in Haryana, faced a number of marketing problems; such as genuine support price not being provided to them; non-availability of marketing facilities; too much wastage of their time in searching marketing facilities; etc. Moreover, they were not satisfied with the transport arrangement, made by themselves or government agencies (Fig. 1.24, 1.25).

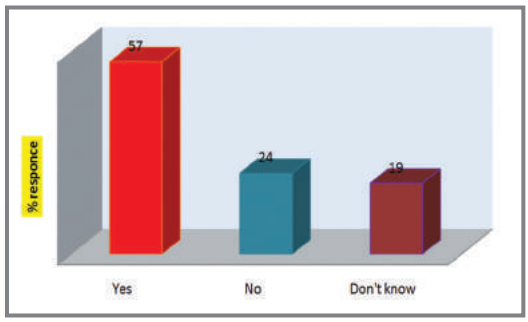


Fig. 1.24 : Knowledge about nutritional value of honey.

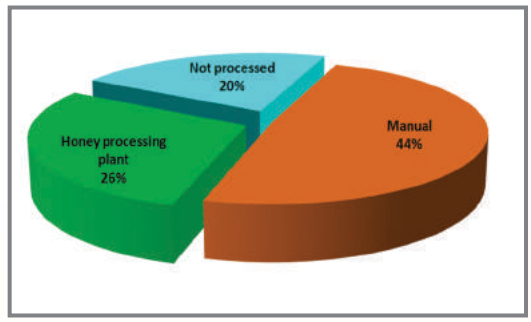


Fig. 1.25 : Preference for different types of processing of honey.

Honey bee Diseases, Pests and Predators

Most of the farmers were having some knowledge about diseases, pests and predators attacking their bee-colonies, although not on appropriate scientific lines. They had enough knowledge about different type of medicines, being used for curing various bee diseases. Most common pests, predators and pathogens encountered by them in the fields were different types of mites, wax moth and wasps etc (Fig. 1.26).

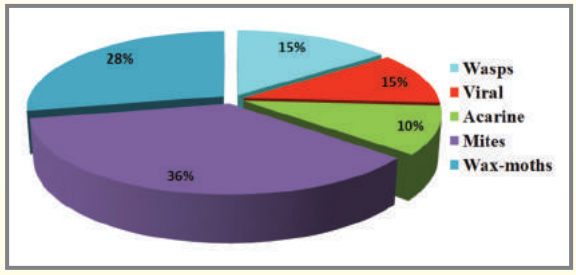


Fig. 1.26 : Types of diseases and attacks on honeybees.

Institutional Support

Regarding institutional support, most of the farmers, were aware, about the financial support provided by the govt. agencies; but were not satisfied with the training programmes and awareness raising campaigns. Majority of the farmers had very little knowledge about the beekeeping training programmes provided in their respective areas as also the agencies, which organize such training programmes, whether government or non-government The number of training programmers attended by different beekeepers organized, or NGOs; varied to larger extent. Some had attended a number of programmes where as, others could not avail themselves of such opportunities due to lack of awareness. Majority of beekeepers were of the view, that they were not much benefitted, through such programmes, although few of them were satisfied with such training programmes (Fig. 1.27, 1.28).

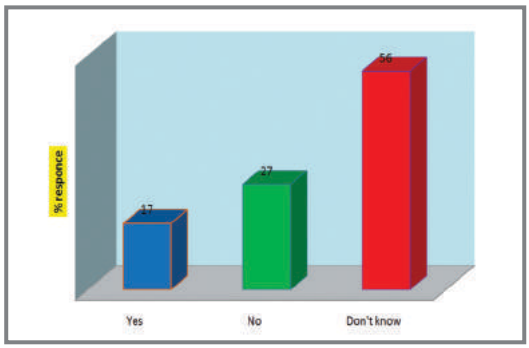


Fig. 1.27 : Apicultural training organized in your area.

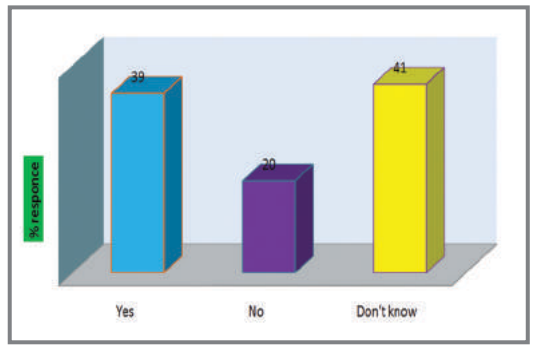


Fig. 1.28 : Benefitted from apicultural trainings.

Constraints in Beekeeping

While taking into notice, their opinion regarding major constraints, which the farmers/beekeepers were facing, in beekeeping from different areas; most important were lack of latest technical operations, followed by non-availability of flora throughout the year; labor problems; little knowledge regarding medicines used for the cure of different diseases; absconding behavior of bees etc. Majority of the beekeepers were not having proper knowledge regarding, various beekeeping promotional schemes, launched by different govt. agencies.

CHAPTER

2

MANAGEMENT OF HONEY BEE COLONIES FOR HIGHER PRODUCTIVITY

Productivity of honey bee colonies is dependent on availability of bee flora, weather conditions and management of honey bee colonies. Management of honey bee colonies both during the major honey flow season and off-season is important for obtaining higher colony productivity. Beekeeping equipment is also a very important component of scientific beekeeping, so its quality and proper use will also boost colony performance. Some of these factors have been discussed below:

2.1 Use of Standard Equipment:

Management of honey bee colonies becomes inefficient and cumbersome if hives and frames used are not of the prescribed standard dimensions and quality. Therefore, it should be ensured that the quality of the hives fabricated and supplied by the registered bee equipment fabricator is checked frequently by a team of experts from beekeeping, wood science or forestry and state department of Horticulture and Agriculture. The advantage of using standard hives and frames will be easier and will result in better colony manipulation. Standard good quality hives will also reduce pest attack by not providing gaps and cracks in hive parts for entry of pests.

2.2 Selection of Colonies:

All the honey bee colonies in any apiary do not have same level of performance in terms of growth and productivity. Therefore, it becomes utmost important to screen the existing stock of colonies to select those colonies which produced higher honey, raised more combs, reared more brood, encountered least problem of bee diseases and enemies, had least swarming tendency in the previous year.

2.3 Maintaining Strong Colonies:

It is the output which matters, not the number of colonies with the beekeepers. We have to make beekeepers aware that instead of having large number of weak or average strength colonies they should maintain strong colonies in order to have higher productivity. Strong colonies maintain proportionately greater number of foragers, thereby resulting in higher honey production. Moreover, strong colonies are better capable of defending themselves against robbing and bee enemies.

2.4 Use of Queen Excluder:

During a major honey flow, honey bee colonies have access to surplus nectar and pollen. This stimulates honey bee colonies to rear more brood. In a colony having more than 10 bee-frames, a super chamber is provided to create more pace. Scientifically,

queen excluder should be placed in-between brood and super chambers so as to obtain brood-free honey combs from the super chamber. However, most of our beekeepers don't use queen excluder between brood and super chambers due to which honey combs in the super chamber may also contain brood. Our beekeepers are getting honey from such combs but by doing so they lose prospective bees because of brood mortality during honey extraction process. So, there is a need to ensure availability of quality queen excluders and popularizing their use.

2.5 Selective Division:

For colony multiplication, most of the beekeepers divide majority of their colonies. This technique is very simple but results in almost uncontrolled or partially controlled multiplication of stock. Drones from better performing as well as from the poor performing and disease susceptible colonies also participate in fertilization of newly reared queen bees. For faster development of honey bee colonies, traditional method of division should be replaced with selective division at small scale beekeeping, and mass queen bee rearing from selected colonies having high honey production and resistance/tolerance to diseases should be adopted.

2.6 Marking and Isolation of Infected/Infested Colonies:

Management of normally working healthy colonies is quite different from management of disease or pest infested colonies. But this is possible only if these diseased colonies have been marked and isolated. Our beekeepers suffer due to faster spread of bee mites and diseases by not following this simple guideline. The importance of this aspect in reducing spread of bee diseases and enemies and thereby avoidance of chemical use should be emphasized in training programmes.

2.7 Proper and Timely Migration:

Beekeepers of Haryana are not able to have bee flora round the year in a large area good enough for getting high honey production and colony growth. This necessitates migration of honey bee colonies in time and space. Migration within and outside the state should be done by properly packing honey bee colonies before migration. Migration with open entrances will result in mixing of bees from healthy as well as diseased or mite infested colonies. This practice will encourage spread of bee diseases and mites. To avoid mortality of bees during transportation of colonies during summer season, colonies need to be fitted with travelling screens on the top and wire screen at the entrances.

2.8 Preventing Swarms:

Swarming may cause major loss to beekeepers, if not taken care of timely. Queen bee rearing from colonies with least swarming tendency and avoiding queens from captured swarms will minimize loss caused by swarming. Haryana beekeepers also face the problem of swarming especially in mustard season. Swarming also acts as a source of spread of bee enemies and diseases to hitherto unaffected/uninfested areas. Therefore, beekeepers should be encouraged to follow preventive measures suggested by CCSHAU Hisar rather than management after the swarms have issued.

2.9 Hiving of Alien Swarms:

Captured swarms add to the profitability of beekeeping. But these captured alien swarms should be kept under supervision for a few days to ensure that these swarms are pest and disease free.

2.10 Check on Robbing:

Preventing robbing is important not only to avoid loss of bees but also to prevent spread of be mites and diseases through robbers. Weaker colonies are more susceptible to robbing.

2.11 Avoidance of Open Feeding:

Several beekeepers in Haryana and adjoining states provide open feeding to honey bee colonies. Although it is easier and quick method of feeding bees but highly unscientific and may result in spread of bee mites and diseases within the apiary as well as among the apiaries sited in the vicinity.

2.12 Off-season Colony Management:

For obtaining higher colony productivity, honey bee colonies should be very strong right at the start of major honey flow season. This necessitates better management of colonies during the off-season. Any negligence in provisioning of feed and colony management could lead to further weakening of colonies thereby exposing them to robbing and pest infestation. Development of palatable and effective pollen substitute will sustain brood rearing during pollen dearth period thereby resulting in maintaining good bee strength throughout the off-season also.

2.13 Quality Honey Production:

In order to meet the quality parameters of honey to be exported, honey should be free from antibiotics, chemicals, pesticides and without any adulterant. For this purpose, extraction of quality ripe honey should be encouraged. This can be achieved by adopting two-pronged approach. Under this, apart from educating, training and encouraging beekeepers, there is an urgent need for development of effective non-chemical control measures for bee diseases and enemies. Several beekeepers are using unrecommended chemicals and treatment methodologies. So our trainings should also focus on these issues to educate our beekeepers. Premium for producing quality ripe honey will encourage other beekeepers to join this movement. Quality honey produced will deteriorate in quality if it is stored in unhygienic and contaminated containers. So, availability of food grade plastic containers at cheaper price will maintain quality of honey.

2.14 Mating of Quality Queens with Drones:

As productivity of honey bee colony is mainly dependent on quality of the queen bee heading it, Queen bees should be raised from the best performing stock. Some of the progressive beekeepers are doing so. However, mating of these queen bees with drone only from the selected drone colonies be ensured to get maximum benefit from the newly raised queen bees. Importance, reasoning and guidance on this aspect should be included in the advance trainings for progressive beekeepers.

CHAPTER

3

TECHNOLOGIES FOR HIVE PRODUCTS

Honey bees give us products namely honey, bees wax, pollen, propolis, royal jelly and venom. The technologies for the production of different hive products are now available in India but require to be standardized at the farmer's field. The implementation and commercialization of these products is essential to enhance the income of the beekeepers in Haryana state.

3.1 Honey

Honey being a biological substance and intended for food and pharmaceutical use needs greater attention in quality and handling. The moisture content in honey plays an important role in deciding the quality of honey. Honey with more than 20 per cent moisture is thinner in consistency. The moisture content in honey increases due to hygroscopic nature of honey in which the surrounding atmosphere moisture is absorbed by honey. If the moisture content is more than 20%, the honey is liable to spoilage due to fermentation and granulation. Considering the present practice of collection, storage and handling of honey under uncontrolled conditions including climatic factors, the honey needs processing, reduction of moisture and packing by utmost care to protect its valuable natural properties.

Further, honey contains pollen, dust and air bubbles which tend to induce granulation (crystallization). The granulation can be retarded by heating the honey to 45°C to dissolve the crystals present in honey. Filtration then removes part of pollen, foreign particles and wax. To prevent fermentation and to destroy yeasts, honey is heated to a temperature of 65°C for 20 minutes, 65°C for 10 minutes and 70°C for 2.5 minutes. Proper temperature control and heating time is a most important factor in honey processing activity. Excessive heating increases the quantity of HMF (Hydroxyl-Methyl-Furfural) which is not desirable. High temperature also affects the colour and flavor of honey. Honey is then cooled before it is packed to keep it for a longer period without contamination and granulation. Edible grade honey could be bottled and branded for sale.

The storage conditions play a very important role on the level of HMF and the diastase content in honey. If the honey is stored in high temperature (more than 30 C) the level of HMF increases to more than 40 mg/kg within a period of 3-5 months. Thus, the honey will not be accepted in international market and it should be processed properly before sale.

3.2 Processing of Honey

There are four medium scale processing plants at Murthal (1), Ambala (1) and Yamunanagar (2) and four small scale honey processing plants at Karnal (1), Sonepat (1), Hisar (1) and Rohtak (1).

Haryana Agro Industries Corporation (HAIC), Ltd. is a registered society which has its R&D centre at Murthal, Sonepat. This centre has a Honey Processing Unit having the capacity of one MT daily. It has signed an agreement with HAFED (Haryana Government Federation) to market honey which is to be procured and processed by this centre with the brand name "Haryana Madhu". This centre is also processing honey of the farmers @ Rs. 5/kg but the response is very poor. Beekeepers are harvesting good quality of honey but most of them are selling raw honey only, they are not coming forward to get their honey processed.

The State Government should explore the possibility of processing farmer's honey at subsidized rates and steps should also be taken to put in use the non-functional processing plants. Further, the Honey processing policy is required to be formulated and new processing plants should be established in Haryana.

3.3 Honey Testing, Quality Control, Standardization and Certification of Honey

For centuries, honey has been used as a natural sweetening agent. It has a vast application in the pharmaceutical, cosmetics and confectionery industry. High demand for honey is always there due to its high nutritive and high medicinal value. Quality control and standardization of honey are essential requirements for selling in the international market. For the export to European Union (EU) and some other countries, it is mandatory to control the level of pesticides and insecticides residues, toxic metal residues and antibiotic residues.

In order to be a potential exporter, the Indian export authorities have started monitoring the quality of honey. Besides the physico-chemical parameters of quality, much emphasis is also being given to the presence of the residues of toxic metals, pesticides and antibiotics. Once the quality of honey is established, appropriate steps can then be taken to ensure that only good quality honey is sold to the consumers. In this regard, one State of the art honey testing laboratory is required to be established in Haryana.

3.4 Storage and Bottling of Honey

Honey can be stored for a longer period if it is clean and sealed in an airtight container, but will deteriorate rapidly and will ferment if it has absorbed water. This is a crucial step in honey harvesting. It is important that all honey processing equipment and storage bottles must be perfectly dry. Before storage, honey is strained through muslin cloth to remove any bits of wax or debris. It is very important that this procedure be carried out hygienically, and that the honey is not exposed to the air, where it will pick up moisture and deteriorate. Honey must be stored in airtight, non-tainting containers to prevent water absorption and consequent fermentation. After processing, honey can be put and sold in wide mouthed glass bottles.

3.5 Labeling / Marking and Packaging of Honey

Honey bottles should contain a label describing the source of the honey (for example sunflower, mixed blossom, mustard honey), the State and district it was produced

in, the weight or amount of honey in the container and name & address of the bee keeper. A grade designation mark shall be securely affixed to each container. In addition, name of the packer, lot number to which honey pertains, date and place of packing, net weight and date of expiry will also be indicated before packaging.

3.6 Value Addition Products of Honey

The primary value addition products of beekeeping industries are honey, bees wax, pollen, propolis, royal jelly, venom and queen bee, etc. Today, the use of honey has multiple applications and can be used for secondary products as a food and food ingredient. As food, honey can be used for baked products like cake, biscuits, breads, confectionery, candy, jams, spreads and milk products. Products of honey fermentation are honey vinegar, honey beer and alcoholic beverages. Honey is being used in tobacco industry to improve and preserve tobaccos aroma. In addition, honey is also used for cosmetic products such as lotion, ointments, creams, shampoos, soap, toothpaste, deodorants, facial masks, make up, lipsticks, perfumes, etc.

The value addition technologies developed by the Government organization viz., Punjab Agricultural University (PAU) Ludhiana, Central Food Technology Research Institute (CFTRI) Mysore, Central Bee Research and Training Institute (CBRTI) Pune and private industries (especially of M/s Kashmir Apiaries Exports) have already started helping bee keepers and bee industry in harvesting rich dividends. Kashmir Apiaries Export and Little Bee Impex, Doraha, Ludhiana are producing honey from various plant origin such as Coriander honey, Litchi honey, Sunflower honey, Multi flower honey, Shivalik honey, Jamun honey and Organic / Forest honey, etc. Some value added products of these firms are Honey 'n' Lemon, Honey 'n' Ginger, Honey 'n' Cinnamon, Honey 'n' Tulsi. Several types of honey and fruit spreads, Honey 'n' Nuts, Honey 'n' Dry fruits, Honey based tea; Honey based sauces / syrups / shakes are being produced and sold.

The low honey consumption in the country, besides it being promoted as luxury item and being largely promoted as medicine, is owing to very few value added products of honey developed and available in Indian market.

The industry has, so far remained unexplored and offers tremendous scope. Commercial beekeepers can be extended support to take up such value addition product activities to enable them to increase employment generation on one hand and ensure better remunerative price to the beekeepers engaged in production of honey on the other. In this regard, infrastructure facilities are required to be created for the preparation of various value addition products of honey in the State.

3.6.1 Bees Wax

Bees wax is secreted by honey bees only. Wax is synthesized by worker bees of 14-18 days old by 4 pairs of glands located on the ventral side of the abdomen. Mainly it is used for making foundation sheets which is the base of the comb. In addition to primary building material for making combs, wax is used to cap the ripened honey and when mixed with some propolis, also protects the brood from infections and desiccation. Fresh bees wax is white, it becomes darker with use inside the hive as pollen and larval debris is inadvertently incorporated. Untreated bees wax comes in varying shades of yellow. It is possible to collect about 800 g of beeswax from one bee colony in one year. Keeping in view the availability of 2.5 lakh bee colonies in the State, we may collect about 180 tonnes of

beeswax (at the most 90% of collection). Since Haryana could sustain about 4.0 lakh bee colonies, there is potential for the collection of about 288 tonnes of beeswax per year. Beeswax is used in candle, pharmaceutical and cosmetic industry.

Beeswax

Comb foundation sheets

Candles

3.6.2 Pollen

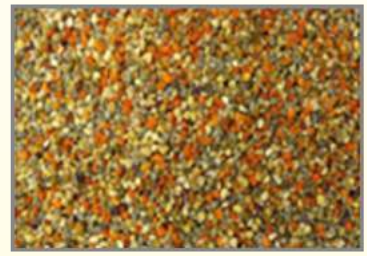
Pollen grains are the male reproductive units produced in the anthers of flowers. The pollen collected by honey bees is usually mixed with nectar in order to make it stick together and adhere to their hind legs. The resulting pollen pellets harvested from a bee colony are therefore usually sweet in taste. Certain pollen types however, are very rich in oils and stick together without nectar or honey. A foraging honey bee rarely collects both pollen and nectar from more than one species of flowers during one trip. Thus the resulting pollen pellets has a typical colour, most frequently yellow, but red, purple, green, orange and a variety of other colours occur. The partially fermented pollen mixture stored in the honey bee combs, also referred to as "bee bread" has a different composition and nutritional value than the field collected pollen pellets and is the food eaten by young worker bees to produce royal jelly. An average size Apis mellifera bee colony needs about 50 Kg or more of pollen in a year for the growth of its bee population and normal functioning.

The pollen can be easily harvested by putting a pollen trap at the entrance of the hive. A pollen trap is a single or double grid device through which the bees entering the hive must stumble, and in this way pollen pellets from their hind legs get knocked off and fall into the tray. During a good pollen flow season, it is possible to harvest few kgs. from one hive of Apis mellifera. The pollen trap should be used during the active pollen foraging period. The pollen trap should not be used for more than two days in a week (at the most 25% of the collection). At present, it is possible to collect about 250 tonnes of pollen from the bee colonies available in Haryana and there is potential of about 400 tonnes of pollen in the State per year.

Pollen or pollen products have been shown to have general beneficial applications for human use. It has antibiotic effect, improves appetite and increases body weight.

Honey bee with pollen pellet

Pollen trap fitted into a hive entrance



Pollen collected by honey bees

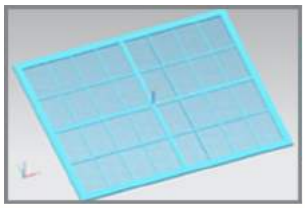
3.6.3 Propolis

Propolis is a sticky, brownish gum gathered by bees from trees and buds. In the bee colony, propolis is used by bees for sealing cracks and crevices and foreign material / predators. As propolis is collected from a large variety of tree and other plant species, these naturally differ in their qualitative and quantitative composition.

Propolis collection is accomplished by putting screens or special plates with small holes are used in place of inner cover, which simulate cracks in the hive walls. Bees try to seal the holes and thus fill the trap with propolis.

Propolis is used to varnish all surfaces inside a hive, not only the woodwork of the hive body and frames but the actual waxen cells also. A mixture of beeswax and propolis is much stronger than beeswax itself, and the bees use the mixture to strengthen their combs at the point of attachment. It is possible to collect about 300 g of propolis from one bee colony in one year. Thus, at present, we may collect about 67.5 tones of propolis (at the most 90% of collection) and there is potential for the collection of about 108 tones of propolis in the State of Haryana per year.

Propolis has been reported to possess anti-microbial properties against various viruses, bacteria and fungi. During World War II, propolis was reported very effective in healing wounds. Currently, propolis is available for purchase as an ingredient in capsule form, lip balm, skin creams, tinctures, tooth-paste, etc.



Propolis strip

Capsule

Cream

Tooth-paste

3.6.4 Royal Jelly

Royal jelly is a milky white secretion of young nurse bees. It is used to feed the queen throughout her life, and is given to worker and drone larvae only during their early larval lives. It is synthesized by the bees in the hypopharyngeal and mandibular glands. It is always fed directly to the queen or the larvae as it is secreted, it is not stored.

The principal constituents of royal jelly are an emulsion of proteins, sugars, lipids and mineral salts in water base. Water makes up about two thirds of fresh royal jelly, but by dry weight, proteins and sugars are by far the largest fractions.

To produce royal jelly on a small scale, a bee keeper may simply de-queen a colony, and harvest the royal jelly from the emergency queen cells. On a commercial scale, royal jelly can be produced by modifying the standard techniques of mass queen rearing. It is possible to collect about 823 g of royal jelly from one bee colony in one year. In this way, at present we may collect about 10.28 tones of royal jelly (at the most 5% of collection) and there is potential for the collection of about 16.46 tones of royal jelly in the State of Haryana per year.

Royal jelly is very nutritious and increases vigour and vitality / fertility.

Queen cell with royal jelly

Royal Jelly

Capsules

Tablets

3.6.5 Bee Venom

Bee venom is the poison of the honey bee. The active portion of the venom is a complex mixture of proteins, which causes local inflammation and acts as an anticoagulant. The bee venom is produced in the abdomen of worker bees from a mixture of acidic and basic secretions. Bee venom is acidic (pH 4.5 to 5.5).

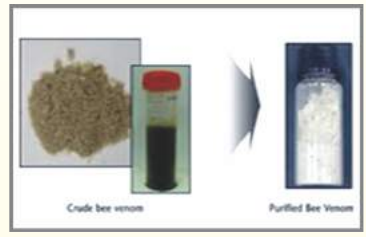
Honey bee uses bee venom as a defensive agent against enemies specially predators. Newly emerged bee is unable to sting because she cannot insert the sting. Moreover, there is very little venom stored in the venom sac. Two weeks old bee has maximum venom in her poison sac.

Since the middle 1950s, the electric shock method has been used to stimulate the bees to sting. The collector frame is usually placed at the entrance of the hive and connected to a device which supplies electrical impulses. The collector frame is made from wood or plastic and holds a wire grid. Underneath the wires is a glass sheet which can be covered with a plastic or rubber material to avoid contamination of the venom. During collection, bees come in contact with the wire grid and receive a mild electric shock. They sting the surface of the collector sheet as they see this to be the source of danger. The venom is then deposited between the glass and the protective material where it dries and is later scraped off. It is possible to collect about 50 mg of bee venom from one bee colony / year. Thus, we may collect about 11.25 kg of bee venom (at the most 90% of collection) and there is potential for the collection of about 18.00 Kg of bee venom in Haryana per year.

Bee venom is the healer of arthritis and rheumatic i.e. pertaining to or suffering from pain in the joints.

Honey bee sting

Bee venom collector frame.



Crude bee venom Purified bee venom

CHAPTER

4

CROP POLLINATION AND BEE FLORA

Pollination is an essential ecosystem service, vital to the maintenance both of wild plant communities as well as agricultural productivity. Pollinators themselves can act as indicators of environmental health. It has been estimated that the total annual economic value of crop pollination worldwide is about $153 billion and about 85 per cent of the world's flowering plants depend on animals, mostly insects for pollination.

The most desired goal for a farmer in agriculture is to get the maximum possible crop yield and better quality fruits and seeds under given inputs and ecological settings. It is particularly important to get a premium price for the produce when farmers are engaged in cash crop farming. There are two well known methods for improving crop productivity. The first method is making use of agronomic inputs, including plant husbandry techniques such as the use of good quality seeds and planting material, and practices to improve yields, for example, providing good irrigation, organic manure and inorganic fertilizers and pesticides. The second method includes the use of biotechnological techniques such as manipulating rate of photosynthesis and biological nitrogen fixation etc. These conventional techniques ensure healthy growth of crop plants, but work up to a limit. At some stage, crop productivity becomes stagnant or declines with additional inputs for the known agronomic potentials of crop which have been harnessed. The third and relatively less known method of enhancing crop productivity, particularly in the Asian region, is through managing pollination of crops using friendly insects, which in the process of searching for food perform this useful service to farmers.

Pollination services depend upon both managed and unmanaged pollinator populations. Managed pollinators play an important role in modern agriculture for the following reasons: the reduction of natural pollinator population by agrochemicals, an increase of greenhouse effect that natural pollinating insects cannot commute, unexpected abnormal weather conditions and extensive public interest in sustainable agriculture. In particular, artificial pollination results in deterioration of fruit quality such as a decrease of the fruit size and uneven fruit shape. With the increasing role and attention on managed pollinators, *Bombus terrestis* and *Osmia cornifrons* have been internationally commercialized. The collaboration between a USA company and Koppert Biological System developed a new variety of pollination insects. In Japan, research for mass production of pollinators and development for a new variety of pollinators have been performed.

The cross-pollination of different crops by honeybees increases the crop yield, improves fruit and seed quality and helps in exploitation of heterosis. Cross-pollination of entomophilous crops by honeybees is one of the most effective and cheapest methods of increasing crop yield. Other agronomic practices like manuring, pesticides, fertilizers etc. are quite cost effective and these may not yield the desired results without the use of honeybees for enhancing the productivity levels of different crops by pollination. It is not only the self-sterile varieties which require cross-pollination, but self-fertile plants also produce more seeds of better quality if pollinated by honeybees and other insects. Robinson et al. (1989) suggested that one million honeybee colonies are rented annually for pollination in USA. On the other hand, in India, the number of bee colonies required for pollination purposes would exceed 150 million against the present strength of only one million. Because, out of total cropped area of about 160 million hectare, 55 million hectare is under entomophilous crops requiring cross pollination.

Honeybees are vital pollinators of agricultural and horticultural crops. It has been estimated that one-third of the human diet can be traced directly or indirectly to bee pollination. Honeybees and flowering plants are dependent upon each other for their existence. Most of the plants are dependent upon insects for their pollination requirements, whereas, insects in turn depend upon plants for energy to maintain their activities. This energy relationship between plants and nectar gathering insects is the necessary basis for studying the crop pollination, honey production and their foraging strategies. Bees and certain flowering plants have, therefore, evolved a well adjusted system of interdependence, which is very important in the process of their organic evolution.

The Food and Agriculture Organization (FAO) of the United Nations estimated that of the slightly more than 100 crop species that provide 90 per cent of food supplies for 146 countries, 71 are bee-pollinated (mainly by wild bees), and several others are pollinated by thrips, wasps, flies, beetles, moths and other insects. In Europe alone, 84 per cent of the 264 crop species are animal-pollinated and 4,000 vegetable species have their life assured thanks to the pollination of the bees. Pollinators are essential for the reproduction of many wild flowers and crops: for one out of every three bites eaten, one can thank a bee, butterfly, bat, bird or other pollinator. Any loss in biodiversity is a matter of public concern, but losses of pollinating insects may be particularly troublesome because of the potential effects on plant reproduction and hence on food supply security. Many agricultural crops and natural plant populations are dependent on pollination and often on the services provided by wild, unmanaged, pollinator communities.

According to the United States Department of Agriculture, huge populations of pollinators are diminishing and it lists over 50 pollinator species as threatened or endangered. Continued decline in pollinator activity could mean rising costs for pollinator-dependent fruits and vegetables. Among the most important drivers of pollinator loss are loss of habitat and land use change, increasing pesticide application and environmental pollution, decreased resource diversity, climate change and the spread of pathogens. Habitat loss is generally thought to be the most important factor driving pollinator declines. Biodiversity losses are affecting not only natural ecosystems but also the services they provided and some of them are vital for human societies, viz the presence of oxygen into the atmosphere, renewing of soils and pollination which is critical to fruit and seed production, and is often provided by insects and other animals. Until very

recently, most farmers considered pollination as one of nature's many 'free services', so taken for granted that it has rarely figured as an 'agricultural input' or even as a subject in agricultural science courses. This assumption has apparently become obsolete as these changes are already being illustrated, need to be monitored and mitigated in the near future, since they are posing threats to the integrity of biodiversity, global food webs and even ultimately to human health. Although, precautions such as better regulation, avoidance of over spray and changes in the type and timings of pesticides can reduce the threat. Currently, the world is facing an "impending pollination crisis" in which both wild and managed pollinators are disappearing at alarming rates. Hence, the future of our farms depends mainly on pollinators.

4.1 Diversity of Pollinators

Majority of wild crops and flowering plant species depend upon animal pollinators for fruit and seed production. Of the hundred or so animal-pollinated crops which make up most of the world's food supply, at least 80% are pollinated by honeybees, wild bees and other forms of wildlife. Bees are the most dominating pollinators of agricultural crops. The diversity of pollinators and pollination systems is striking. Most of the 25,000 to 30,000 species of bees are effective pollinators, and together with moths, flies, wasps, beetles and butterflies, make up the majority of pollinating species. Vertebrate pollinators include bats, non-flying mammals (several species of monkey, rodents, lemur and tree squirrels etc.) and birds (humming birds, sun birds, honey creepers and some parrot species). Current understanding of pollination process shows that, while interesting relationships exist between plants and their pollinators, healthy pollination services are best ensured by an abundance and diversity of pollinators. Approximately 73% of world's cultivated crops, such as cashews, squashes, mangoes, cocoa, cranberries and blueberries are pollinated by bees, 19% by flies, 6.5% by bats, 5% by wasps, 5% by beetles, 4% by birds, and 4% by butterflies and moths. Of the hundred principal crops that constitute most of the world's food supply, only 15% are pollinated by domestic bees (mostly honey bees, bumble bees and alfalfa leafcutter bees), while at least 80% are pollinated by wild bees and other wildlife forms.

In agro-ecosystems of Haryana State pollinators are essential for orchards, agricultural and forage production, as well as the production of seed for many root and fibre crops. Pollinators such as bees, birds and bats affect 35 percent of world's crop production, increasing outputs of 87 of the leading food crops worldwide, besides many plant-derived medicines for pharmacies. Food security, food diversity, human nutrition and food prices all rely strongly on animal pollinators.

4.2 Honey Bee Diversity and Crop Pollination

At present four or more species of honeybees are found in the Indian sub-continent. Of these, *Apis cerana F., Apis dorsata F. / laboriosa* and *Apis florea F.* are native to this region, whereas, the European honeybee, *Apis mellifera L.* was introduced in the northern India including Haryana during mid-sixties for increasing honey production and crop productivity. *A. cerana* is considered equivalent to *A. mellifera* because both of these species build parallel combs and can be domesticated. The genetic diversity of *A. mellifera* has been organized into 24 sub-species having varied economic usefulness. These sub-species are adapted to a wide range of ecological conditions and occur at latitudes ranging from 0° (equator) to 50° N and 30° S. With regard to native bee species, *A. cerana,* our research group at Himachal Pradesh University, Shimla has successfully identified and

recognized three sub-species of *A. cerana viz., A. cerana cerana, A. cerana himalaya* and *A. cerana* indica corresponding to the geographic distribution in the Northwest, Northeast Himalayas and South India respectively. There may be similar geographic populations of *A. cerana* in different parts of the country. Such tremendous biodiversity of both *A. mellifera* and *A. cerana* honeybees can be utilized for increasing crop productivity in India and may help in providing food and nutritional security to millions of poor people below poverty line.

4.3 Principles of Bee Pollination

Most of the investigations of crop pollination have been carried out in developed countries where the European honey bee, *Apis mellifera* has been extensively utilized to increase the yield of different cultivated crops. However, there is very little information available on the role of the Asian hive bee, *Apis cerana,* in pollinating agricultural crops in the developing countries of South and Southeast Asia. Both these species of honey bees, however show remarkable similarities in foraging behaviour, thus the basic principles involved in crop pollination by these two species of honeybees should not differ significantly. At present, in Haryana state, *A. mellifera* is playing most crucial role of crop productivity.

4.4 Honey Bees and Sustainable Crop Productivity

4.4.1 Vegetables Crops

Availability of the desired quantity of quality seed is one of the most important aspects for a successful vegetable industry in Haryana. For the production of such quality seeds, sufficient or adequate cross-pollination of vegetable crops is essential. Further, many of the vegetable crops are completely or partly self-incompatible and incapable of pollinating themselves. Cross-pollination by honeybees is, therefore, very important. Vegetable flowers in return are excellent sources of pollen and nectar to bees.

Recently in some parts of the Northern India including Haryana, a large area of land has come under off-season vegetable production which brings to the farmer four to five times higher income than the normal seasonal vegetables. Similarly, in other parts of the northern India, vegetable cultivation is expanding rapidly because of the change in the food habits of the people and also because it is a source of cash income. Keeping this in view, the demand for high quality vegetable seed at a cheaper rate will increase tremendously in the future. One way to meet such demands will be through the utilization of pollination services of honeybees and including beekeeping as an essential component of vegetable seed production technology.

It is now well-documented that cross-pollination by honey bees helps in increasing the yield and quality of vegetable seeds in Haryana. This activity of honeybees also hampers pure seed production in such crops due to intercrossing. This problem can be solved by providing the necessary isolation distance between different cultivars of the same crop in order to avoid crossing and contamination. Foraging areas of the adult worker bees are always limited and they keep their foraging activities confined to this particular area only during their successive field trips to collect pollen, nectar or both. In cases where fields with compatible varieties/cultivars are quite adjacent, chances of intercrossing or contamination will be more. However, in distant fields with compatible varieties or cultivars, foraging areas of bee visits will not overlap and pure seed production is possible. Such actual isolations distance would depend upon the degree of the purity of seed required.

4.4.2 Oilseeds Crops

Oilseeds play an important role in the national economy of many countries. Oils and fats derived from oilseeds not only constitute an essential part of human and animal diet, but are also indispensable. It has been noticed that oilseed production in some parts of the country including Haryana is either stagnant or declining gradually. Efforts are being made by different Government agencies of Haryana to bring more area under oilseed production in order to meet the growing demand. One way of increasing oilseed production is by introducing a planned honeybee pollination programme as one of the essential inputs which has not been so in this region, the main reason for which is ignorance on the part of the agriculture extension agencies and farmers.

Among the important oilseed crops, groundnut, mustard, sesame, safflower, niger and sunflower are extensively grown in India. Since most of these crops, except groundnut, are cross-pollinated, adequate pollination is vital for increasing the yield per unit area of the land. It is also now well-documented that pollination by honeybees ensures uniform maturity and early harvest of these oilseed crops, thus facilitating timely sowing of the next crop in rotation (Fig. 4.1). In view of such encouraging results, farmers in India including Haryana are being given honeybee pollination demonstrations by different extension agencies to create awareness of the beneficial effects of honeybee pollination.

4.4.3 Fodder and other Miscellaneous Crops

Improvement of animal products such as beef, pork, poultry, lamb or dairy products, is strongly dependent upon improving the quality and quantity of fodder and livestock ration feed. Availability of such quality fodder in sufficient quantities would depend upon reliable, cheap and good quality seed supplies. Three conventional components of seed quality (i.e. physical, genetical and vital quality) are greatly improved if the flower in bloom is pollinated by honeybees. Many of the fodder crops are dependent on or benefited by honeybee pollination. Major fodder crops grown in India including Haryana are: alfalfa, clover, trefoil, vetch and sainfoil. Where in cross-pollination is either essential or beneficial to enhance the seed production.

Besides fodder crops, some miscellaneous crops like buckwheat, coffee, cotton, field beans and cardamom, which is one of the world's costliest seed species and a cross-fertilized crop, also depends exclusively upon honeybees for pollination. A large number of insect pollinators such as different species of honeybees, wild bees, dipterans, coleopterans lepidopterans etc. help in pollination of above crops. However, honeybees are the main pollinators constituting more than 88 per cent of the total insect pollinators and help in increasing their crop productivity.

Syrphus sp. on *Brassica sp.*

Eristalis sp. on *Brassica sp.*

Apis dorsata on *Brassica sp.*

Bombus haemorrhoidalis on *Cassia sp.*

Fig. 4.1 : Insect pollinators on *Brassica* and *Cassia* crops in Haryana state

4.5 Decline of Honey Bees and other Pollinators

Pollinators which have evolved over a very long period, are declining at a very fast rate throughout the world. Currently many important pollinators especially honeybees are dying across the globe in an unprecedented manner and no proper reasons for this declining trend have been suggested so far by different authorities. This constant decline in honeybee and other pollinators' population will have serious ecological and economic implications in the long run because they are integral to the pollination of most of agricultural, horticultural and cash crops in the world. Many other pollinators such as digger bees, sweat bees, alkali bees, squash bees, leafcutter bees, carpenter bees, mason bees and shaggy fuzzy foot bees are also declining, but data providing unambiguous documentation of trends are simply not available.

4.5.1 Causes of Decline of Wild and Domesticated Pollinators

No scientific facts are yet available on decline of the pollinators. However, based on our own observations, experiences and earlier resources, it can be concluded that population of the pollinators especially the insect pollinators such as the honeybees, bumble bees, dipterans etc. is declining in the entire Indian sub-continent including Haryana. Major factors responsible for the decline of pollinators are as follows:

- Excessive and indiscriminate use of chemical pesticides
- Land use changes, monoculturing and deforestation
- Conventional methods of honey extraction from wild bee colonies
- Minimal efforts for conservation of the native pollinators
- Agricultural intensification and promotion of high yielding composite and hybrid varieties
- Global warming/climate change
- Introduction of exotic vegetables
- Destruction of natural pasture lands
- Unawareness among the farmers and general public about significant role played by pollinators including honeybees
- Natural calamities and perpetual forest fires
- Lack of promotional policies

4.6 Strategies for Conservation and Management of Insect Pollinators and Honeybee Diversity

Following strategies can be adopted for the conservation and management of Honeybee and other pollinators at national level and in the state of Haryana:

4.6.1 Managing Bee Nest Sites

i) Leaving standing dead trees and branches undisturbed on the fields or adjacent to the fields to offer nesting sites for cavity-nesting bees.

ii) Conserving sites where wild bees may nest, such as patches of bare grounds (adjacent to cropping sites and along road/path sites), bamboo stems, structural timbers etc.

iii) Avoidance of flood irrigation to conserve the underground nests of wild pollinators.

4.6.2 Forage for Pollinators

i) Mixed cropping to extend the foraging period of pollinators.

ii) Cultivation of crop varieties that flower at different times to reduce or eliminate dearth periods of wild pollinators.

iii) At landscape scale, conservation of perennial grassland, old fields, shrub lands, woodlands comprising wind-pollinated plants providing pollen sources for wild bees.

iv) Selective weeding to conserve weeds good for pollinators.

v) Floral diversity should be conserved and maintained to encourage the wild pollinators.

4.6.3 Reduction of Excessive use of Chemicals

i) Use of broad spectrum pesticides should be avoided because they are much more harmful to pollinators than selective pesticides.

ii) Pesticide application should be avoided during the blooming period of crops.

iii) Use of chemical pesticides should be discouraged and that of bio-pesticides be encouraged.

iv) Less use of chemical fertilizers so that ground nesting bees remain undisturbed.

4.6.4 Managed Pollinators

i) Management of pollinators like honeybees, carpenter bees and bumble bees.

ii) Development of a technique for mass rearing of insect pollinators including honeybees.

iii) Diversification of traditional beekeeping.

iv) Placing of Colonies of European bee in agricultural fields while in flowering stage. Number of colonies to be placed will vary according to the agricultural crop.

v) Placing of Honey bee colonies in the orchards/agricultural fields when 10 to 15 per cent flowering has taken place so that the bees would only forage on a specific bloom and ignore alternate forage in the vicinity of the orchard.

4.6.5 Green Accounting

- A way to help policy makers at national and state level (Haryana) recognize the importance of pollination services, and thus guide their decisions, is to promote

the inclusion of ecosystem services, such as watershed and non-timber forest values, which include pollination services, in national/state accounting practices. These services could then be given visible economic value for understanding national wealth; for example the gross domestic product (GDP).

- Developing 'greener' national accounting methods holds the promise of introducing environmental problems into a framework that key economic ministries, governing bodies and Heads of States could understand.
- Rarely are ecosystem services included in accounting spreadsheets or economic equations and models. Policy choices that keep a natural resource base intact or encourage 'free' ecosystem services, such as native bee pollination of crops, would make a country wealthier.
- Pollination services, if they are to enter into green accounting, should be considered in the first component of the methodology for developing natural resource asset accounts. This requires measuring 'opening stocks' of natural resources at the start of a given year, and 'closing stocks' at the end of the year. If pollination cannot be entered into such 'national stock-taking' by itself, it should be factored in as 'added value' to wild lands and forest 'stock', along with other values such as carbon sequestration and soil fertility.

4.6.6 Other Suitable Measures

Following steps can help in stopping the decline of pollinators including honeybees in the state of Haryana:

i) Updating of databases on pollinators, their host plants, biogeography, nesting requirements etc.

ii) Improved local taxonomic information and capacities.

iii) Studies on the indigenous knowledge and management practices regarding pollinators.

iv) Adoption of pollinator-friendly management practices.

v) Studies on the pollinating efficiency of various pollinators.

vi) Studies on the pollination requirements of various crops.

vii) Improved farmer capacity to manage pollinators sustainably.

viii) Increased capacity to conserve and sustainably use and manage pollinators by a wide range of stakeholders (other than farmers).

ix) To apprise policy makers regarding economic and socio-cultural value of pollinators to render enabling environment for conservation and management of pollinators with ecosystem approach.

x) Enhanced integration of pollination issues into sectorial policies, including agriculture and environment.

xi) Improved understanding of management practices that contribute to the conservation/restoration of pollinator diversity.

xii) Enhanced understanding and awareness on the ecological and economic value of pollinators, the cause of pollinator decline and its impact economically and on pollination services.

xiii) Economic evaluation of pollinator services.

xiv) Formation of policies to encourage the conservation of native pollinators.

xv) Involvement of NGOs and other volunteers for conservation of honeybees.

The introduction of pollinator-friendly management practices can affect farmers' livelihoods and well being in less tangible ways. It is important to be aware of these and examine how important they are relative to the impacts that have more clear cut financial and resource implications. These impacts may affect a farmer's decision to take up a pollinator-friendly practice.

4.7 Impact of Climate Change on Honey bees and other Pollinators

Climate change could be a major factor in diminishing the honeybee populations and is affecting the crop pollination in many agricultural zones. It could be the result of numerous factors, but historical records show that there are fluctuations in beehives every seven to eight years due to changing weather conditions and this in turn affects crop yields. Climate change also influences the distribution of pollinators and also the plants they pollinate, as well as the flowering time and migration. With the change in climate, the habitats suitable for survival of pollinators may change with some areas being lost and others being newly created. When a habitat disappears or the pollinator is unable to move to a new habitat, then local extinction can occur. Climate change may also disrupt the synchrony between the flowering period of plants and the activity season of pollinators including honeybees.

4.7.1 Influence of Declining Pollinator Population and Climate Change on Crop Productivity

It has been noticed that agricultural production, agro-ecosystem diversity and biodiversity are threatened by declining populations of pollinators and honey bees due to climate change. Many pollinator population densities are being reduced below certain levels at which they cannot sustain pollination services in agro-ecosystems, natural ecosystems needed for the maintenance of wild plant reproductive capacity. Ecological dangers of pollinator decline include the loss of essential ecosystem services (particularly agro-ecosystem services) and functions that pollinators provide. Ecosystem services in turn have their own value not only biophysical, but also economical.

Investigative studies from Asia show a linkage between declining natural insect population and decreasing crop yields - as a result, people have begun to manage crop-associated biodiversity (i.e. pollinators/honeybees) in order to maintain their crop yields and quality. For instance, farmers in Himachal Pradesh, a northern Indian state, are using honeybees to pollinate their apples. Due to declining pollinator populations and changing cultivation practices, an increasing number of farmers around the world are now paying for pollination services and are importing and raising non-native pollinators to ensure crop production i.e. managed crop pollination. In many developing countries, however, external pollination services are not available and rural communities have to survive with reduced quantity, quality and diversity of foods. In fruit orchards in western China, the decline of useful insect populations has led farmers to pollinate by hand, thus acting like human bees. Despite a general recognition of the impacts of declining pollinator population on ecosystem functioning and economy, certain bottle necks and constraints hinder the conservation

and management of pollinators for sustainable agriculture. Thus in Haryana state, this is appropriate time to focus on managed up pollination practices.

4.8 Bee Flora

In Haryana state, about 250 plant species have been identified as bee forage from which bees collect nectar and pollen for their growth and development. Of the total bee flora, 29 species are source of nectar, 21 species pollen and 200 species are source of both pollen and nectar. According to the relative utility of the bee flora, the plant species have been grouped into four categories. Nine plant species included in the major category are very rich source of nectar, pollen or both. Their acreage is quite high in the state. Of these, major sources are mustard, eucalyptus, berseem, sunflower, bajra, cotton, pigeon pea, acacia and neem. Multiple honey extraction is possible in the state where these sources are available in succession. Twenty plant species comprising the medium utility bee flora are rich source of nectar, pollen or both and have abundant occurrence in the state. These sources are mainly utilized for maintaining the colony strength throughout the year. The minor and poor utility category bee flora contains 45 and 95 plant species, respectively. These plant species are either poor / very poor source of nectar and pollen or their intensity is very rare. These sources are comparatively of lesser importance to honey bees and have use only as subsistence food sources.

4.8.1 Propagation of Bee Flora

Decline in bee flora due to deforestation and cleaning of waste lands for extensive agriculture has been one of the serious setbacks for Indian beekeeping. Propagation and mass plantings of bee flora through at forestation should be done on the principle of planting flora having multiple uses, since it is not practically possible to plant melliferous plants for honey bees alone. These plantations can be undertaken along highways, railway lines as well as in waste lands with the help of some central agencies. People can be encouraged to take up plantation of bee flora under social forestry and agroforestry schemes.

CHAPTER

5

HONEY BEE PESTS, PREDATORS, DISEASES AND THEIR IMPACT

Like other animals, honey bee colonies also suffer losses from various diseases and enemies. The bee diseases may infect bee brood or adult bees. Similarly some of the bee enemies attack bee brood whereas others infest adult bees. These bee enemies not only cause reduction in population of honey bee colonies, but also reduce productivity and profitability of these colonies. Among the bee diseases, European foulbrood, sac brood and nosema are commonly reported from north India. To manage these diseases, first of all our extension officers and beekeepers should be able to identify the symptoms of these bee diseases. The symptoms of these diseases have been given below briefly.

5. Bee Diseases

5.1 European Foulbrood (EFB):

It is caused by the bacterium *Melissococcus pluton* and is occasionally found in *A. mellifera* colonies in India. Infected young larvae get displaced in their cells, have yellowish tinge initially, become light brown later and die before cell capping. These dead larvae become soft, watery and have prominent breathing tubes Finally, the dead larvae dry and form brown removable rubbery scales at the cell bottom. Brood pattern becomes irregular.

5.1.1 Nosema Disease:

This disease, caused by a protozoa *Nosema apis* Zander, infects all three castes of adult bees. The infected bees start foraging at younger age. Flying ability of the infected bees is affected and they fall down during their return journey. Bees crawl up the grass blades and fall down on the ground and such affected bees gather in small pits or depressions. Abdomen is distended with faecal matter. Body hair are lost and bees become shiny. Mid intestine is swollen and if dissected, shows dull greyish white contents in contrast to amber or brownish gut colour of healthy bees. Bees defacate at the entrance of the hive entrance and on the ground in front of the hive.

Among the bee pests, *Varroa* mite, *Tropilaelaps clareae* mite, wax moths, ants and predatory wasps and birds are major problems. Identification of these pests and their symptoms will help the beekeepers to minimize damage to bee colonies.

5.1.2 *Tropilaelaps clareae:*

The female mite is elongate, light reddish brown in colour. Body is oval shaped and entire body is covered with short setae. It is much smaller than *Varroa* mite. The female mites can be seen moving on the brims of the comb cells. Cappings of the infested brood become sunken and sometimes have perforations. The brood area becomes patchy.

Infested bee pupae have dark pin prick size spots. Pupae, that are able to survive mite infestation, develop into deformed adults with smaller and twisted wings or lack wings. The mite infested brood and crawling adult bees with deformed wings may be present in front of the hive.

5.1.3 *Varroa destructor:*

Adult female mite is dorso-ventrally flattened, brown to dark brown and shining in colour, shaped like a tiny crab, and is broader than its length. The mite can easily be seen on infested bee brood and adult bees. Adult males are yellowish with lightly tanned legs and spherical body shape. In the infested colonies, adult mites can be seen on adults, larvae and pupae of honey bees. Two to six mites on an infested individual honey bee adult/ brood result in decline in colony size and activity. A large number of dead and live mites can also be seen in the debris on the bottom board. The cell cappings of infested brood show perforations. Heavy infestation results in typical bald-brood symptoms. As this mite prefers drone brood, drone brood should be checked for mite infestation during breeding seasons.

5.1.4 Wax Moths:

Honey bee colonies of species are infested by Greater wax moth *(Galleria mellonella)* and Lesser wax moth *(Achroia grisella)*. Out of these two species, Greater wax moth is more damaging. Adult moths are brownish grey; the females are lighter in colour, larger and heavier than males. In the females, the outer margin of fore wing is smooth while semi-lunar notch is found in males. Labial palp in females is extended forward. Stored and deserted combs, improperly cleaned wax and weak or poorly managed colonies and deserted combs of wild bees are constant source of wax moth population. Several overlapping generations are present. Wax moths are active from March to October, but peak activity is from August to October. It over-winters in larval and pupal stages in stored combs during November to February. The wax moths are more serious during nectar dearth and monsoon. The moth infests combs with all stages of brood, cells and pollen. Silken galleries spun by wax month larvae around them near the mid-rid of the brood comb is the cause of *Gallariasis,* a condition in which adult bees are unable to come out of cells as their legs get entangled in the silken galleries underneath. Wax moth larvae can reduce the combs to a mass of web and debris which has black thin and elongated excreta entangled in it. Severe infestation leads to suspension in brood rearing, foraging activity and ultimately desertion of colony. A. *mellifera* species collect more propolis, hence, it is less prone to the attack of wax month than other *Apis species*.

Greater wax moth complete its life cycle through four developmental stages i.e. egg, larva, pupa and adult. Eggs are spherical, smooth, pinkish to creamish white in colour and 0.4-0.5 mm in diameter. Eggs are laid in clusters of 50 to 150 in cracks and gaps among the hive parts. Single female lays on an average of 300-600 eggs. Larva is 3-30 mm in size and white to dirty grey in colour. After hatching, it feeds on honey, nectar and pollen. The larva makes silken tunnels in combs and extends these to the midrib of comb. It spins silken galleries that give it protection from bees and trap the newly emerged bees in their cells. This condition is known as Gallariasis. The fully grown larvae move to wooden hive parts, make a small depression in the wood and pupate in white silken cocoons in clusters. These cocoons may be found on inner walls of hive chamber, underneath inner cover and on frames.

The lesser wax moth larvae are 15-20 mm in size, white in colour with brown head and live segregated in silken tunnels covered with frass and webbings whereas greater wax moth larvae congregate. Moths are smaller than greater wax moth and silver grey without markings on wings.

5.1.5 Predatory Birds:

Several birds predate on honey bees. Important bee eaters present in Haryana include Green Bee-eater *(Merops orientalis)* and Black Drongo/ King Crow *(Dicrurus ater)*. These birds catch and eat adult bees, resulting in loss of huge number of foragers.

5.1.6 Predatory Wasps:

Wasps catch the bees, macerate them for feeding to their young ones. *Vespa orientalis, Vespa cincta, Vespa auraria, Vespa magnifica* and *Vespa basalis* are the major wasp species predating on bees. Among these bee predatory wasp species, brown wasp *(V. orientalis)* is the most common enemy of bees in Haryana during monsoon and post monsoon period (July-October). During winter, except the fecundated (pregnant) female wasps, all other castes die. The fecundated female starts egg laying during the ensuing spring and gradually builds up colony.

For managing the menace of bee diseases and enemies in Haryana, we should adopt three-pronged strategy. The three major components of this strategy should be scientific solutions by researchers, updated and accurate disease identification and management technology dissemination by extension personal and implementation of recommended practices by the beekeepers.

5.2 Strategies for Scientists : Management of Pests and Diseases.

5.2.1 Develop Non-chemical Methods for Disease and Pest Management:

There is an urgent need for development and evaluation of non-chemical methods for management of bee diseases and enemies to eliminate chances of chemical residue in honey. This will also help in having better acceptability of honey in international and domestic market.

5.2.2 Refine Chemical Measures:

Existing recommendations of use of chemicals for management of bee diseases and enemies should be re-evaluated to know their effectiveness. Evaluation of strips being used by beekeepers for management of *Varroa* mite should be done.

5.2.3 Quantify Impact of Unscientific Practices on Colony Productivity

Several beekeepers are using many unscientific and unrecommended practices and equipment. Negative impact of these unscientific and unrecommended practices on pest management and economics of beekeeping should be demonstrated to beekeepers through on-farm trials.

5.3 Strategies for Training Faculty

5.3.1 Aid in Identification:

Training faculty should develop pictorial charts of symptoms of various bee diseases. These charts will be helpful in explaining the typical symptoms of bee diseases to beekeepers.

5.3.2 Updated Information on Pest and Disease Management:

For obtaining highly effective management of bee diseases and pests, the beekeepers should have complete and updated information regarding various pest management strategies recommended by the scientists of the state university. But this is possible only if the training faculty is having recent information on pest management. This necessitates frequent interaction between the training faculty and SAU scientists.

5.3.3 Demonstration of Accurate Methodology for Pest and Disease Management:

To achieve best management of bee diseases and enemies without any detrimental effect on brood and bees, short term trainings should be organized for demonstration and hands-on practice of these management measures. This will help in tackling the problems of over dose and over exposure of chemicals and will help in dissemination of proper methodology for using these chemicals.

5.3.4 Awareness About Losses Incurred Because of Wrong Practices Adopted by Beekeepers:

Beekeepers need to be made aware about the losses incurred by them due to adoption of wrong chemicals and practices for management of bee diseases and pests. This can be done by holding one day workshops and field days. Distributing pamphlets, booklets etc on these topics should be distributed for wider distribution and adoption.

5.4 Strategies for Beekeepers

5.4.1 Proper Identification of Bee Diseases and Enemies:

Beekeepers should learn to differentiate symptoms of various bee diseases and pest attack. For this purpose they should ask for every detail of the symptoms of bee diseases during the training i.e. stage of infection, initial symptoms, progressive change in colour and texture of the infected brood or bees, most vulnerable colony conditions, difference from similar looking symptoms caused by other diseases and pests, any specific preference for worker, drone or queen castes, etc. For confirmation or in case of any confusion, they should contact nearby KVK or University scientists and, if needed, the beekeeper should present the sample of diseased brood or bees for inspection by the experts. Wrongly collected, packed or transported samples lead to deterioration of samples, thereby, sometimes creating problems in exact identification of the cause. Therefore, the beekeeper should ask the expert, beforehand, what should be sampled, how to collect, pack and transport samples of the infected brood or bees. In case of non-availability of the expert at the time of your visit, hand over the samples to the supporting staff, with complete details of name and postal address, contact number, site of apiary, date of sample collection, visible symptoms, colony strength and recent history of migration or use of any chemical, etc.

5.4.2 Check Causes of Spread of Diseases and Pests:

To check spread of bee diseases and pests within the apiary and to other apiaries, beekeeper should manage his/her colonies scientifically to avoid creating situations congenial for the spread of bee diseases and pests. Major causes for spread of bee diseases and pests among colonies of an apiary enlisted below need to be addressed at the earliest:

5.4.2.1 Exchange of Combs Among Healthy and Infected Colonies:

Exchange of combs from diseased to healthy colonies during the process of honey

extraction, uniting honey bee colonies or providing empty combs, brood, pollen or honey combs for colony equalization or space management may result in spread from infection from diseased to healthy colonies.

5.4.2.2 Open Feeding:

Although it is easier and cheaper to provide open feed in the apiary, but this practice is not recommended as it may result in spread of bee diseases and mites from infested to healthy colonies. It may also attract bees from disease and pest infected adjacent apiaries and wild bee colonies.

5.4.2.3 Robbing among the Colonies in an Apiary:

During the feed dearth period, honey bees from stronger colonies may attack weaker colonies for robbing honey. This unwanted process may lead to spread of bee diseases and mites from infested to healthy colonies. So, beekeeper should take all preventive measures to avoid robbing in the apiary. These measures include providing feed inside all the colonies at the same time late in the evening after narrowing down colonies entrances. Feed should not spill on or near the hives in the apiary.

5.4.2.4 Robbing among the Colonies of Adjacent Apiaries:

Honey bees from nearby apiaries or wild bee colonies may also rob infected colonies during the nectar scarcity period. This will result in spread of bee diseases and mites among the apiaries in that area.

5.4.2.5 Drifting of the Bees among the Colonies:

Young bees or drones usually drift to adjoining colonies. This drifting of bees may be because of less distance among the colonies and rows of colonies or strong wind, etc. Drifting of bees from infected colonies may spread diseases and pests to healthy colonies into which drifted bees enter.

5.4.2.6 Use of Contaminated Equipment:

If apicultural equipment used in the diseased colonies is subsequently used in the healthy colonies, bee diseases may spread in the apiary. Hive tool and gloves used during colony management and uncapping knife and honey extractor used during honey extraction process are more liable to spread bee diseases.

5.4.2.7 Capturing and Hiving Alien Swarms:

Capturing and hiving a swarm from another apiary is economically beneficial, if the captured swarm is healthy. But there is a chance that these alien swarms may be carrying inoculums of bee diseases. Therefore, these captured swarms should be kept separately and under supervision til it is ascertained that there is no risk of introducing a disease or pest into our apiary.

5.4.2.8 Purchase and Sale of Colonies:

New colonies purchased should be marked, kept separately and be examined regularly so as to avoid introduction of pests and diseases in the apiary. Severity level of pests and diseases already existing in the apiary may also increase if newly purchased colonies are heavily infested.

5.4.3 Prefer Non-chemical Measures:

wherever possible, prefer to use non-chemical measures to manage bee diseases and pests. For example, trapping of *Varroa* mite in drone brood and destruction of infested

sealed drone brood will help in reducing population of the mite in the colonies. Use of sticky paper at the bottom board or *Varroa* bottom board or using screened bottom will be helpful in eliminating mites which fall down on the bottom board. For managing European foulbrood disease, shook swarm method may be used. This method does not involve use of any chemical. In this case all the bees of the infected colony are shaken and all the combs in these colonies are replaced with frames having comb foundations. Small scale infestation of wax moths may be managed by exposure of these infested combs to sun.

5.4.4 Adopt Recommended Practices Only:

Beekeepers should follow the recommended practices for management of bee diseases and enemies. Over dose of recommended chemical may severely affect survival of brood and bees. Using dose lower than recommended, will not result in desired mortality of the pest. In certain cases if dose of the chemical used is as per recommendation but exposure period is shorter than the recommended one, pest management will not be successful. Recommended interval between two applications and number of treatments should be followed.

5.5 Selection of Stock:

Beekeepers should keep full record of incidence and level of severity of infection of bee diseases and seasonal incidence of bee enemies. This will enable them to select colonies showing resistance to bee diseases and pests for use as breeder colonies for mass queen bee rearing. By adopting this practice, a healthy stock may be maintained which will minimize use of chemicals for management of bee enemies and diseases.

5.6 Impact of Insecticides:

Major impact of insecticides on pollinators is mortality of honey bees and pollinators due to their direct exposure to insecticides when these pollinators are foraging on flowers of the crops. The residual insecticide on the flowers may also cause toxicity to pollinators visiting the contaminated flowers. Drifting of insecticides may also cause toxicity to pollinators through contaminated air or water around the area where insecticides have been sprayed. Collection of insecticide contaminated pollen or nectar may also result in toxicity to young bees or brood.

5.7 Symptoms of Pesticide Poisoning in Honey Bees:

Sudden and excessive bee mortality is seen of honeybee colonies in the apiary. Dead bees may be found in front of the hives or even on the bottom board of the hives. These dead bees in front of the colony may have some of the bees with pollen loaded in their pollen baskets. Crawling and trembling movements of legs. The poisoned bees may sometimes fall side-ways or upside down and make trembling movements.

5.8 Factors Which Influence Toxicity of Insecticides to Pollinators:

5.8.1 Stage of the Crop:

Pollinators are mainly attracted to flowers of the crops although extra floral nectarines in some crops also attract honey bees and other pollinators during non-blooming stage of the crops. However, bee floral crops attract large number of pollinators during their blooming period. Therefore, application of pesticides during crop flowering stage will result in large scale mortality of honey bees and other pollinators.

5.8.2 Time of Insecticide Application:

Time at which insecticide application is done, has tremendous effect on the mortality of pollinators. Insecticides applied during the peak activity period of pollinators will be most deleterious to pollinators' population.

5.8.3 Nature of the Pesticide:

Nature of pesticide applied also impart the toxicity to pollinators. Persistence and residual action greatly influence their toxicity. Synthetic pyrethroids have high toxicity to honeybees, but are considered comparatively safer because of their repellent effect. Green chemistry should be promoted.

5.8.4 Type of Formulation:

The formulation of an insecticide also greatly affects its toxicity to the pollinators. In general, granular formulations are safer than the spray and sprays are safer than dusts.

5.9 Measures to Minimize Pesticide Toxicity to Pollinators:

5.9.1 Beekeepers' line of Action:

1. If it is known that the crops are to be spread with an insecticide, never site your colonies in the crop to be sprayed but to place at some distance from such crops.
2. The beekeepers should maintain their apiaries on such locations where the use of pesticides is minimum.
3. Beekeepers should collect information regarding the time, frequency and type of pesticide application in the area around their apiaries.
4. At the migrated site, colonies should be placed in such a way so as to prevent damage to honey bee colonies because of drifting of insecticides which is sprayed on the nearby crop.
5. Beekeepers should remain in regular contact with the farmers of the area around their apiaries to keep an eye on the insecticide application trend and plan of the farmers. This will enable the beekeepers to take precautions to minimize bee mortality by closing the entrances of the colonies with wire screen early in the morning before bees start foraging. Farmers must insure that the colonies are having adequate space and food to cope up with the confinement period.
6. If a crop is sprayed very frequently, beekeepers should migrate their colonies to some other flora or area which is safer for the bees.

5.9.2 Farmers' line of Action:

1. Wherever possible, farmers should avoid spraying of insecticides during the flowering stage of bee floral crops.
2. During flowering stage of the crop, farmer should prefer non-chemical measures to manage pests and diseases.
3. If necessary, use green chemistry i.e. insecticides which are relatively environment friendly and thus least toxic to honey bees and other pollinators.
4. If option is available, apply pesticides in granular or spray form rather than using dust formulation.
5. Avoid insecticide applications during the time of the day when activity of the pollinators on the crop is maximum.

6. Avoid spray of insecticides during strong wind, as it will lead to lesser effectiveness and more drift of the insecticide to non-target crops, insects and animals.
7. The farmers should intimate the beekeepers, preferably at least one day in advance, regarding application of insecticides so that the beekeepers can make necessary arrangements or take precautions to minimize loss to honeybee colonies.

5.9.3 Researchers' line of Action:

1. Research on bee floral crops should be done to find out relatively safer time window for application of insecticides.
2. Development and evaluation of repellents to keep honeybees and other pollinators away from the insecticide treated crop blooms.
3. Emphasis should be laid on the development of non-chemical methods for the management of crop pests and diseases.
4. Ensure development of non-chemical methods for management of bee pests and diseases which are effective in the field.

5.9.4 Extension Officials' line of Action:

1. Conducting on-farm training for farmers
2. Creating awareness among farmers about the availability of safer insecticide and their use.
3. Demonstration of proper spray methodology and appropriate spray technology
4. Survey of bee floral crop areas to monitor any sudden and major shift in mortality of honeybees and other pollinators.

CHAPTER

6

MARKETING AND ECONOMICS OF BEEKEEPING

Haryana beekeepers are producing large quantity of honey by rearing *Apis mellifera*. Almost all of the honey is sold in wholesale market. Our beekeepers generally do not put in much effort in retail marketing of honey. Majority of the beekeepers just remember how many buckets of honey they have sold in the season, but do not maintain record of expenditure and income from their beekeeping enterprise.

6.1 Marketing of Honey

To have better marketing of honey, there is a need to make beekeepers aware about the importance of honey bottling, labeling, presentation, promotion and maintenance of quality of honey. Various aspects of honey marketing have been discussed below briefly:

6.1.1 Balance in Wholesale and Retail Marketing

Honey marketing in Haryana is mainly dependent on wholesale honey purchasing by exporters and traders. These honey exporters and traders have a tremendous role in maintaining demand for honey in Haryana. But beekeepers should be encouraged to develop market for sale of their honey in retail market. To begin with, beekeepers should be encouraged to keep a small portion of their produce to be sold through retail market channel.

6.1.2 Expand Products list by Value Addition

More customers may be attracted by having a wide array of products. Therefore, beekeepers should be motivated to go for value addition to honey, especially during the festive seasons like Diwali, etc. Preparation of honey *ladoos,* honey aonla *burfi,* honey *aonla* candies, etc. Specialized training programmes should be organized for beekeepers and their families to train them in value addition to honey.

Unifloral honey and comb honey will add to variety of the product list and will help in catering to the needs of specific group of customers interested in purchase of something unconventional.

6.1.3 Advertise and Promote Brand for New Market

To tap new market for honey, the beekeepers should promote their honey and honey product's brand. This promotion can be done by distributing pamphlets, by offering honey through confectionary or general stores in the area.

6.1.4 Contractual Retailing of Honey by Involving Unemployed Rural Youth, Urban Market

To expand market for honey sale, beekeepers may be encouraged to create a network of sales persons for marketing of honey in different areas of adjoining cities and

towns. For this purpose unemployed rural or urban youth may be employed on contractual or profit sharing bases.

6.1.5 Attractive Gift Packing

To promote honey as a healthy gift alternative, its packing should be very attractive and colourful. Printed hard paper cases, net or even transparent polyehene sheet, etc. will improve presentation. Gift packing may also include a combination of honey and other healthy food items such as dry fruit.

6.1.6 Attractive Bottles

Use of attractive, wide mouth glass bottles for retail sale of honey should be promoted. Transparent plastic squeeze bottles present a convenient to use packing. Teddy bear toy shape of bottle will encourage children to consume honey.

6.1.7 Attractive Display of Honey on Roadside

Generally road side stalls of honey have a simple table or bench on which bottles are placed for display and sale. This is quite an effective method but only for slow moving vehicles or commuters. These display are visible from small distance only. There is a need to promote construction of tiered high stand for display of honey bottles to enable the stall to be noticed from quite a distance.

To further improve impact on travelers, there is a need to make beekeepers aware to get attractive, coloured banners for honey sale. These banners should be printed on both the sides so that it is visible to travelers from both sides of the road. The banners should have minimum written material, so that font size could be large to have more impact.

Honey packaged in different capacity bottles also make the display more attractive and will provide options to customers as per their requirement.

6.1.8 Festivals and Melas

Various festivals and village level melas offer great opportunity for retail selling of honey. If beekeepers do not have time to sit and sell their produce, they should hire a needy and active person for selling honey in retail during these melas. By doing so, beekeepers can earn almost double than what is earned by wholesale selling of honey.

6.1.9 Promotion through Print Media

Before the onset of winter season, several residents of towns and cities are interested in purchase of honey for consumption. But they need to have information about the source from where they may get good quality pure honey. Therefore, marketing of honey in local population should be promoted and one of the options is by getting printed advertisement brochures distributed through newspaper vendors.

6.1.10 Maintenance of Quality of Honey for Customer Loyalty

Maintenance of good quality of honey is of utmost important both for maintaining loyalty of customers and to attract new customers. Beekeepers should continually ask their customers for their feedback about the product, packing and presentation of the product. This will enable our beekeepers to further improve market for their produce.

6.2 ECONOMICS OF BEEKEEPING

6.2.1 Economics of Migratory Beekeeping with 50 Colonies

6.2.1.1 Expenditure

6.2.1.1.1 Non-recurring Expenditure

PARTICULARS	Qty. (No./kg)	Rate (Rs.)	Amount (Rs.)
• Bee hives (with super chamber & queen excluder) of Kail wood	50	2700/hive	1,35,000
• Nucleus honey bee colonies (on eight bee frames each)	50	2000/colony	100,000
• Honey extractor (4 frames), drip tray and uncapping knife	One set	4700/set	4,700
• Smoker, bee veil, bee gloves, hive tool, etc.	One set	750/set	750
• Honey buckets	40	120/pc	4,800
		TOTAL	**2,45,250**

6.2.1.1.2 Recurring Expenditure

PARTICULARS	Qty. (No./kg)	Rate (Rs.)	Amount (Rs.)
• Comb foundations	800	25/CF	20,000
• Sugar for dearth period feeding (5 kg/colony)	250 kg	40/ kg	10,000
• Sulfur (50 g/ colony)	2.5 kg	80/ kg	200
• Stickers (25/colony)	1250	2.5/ pc	3,125
• Formic acid (140 ml/ colony)	7 liters	320/ l	2,240
• Transport for migration	3 trips	5000/trip	15,000
• Miscellaneous (winter packing, etc.)	50 colonies	20 /colony	1,000
		TOTAL	**51,565**

6.2.1.1.3 Recurring Expenditure

PARTICULARS	Amount (Rs.)
• Interest on non-recurring cost @ 12.75 %	31,269
• Recurring cost	51,565
• Interest on recurring cost (except labour) for 6 months @ 12.75%	3,287
• Depreciation on permanent articles @ 10% (except on bee colonies)	14,525
	1,00,646

6.2.1.2 Income

PARTICULARS	yield	Total Quantity Produced	Rate (Rs./unit)	Amount (Rs.)
• Honey Production	50 kg/colony	2500 kg	140/ kg (bulk sale)	3,50,000
• Sale of extra colonies	25%	12 colonies	2,000/colony	24,000
• Beeswax	2% of the honey produced	50 kg	250/kg	12,500
				3,86,500

6.2.1.3 Profit

- Net Profit during First Year : Rs. 3,86,500 – Rs. 1,00,646 = Rs. 2,85,854
- Profit per colony (@ Rs. 140/ kg of honey) = Rs. 5,717

CHAPTER

7

CONSTRAINT ANALYSIS IN BEEKEEPING INDUSTRY

7.1 General Constraints

7.1.1 Nomenclature:

Name reflects our ideology, thoughts, orientation and efforts. The Khadi and Village Industries Commission (KVIC), that patronizes beekeeping in India, named it as "Beekeeping Industry" after the dream of Mahatma Gandhi to empower rural masses with self sustaining village industries. In purely scientific parleys at State Agricultural Universities (SAU's), it is called Apiculture, restricting its scope mainly to Entomology component of broader discipline of Apiculture. In the realms of Indian Council of Agricultural Research (ICAR) and Union Ministry of Agriculture, its scope has been further confined to a limited sub-branch of "pollinators" as if pollination can be achieved automatically without the basic concept of beekeeping. For beekeepers, it is purely beekeeping, the art of rearing honeybees with little scientific inputs and with the sole aim of producing honey. For exporters, it is purely a commercial activity of procuring honey (commodity) for profit maximization bereft of the ethics. Honeybees as creatures are epitome of symbiosis and can't be limited by narrow physical, geographical and thought barriers. It is time not only to perfect the nomenclature but also our approach, thought process and course of action.

7.1.2 Huge Unexplored Potential:

Tremendous scope of beekeeping growth exists in India. Bees have direct bearing on production of crops sown in about 48.5 per cent area of India besides substantial indirect pollination support. Incidentally, 98.3 per cent of beekeeping potential remains unexplored and gigantic national resource is being allowed to go waste.

7.1.3 Technical Manpower Engaged in Beekeeping in India:

Technical strength of Central Bee Research and Training Institute (CBRTI), Pune and KVIC has dwindled from more than 2000 in 1980's to about 50 (only handful technical, rest extension staff). ICAR has only one scientist (PC) mostly engaged in administrative and coordinating activities. In Haryana, only 2 scientists deal with research and 2 ADO's with the development aspects. It is a pity that in India with 1.25 billion people and 1.3 million honeybee colonies, there are no more than 30 scientists (Entomologists) and 85 development staff, meaning 1 scientist per 40,625 colonies and 1 development staff for 15,662 colonies. There is an urgent need to substantially increase this manpower.

7.1.4 Low Priority, Miniscule Industry with no Role of Sector Management Organizations:

In terms of priority and resource allocation, beekeeping is a miniscule segment of 2.42 lakh beekeepers maintaining 13 lakh colonies and producing about 52,000 MT honey. Absolute lack of a powerful lobbying group and sector management organizations (associations/ federations) have failed to provide beekeeping its rightful place at national level. In contrast, it is provided the highest priority in agriculturally developed countries like US, EU, etc.

7.1.5 Profit Analysis of Beekeeping Enterprise:

Beekeeping once was a highly profitable activity but increased cost of production (labor, migration, medication, feeding, rentals, etc.) has made it unsustainable. Cost of honey production has exponentially negative relationship with productivity. At a higher productivity level (25 kg/hive/year), cost of production is a factor of 2.72 and at moderate level (20 kg) grows 1.6 times to 4.25. However, at a lower productivity of 12 kg, as recorded during 2013-14, it leaped exponentially by 4.3 times (11.75) of the production cost, coupled with other negative traits. There is thus, an urgent need to improve profitability by adopting specially designed management aspects, technological innovations and diversification.

7.1.6 Ethical Erosion of Beekeeping Segments:

Beekeeping till 1980's was scientifically driven but in late 1990's it turned exporter centric when mustard honey exports to EU and USA began. Exporters wanted more honey, adopted unethical means and even encouraged beekeepers to adopt wrong practices of extraction of unripe honey without supers. Beekeepers after 2004-05 *Varroa destructor* epidemics turned their energies to cost reduction to offset exorbitantly higher cost of medication. Scientists failed to predict the catastrophe and provide inputs at crucial time. However, exporters and beekeeper's combination proved disastrous as Indian honey was banned in EU due to poor quality and contaminations. After lifting of ban in 2011, policy makers failed to frame rules and implement them. Instead of learning from past mistakes, it was free for all. Exporters exploited the beekeepers without investing anything to good beekeeping practices (GBP). Exporter wanted more profit, beekeeper wanted more money and labor wanted to do no extra work. The honey production and productivity reached lowest ebb and honey quality deteriorated alarmingly. Today, almost all these segments of the industry are at fault.

7.2 Administrative Constraints

7.2.1 Non-technical Persons Heading Beekeeping:

An industry takes the shape of the thoughts and actions of its leaders. Gandhi ji had the vision to incorporate beekeeping in his swarojgar movement and laid the foundation of a holistic beekeeping industry under Khadi and Village Industries Commission (KVIC). Directorate of Beekeeping Industry handled development and marketing while CBRTI, Pune headed by eminent and dedicated scientists lead the research front. Declaration of beekeeping as non-core industry by KVIC and its subsequent leadership by non-technical Heads has led to its down fall.

All India Coordinated Research Project on Honeybees (AICRP) is mainly focusing on crop pollination. In the state agricultural universities (SAU's) beekeeping is the least priority of Entomologists. National Bee Board (earlier Beekeeping Development Board) was established in 1993 by joint efforts of KVIC. However, All India Beekeeper's Association (AIBA) in the Union Ministry of Agriculture and Cooperation failed to become a fully autonomous body. It was later converted into a private unit, run mainly by exporters for their narrow gains and was subsequently headed by a non-beekeeping Executive Director thus, losing the direction. National Horticulture Board (NHB) and later National Horticulture Mission (NHM) were entrusted with the implementation of centrally sponsored schemes.

Department of Horticulture, Haryana is establishing "Center of Excellence in Beekeeping" under Indo-Israel project to provide highly technical and specialized services to beekeepers. It is expected that it will be headed by a technical person possessing a wide experience in scientific beekeeping.

Rise and fall of these mighty beekeeping institutions reflects the blurred and narrow vision of leaders. There is thus an urgent need to involve real beekeeping persons into these bodies.

7.2.2 Integrated and Inclusive Approach is Missing:

Beekeeping is an inter-disciplinary science involving disciplines of Apiculture, Bee Botany, Melissopalynology, Pollination, Genetics, Bee Breeding, Honey Chemistry, Quality control of honey and hive products, Wild bees, Entomology, Zoology, Pathology, Engineering, Extension, Training, Information Technology, Honey Processing and Marketing, etc. and is wrongly considered a part of Entomology. Now, it is high time that beekeeping is treated as it is by making it holistic, integrated and inclusive.

7.2.3 Multitude of Implementing Agencies Working in Isolation:

Honeybees are the most coordinated creatures and its policy makers and implementers must learn this art. There is multitude of organizations at national and state level but no one knows what others are doing. Pooling and coordinating vast resources, manpower and efforts could create a giant body capable of providing gigantic growth and employment opportunities.

7.2.4 Abolition of Tax on Honey and other Equipments:

It is strange that an agrarian and progressive state like Haryana levies 4% Tax on honey, which in turn provides meager revenue to the State and even proves counterproductive. Honey produced in the State is not reflected as its own production but is rather sold off to traders in the neighboring states. Tax needs to be immediately abolished. Likewise, Tax on other beekeeping equipments should also be abolished.

7.2.5 Compensation of Colony loss by Disasters:

Beekeepers now consistently incur severe colony losses due to failure of honey seasons and disasters like, rain, hail storm, fire, flood and theft etc. Government compensates farmers of their crop losses and beekeepers must also be extended this cover. Even loss of productivity in terms of lost yields needs be compensated for beekeepers as is done in many foreign countries including USA through a revolutionary Farm Bill, 2014.

7.2.6 Compulsory Registration and Insurance of Beekeepers:

To provide relief to beekeepers from calamities like fire, theft, etc. their registration with state association and insurance should be mandatory. Government should ensure special insurance schemes for beekeepers.

7.3 Policy Constraints

Sectoral policy formulation is done without the involvement of target groups and is influenced by dominant group of exporters. A comprehensive policy formation for sector is the need of hour.

7.3.1 Considering Beekeeping as Legal Agriculture Activity:

Beekeeping is 100 per cent agro-forestry based activity but wrongly considered otherwise. It is rather an "orphan" discarded by Ministry of Industries and also abandoned by Ministry of Agriculture to which it actually belongs. It should be declared an agriculture activity for all legal purposes.

7.3.2 Lack of National Honey or Beekeeping Policy:

There is an urgent need of framing "National Honey/Beekeeping Policy" followed by state policies. It is a long pending demand by the beekeeping fraternity and imprints were suggested as far back as 1993 to the Union Ministry of Agriculture during first National Conference on Beekeeping and also later on many other occasions. It is high time that such an inclusive policy is framed that shall encompass is the guiding principles of the industry and the realistic action plan. It shall also encompass:

7.3.2.1 National Beekeeping Medication Policy:

In the absence of a uniform policy for treatment against insect-pests and diseases of honeybees, beekeepers resorted to cheaper, un-recommended and unethical remedies, thus increasing substantially the cost of medication and production of contaminated honey. The proposed medication policy shall include all gamuts like quarantine, use of recommended chemicals, their time and method of application, waiting period, supervisory authority, etc.

7.3.2.2 National Policy on Organic Honey Production:

Haryana has designated organic areas with potential to produce premium "organic honey" which remain unutilized for want of policy support.

7.3.3 Comprehensive and Integrated Beekeeping Plan for Haryana:

There is an urgent need to formulate integrated beekeeping planning (IBP) for Haryana with realistic and workable action plan.

7.3.4 Beekeeping be Declared Priority Sector by Government:

Realizing the yeomen service rendered by honeybees in increasing crop production and productivity, it should be declared the top priority sector of country. But unfortunately, except inserting a line "honeybees as an input to agriculture", precious little has been done by the government. Our governments should be extra sensitive as beekeeping directly touches farming community and influences agro-based industries.

7.3.5 Creation of Cadre of Experts:

There is an urgent need of a cadre of scientists in different disciplines of beekeeping by identifying their interests and potential and ameliorated through advanced

trainings and experiences. A similar cadre of field officers and beekeepers should also be created.

7.3.6 Separate Division of Apiculture in SAU's:

As discussed earlier, an Entomologist may not be an ideal apiculturist. A separate functional division of Apiculture needs to be created in SAU's with scientists drawn from different disciplines.

7.3.7 Increased Curriculum in Universities:

As honeybees touch almost every gamut of our life, it is important to introduce more courses in curriculum of universities. Even in SAU's, there is a need to make beekeeping courses as mandatory at UG level and more courses at PG level may be introduced.

7.3.8 Increased Awareness:

Beekeeping is a low profile industry though with immense benefits to humanity at large. All segments of society need to be sensitized especially leaders, planners and farmers about pollination benefits and consumers about honey and other products through electronic and print media, honey festivals/days, workshops, promotional events, etc.

7.4 Research Constraints

7.4.1 Prioritization of Research:

Beekeeping in India has reached its pinnacle due to untiring and selfless work of beekeeping scientists at SAUs and other Government organizations. Presently, the research priorities are more academic and less beekeepers or industry oriented, and thus need complete reorientation. In SAU's, Entomologists are mainly engaged in pollination research (without Botanists), but there is no field adoption in any crop (except apple). Even the pollination studies in enclosures are the least priority. Other important aspects are: effect of global warming on honeybees and pollinators; mechanization; hives and value-added products, apitherapy; residues; disease resistant, bee breeding, development of equipments, etc.

7.4.2 Large Scale Death of Honeybees:

Alarming bee deaths have become a global phenomenon with more than 50% colony loss in US and EU due to CCD (Colony Collapse Disorder) primarily due to newer pests and pesticides like neonecotinoids. Annual winter and summer stands at 30 and 12.5%. CCD will also reach India and we shall again be caught unawares due to lower priorities.

7.4.3 Beekeeping is a Missionary Work:

Beekeeping is not a 9-5 job, it is a missionary field work. That's why it is on the lowest priority of scientists or field functionaries. There must be special incentives to them and freedom of working hours, if results are to be achieved.

7.4.4 National Beekeeping Institute (NBI):

A country or industry's success is mapped by its scientific institutes. It is a matter of great concern that in India, we have no national level institute of beekeeping now except CBRTI, Pune. In Germany, there are 18 institutes of beekeepers.

7.4.5 Bee Breeding:

An absolutely essential but entirely neglected aspect of Genetics. Bee Breeding is not even practiced by apiculturists in India. However, the work on bee breeding has

already been initiated in another laboratory. Top priority has to be accorded by ICAR and SAU's to breed pest resistant and higher productive lines. Beekeepers should be provided with this nucleus stock for further multiplication and distribution under critical scientific supervision.

7.4.6 Research on Wild Bees:

India is home to two most important species of wild bees viz. rock bees and dwarf honeybee, former being the largest source of honey and pollination. There is rapid decline of these species and practically little research is being done on these bees in India.

7.5 Improving Efficiency of the Bee Breeders :

To usher this advanced system and technology of mass queen rearing, following points are suggested to improve this scheme:

i) Selection of Bee Breeders: As described earlier, there is an urgent need to rework the selection procedure. Based on scientific criteria, competent beekeepers should be selected afresh.

ii) Provision of High Pedigree Material from the Bee Breeders of SAUs

iii) Provision of Specialized Equipment and Infrastructure grant: Once new breeders are selected, they should be provided with one-time grant for specialized equipments and infrastructure.

iv) Proper Utilization of Resources: Earlier also, State government gave one-time lump sump grant to these bee breeders for technical upgradation, but there seems to be no improvement. Instead, a realistic component wise grant pattern should be framed and its monitoring and implementation should ascertained.

v) Intensive Practical Training to Bee Breeders: Training on the techniques related to mass queen rearing, queen mating, etc. followed by periodic updating at State's cost at national and international avenues is necessary.

vi) Regular Monitoring of Schemes: Proper procedure should be devised in respect of marking, documentation and verification of bee breeders and their colonies at regular intervals by technically competent person/team to ensure they really provide services they are being paid for.

7.5.1 Proper Monitoring and Evaluation of Scheme:

Seeing the nature of industry, recirculation and bogus distribution can't be ruled out and there is an urgent need to make the system water-tight.

7.5.2 Project Patterns Need Upgrade:

Beekeepers are generally from marginalized and weaker (economically) section and there are many target oriented government sources of finance (DRDA, NHM and special segment schemes for SC/ST), while there are others like KVIC, KVI Board, National Horticulture Board etc. which are project based. It is very difficult for a poor or less resourced person to formulate a project and get financing. To improve financing to real beneficiaries, following points are suggested:

- There is little objective public display of information about schemes and still they are fully or over-subscribed.

- There are huge and unrealistic variations in project components and needs uniformity.
- There are many unrealistic conditions of lease agreement of land (in NHB) even when beekeeping is a landless enterprise.
- Thorough monitoring and follow-up of projects is a must.
- Financing pattern for projects needs thorough up-gradation.

7.6 Human Resource Development

Every segment of industry needs training, but where and by whom is the question.

7.6.1 Beekeepers:

Beekeepers are generally privy to a 3-day "general beekeeping course" run by SAUs, HTI, etc. where they are taught only the basic concepts of beekeeping with very low practical exposure. This course enables them to acquire a certificate which is an essential prerequisite to purchase honeybee colonies at subsidized rates under centrally sponsored scheme. Some graded training courses are run at CBRTI and some other places. There is an urgent need to enhance the scope and tenure of need-based (customized) trainings with more hands on practical components. These must be work-driven and ready for private sector uptake.

7.6.2 Scientists:

Scientists are self possessed and believe that being trainers they are supposed to know everything. A true scientist on introspection will know how little he actually knows about real beekeeping. There is thus, an urgent need to update their skills periodically at international level as India at present, does not have any center of excellence for beekeeping.

7.6.3 Implementing Agencies:

Persons concerned/beekeepers need thorough training on various aspects of project formulations, evaluation, implementation and monitoring. They need be exposed to practical beekeeping as it is operationally an entirely different from other branches/ industries.

7.7 Technological Constraints

Beekeeping differs in western countries and India. Beekeepers in west go for scientific techniques and standardized equipments, whereas Indian beekeeper's priority is cost reduction. In India, there is hardly any use of modern technology in beekeeping, except in honey processing and packaging. Some technological constraints are discussed here.

7.7.1 Constraint Analysis in Beekeeping Industry

7.7.1.1 Beekeeping Information Centre:

For a beginner, first step is the information about beekeeping, its benefits, economics, feasibility, projects, etc. Even in this seem-less world of high technology, all such information is not available at one place. A prospective beekeepers gets scattered information.

7.7.1.2 Communication channels:

Beekeepers use non-conventional communication ways and conceal information from fellow beekeepers, as required information is not in public domain.

7.7.1.3 Web Site:

There is no Indian web site catering to beekeeping and the foreign web sites have contents not entirely suitable to Indian conditions. The portals of implementing agencies show only a skeleton as if to hide more than to disseminate.

7.7.1.4 Sources of Colonies:

To start beekeeping enterprise one has to search for the source of good quality honeybee colonies and such information on sources is not available even though government also approves of these sources.

7.7.1.5 Quality Equipment:

It is really a matter of concern that 99.99 per cent of bee hives used today are non-standard (wooden boxes) and so is the other equipments. The wood used and manufacturing is faulty. This unhygienic box is the root cause of many ill effects faced by the honeybees.

7.7.1.6 Non Renewal of old Combs:

Most of the combs in colonies are almost black with shorter cell space leading to small size of worker honeybees.

7.7.1.7 Supers and Queen Excluders:

Adoption of the best practice of honey extraction from supers using queen excluder is almost non-existent in India and Haryana with only 0.17 per cent supers (Chaudhary, 2005). Supers in fact are considered excess inventory and beekeepers feel it difficult to work with them. There is an urgent need to reverse this practice to get best quality honey.

7.7.1.8 Availability of Quality Queens:

Queen is the life-line of colony. The concept of mass queen rearing to get quality and prolific queens is lacking in Haryana. To improve production and productivity of honeybee colonies, mass availability of good quality queen should be made mandatory with quality germplasm coming from SAUs.

7.8 Need to Adopt Futuristic Technologies

7.8.1 Real time Pollination Service Approach (RTPSA):

Government is worried about declining production, productivity and quality of crops/products but in reality a lot needs to be done. Barring apple crop in Himachal Pradesh (that too a farmer-beekeeper initiative), there are no contractual "pollination services" between farmers and beekeepers this otherwise is the universal concept worldwide.

7.8.2 Identification and Trekking of Bee hives:

Beekeeping being migratory in nature, the basic requirement of a subsidized colony distribution system is marking of bee hives, followed by their trekking and monitoring over time and space – a component till now compromised with. In absence of such a system, a very high probability of bogus hive distribution and their re-circulation exists. Effective means exist of permanent branding of not only the bee hives with scientific coding system but also of its parts (even frames) by embossing. It is essential to trek bee hives of beneficiaries and bee breeders following traceability procedure.

7.8.3 Mechanization:

Indian beekeeping is entirely labor dependent who are illiterate and are in acute short supply. The cost of the labour has doubled over the years. Without segmental mechanization, it will be difficult to run beekeeping enterprise in future. Immediate semi or full mechanization in fields of migration, honey extraction, honey transportation, medication, feeding, etc. is needed.

7.8.4 Turning Beekeeping into a Highly Professional Enterprise through HTIBS Approach:

Honeybees are most specialized and professional creatures, but in India, this enterprise is run in most unprofessional ways. "High-Tech Integrated Beekeeping System (HTIBS)" is needed to usher professional and scientific approach in sectors of colony inspection, medication, survey, trekking, certification, queen rearing, collection/preservation of hive products (pollen, propolis, etc.), traceability, etc. in order to have uniformity (time, methods, chemicals, etc.) and efficacy. Centrally monitored system has greater commercial potential. A team of few dedicated and trained professionals can effectively perform all such end-to-end functions in a state like Haryana and even at national level at a fraction of cost.

7.8.5 Record Keeping of Apiary using Integrated System :

Honeybee colony and apiary are so dynamic that fortunes may fluctuate in a week. Proper record keeping allows daily as well as seasonal planning. There is no operational record keeping by beekeepers. More surprisingly, such records are not generally maintained ever for research and development apiaries. Many detailed colony growth parameters are repeated mainly for scientific work, which are of little help to the beekeepers. Author has devised a unique system of stock taking, colony inspection and advisory report for an apiary called STCIARS that involve complete stocking, random sample colony inspection followed by evaluation and advisory report.

7.8.6 Effect of Climatic Change and Persistent Failure of Honey Crops:

Global warming and other weather related factors have disastrous effects on plants and honeybees, resulting in complete to partial failure of most copious honey plants like eucalyptus, rubinia, pahari kikar¸ *Delbergia sissoo,* litchi, *Accacia catechu,* ber, cotton, *Plectranthus rugosus*, pigeon pea, coriander and most importantly the mustard in recent years, making beekeeping a losing enterprise. Following two MIS based integrated systems may be adopted by beekeepers to plan and coordinate their activities in advance:

7.8.6.1 Advanced Information System of Area-wise Crops and Densities (ISFMMP):

There is an urgent need for a web-based information management system about cropping densities of honeybee forage crops up to village level allowing advanced migration planning for beekeepers to ensure optimum crop pollination. Presently, the crops are either grossly unutilized or highly exploited – resulting in resource wastage in both the scenarios.

7.8.6.2 Weather Forecasting System (WFBOAS):

Beekeeping of late has become a totally weather dependent industry. An integrated weather forecasting-cum-beekeeping operations and advisory service (WFBOAS) for various beekeeping regions of state/country may guide beekeepers to perform timely operations to maximize their productivity and save their colonies.

7.8.7 Disease Survey, Forecasting, Diagnosis and Management System (DSFDMS):

Honeybees in India have befallen to many threats like "Thai sac brood virus" in *"Apis cerana"* and epidemic of *"Varroa destructor"* on *A. mellifera*. Indian scientists should remain ready for the impending disasters like of CCD (Colony Collapse Disorder), neonicotinoid insecticides, etc reported in several other countries. It is suggested to put in place a centrally coordinated system with state-wise branches and international cooperation.

7.8.7.1 Immediate Establishment of Disease Diagnostic laboratory.

7.8.7.2 Highly Qualified Disease Diagnostic Officials/Inspectors

7.8.7.3 Colony loss Surveys:

Periodic survey of honeybee colonies in liaison with stake holders to the quantum and cause of such losses.

7.8.7.4 Cadre of Trained Persons:

A strong professional technical cadre has to be raised to operationalize findings and recommendations of above 3 units at beekeeper's apiaries.

7.8.7.5 "National Beekeeping Medication Policy"

7.9 Honey Production, Value Addition, Diversification and Quality Control

7.9.1 Deteriorating Honey Quality:

The quality of honey being produced now is really worrisome due to contamination by antibiotics, lead, etc. Some of the reasons are extraction of unripe honey from brood chambers and not from supers (99.99%); storage in tin containers (though plastic buckets were introduced but later almost withdrawn); use of un-recommended chemicals applied using wrong methods and time; low production, etc. Though traceability system is in place but it has been breached several times. Officials, scientists and extension workers should remain alert so as to avoid any negative effect on export of honey from India.

7.9.2 Adulterated and Fake Honey:

Recent reports of large scale adulteration of honey with sugar by beekeepers and especially traders coupled with import of fake/spurious honey entering Indian market may prove disastrous and kill this enterprise which is entirely export oriented. Recently, large imports of invert/corn syrup, etc. have been reported and there is a strong fear that it may enter honey industry. A strong and immediate action from government is solicited.

7.9.3 Export and Domestic Marketing:

Honeys conforming to international quality standards are exported mainly to US, EU and middle-east but rest finds way to domestic market as proposed domestic honey standards (at par with international standards) are still not promulgated. Indian customer must not be put to such great risk and government must act fast and decisively.

7.9.4 Honey Testing Lab:

With a great magnitude of contaminants in Indian honeys, its export is jeopardized owing to policy of "zero-tolerance of contaminants" in importing countries. To analyze such an array of contaminants, highly sophisticated testing facilities are essential which involve fixed assets of nearly Rs. 15 crores in addition to trained manpower, running cost, etc. There is no accredited honey testing lab in India and all samples are sent to Germany for analysis and export certification. It is not only time consuming but also economically exorbitant involving a cost of about Rs. 20,000 per sample. It is absolutely necessary that a

centralized testing lab be established by the government with testing facilities at nominal charges.

7.9.5 Diversification:

Tremendous scope exists and it is the need of the hour in present times of declining profitability to diversify beekeeping into many full-fledged industries like hive bee products (royal jelly, pollen, bee venom, propolis, etc.), manufacturing (equipments and tools), marketing (honey); value added products (honey and hive products), research, pollination (high-tech and high-value crops, enclosures, general crops), bee rearing (specialized), apitherapy, ayurvedic/naturopathy and pharmaceuticals, transportation (migration), food industry, confectionary/bakery, cosmetic industry, etc. No other industry has the potential to diversify into such great independent variants.

7.9.6 Production of Specialized Hive Products:

To make beekeeping really sustainable and profitable, it is pertinent to diversify into the production, processing, storage and marketing of specialized hive bee products like royal jelly (RJ), pollen, propolis, bee venom, etc. These are highly skilled initiatives with immense export potential. As proposed earlier for bee breeders, provision of specialized trainings, specialized equipments and infrastructure package along with marketing support, needs to be provided.

7.10 Marketing Constraints

Honey marketing is in unorganized sector and mainly export oriented. It is a specialized field and should be handled by only professionals. Product margin could go even beyond 200 per cent for traditional products and still higher for specialized products. A sharp increase in domestic consumption in India is witnessed from 8.4 grams per capita in 1993 to 25.6 g now.

7.10.1 Marketing Ventures:

There are many examples of development of wonderful products by many companies (Honey Bee Natural Products, Kashmir Apiaries, etc.) and their subsequent failures only due to faulty marketing strategies. In contrast there are successful marketing ventures also that included first "Honey Parlour" in India at CBRTI, Pune and honey marketing network in KVIC, "Honey Hut", Dabur, etc. There are successful ventures of private labeling by the exporters for international clients as well as Indian marketing chains.

7.10.2. Comprehensive Marketing Policy and Support for Honey and Value added Products:

Beekeepers are poor and due to many factors like low product retention capacity, lack of capital, lack of knowledge, etc. are unable to market their product which is slow moving and has seasonal consumption pattern. A comprehensive support system right from crop forecast, trends, prices, procurement, processing, value addition, advertisement, awareness, sale, etc. is urgently required involving government, beekeeper, honey exporter, etc. to safeguard the interest of the beekeepers. The real players have to be private entrepreneurs. The government, at best, can provide infrastructure and policy support. The honey prices, nowadays, are governed by production (domestic and international), demand, export orders, pooling strategies of honey exporters, etc.

7.11 Conservation of Bee Plants, Pollinators and their Habitat

A global problem with more pronounced results in developing countries, demands holistic approach with natural resource conservation in response to rapidly declining pollinator population threatening the productivity and even survival of important commercial crops.

7.11.1. Conservation of Wild bees:

The most endangered honeybee species are rock bees and dwarf bees whose population has dwindled alarmingly and no efforts are being made to conserve these species.

7.11.2. Propagation and Conservation of Bee Plants:

The propagation efforts should supplement prioritization of bee plants over purely woody/timber species in the forest (social forestry), ornamental spaces, barren areas, etc. and needs coordination between various departments like forests, wasteland, environment, agriculture and rural development, etc.

7.11.3. Permission to Utilize Government Farms/land by Beekeepers:

Presently there is no policy to utilize vast tracts of forests, plantation and farm land of government for beekeeping (temporarily during flowering period only), wasting valuable resources and hindering biodiversity enrichment. It could be concluded that despite facing endless constraints beekeeping has potential not only to full the bellies of Indians and the world through increased production and productivity but can make it nutritionally perfect in the sweetest way. The only thing required is little attention and the way we look at this tiny but most magnificent friend of humanity.

7.12 Constraints in the Development of Beekeeping Industry :

The major constraints confronting the development of beekeeping industry in the State are as follows:

i) Huge unexplored beekeeping potential

ii) Low Priority Field - Apiculture could not get its due recognition in educational institutions and at government level.

iii) Lack of adequate laboratories for diagnosis, prevention and control of pests and diseases of honeybees and their management.

iv) Deforestation and depleting floral resources

v) Difficulties in the migration of honeybee colonies

vi) Lack of quality nucleus stock of Apis mellifera

vii) Lack of infrastructure at the grassroots as well as National level for producing large volumes of genetically superior queen bees for supply to beekeepers

viii) Lack of facilities for imparting practical training in scientific beekeeping to the farmers/beekeepers

ix) Lack of technical knowledge for efficient management of honeybee colonies for high honey yield

x) Poor quality control for production of honey and other beehive products

xi) More emphasis for production of honey as compared to other beehive products

such as bees wax, pollen, propolis, royal jelly and bee venom

xii) Lack of institutional support for beekeeping in terms of bank loans, etc.

xiii) Lack of marketing facilities and proper pricing policy for honey and other beehive products

xii) Indiscriminate use of insecticides, pesticides and weedicides, etc.

xiii) Adverse weather conditions and pollution of water and air

xiv) Lack of consumer awareness about honey and its products

xv) Lack of accurate scientific database i.e. contradictory figures about potential, present status and future prospects of the beekeeping industry in India.

xvi) Lack of adequate research facilities for beekeeping

CHAPTER

8

BEEKEEPING TRAININGS AND EXTENSION

Beekeeping in Haryana is being practised for several years. It has been a source of income for thousands of families in Haryana. Beekeeping has developed greatly with tremendous efforts of scientists, extension officers and workers and off course beekeepers in Haryana. But still there is a great scope for further development of beekeeping in newer areas which are still unexploited or under-exploited for beekeeping. Faster growth of beekeeping can be achieved only through development of sound bee management techniques and their proper dissemination to the beekeepers. For effective and proper dissemination of apicultural technologies throughout the state, there is an urgent need to develop extensive training centres with well trained extension personnel. Some of the strategies for effective and practical trainings are discussed below:

8.1 Establishment / Strengthening of Training Units

8.1.1 District level Training Centers

a) **Trained Faculty at KVKs:** Faculty involved in beekeeping trainings at KVKs should have updated knowledge in beekeeping and should be able to handle and manage honey bee colonies. This will help in gaining confidence of the trainees. If possible, long term engagement of the faculty should be done in this specialized field. This will significantly improve impact of these trainings and will result in tremendous increase in adoption and success of beekeeping.

b) **Supporting Staff:** The supporting staff should be well trained in all colony management practices. Regular supporting staff, after a few seasons of involvement in apicultural trainings, will become an asset for conducting praticals during the training programmes and management of honey bee colonies throughout the year. Repeated shuffling of these persons should be avoided.

c) **Model Apiary:** Apiary of the training institute is the first and the most important single factor to create first impact on the trainees. So, following points should be considered for developing an apiary:

- There should be a minimum of 50 honey bee colonies in the apiary.
- It is not only the number, but the quality of the colonies is also very important. The colonies should be strong and well managed.
- Apiary should be well planned and well maintained.
- Availability of sufficient farm area for growing bee flora is required for proper colony growth and productivity.

- Hives and other equipment should strictly be of standard measurements and quality. Use of very good quality equipment in training centre will be highly useful in convincing the farmers/beekeepers for adoption of these equipment. Standard equipment will also make colony management more efficient.

8.1.2 Beekeeping Exhibition Gallery

8.1.2.1 Display of Technologies, Strategies, Funding Schemes and Potential of Beekeeping

i. Bee species, Castes and Development Stages: specimens and pictorial charts of different hive and wild honey bee species and their castes will facilitate in quick and effective learning of variations in body size and colour in different species and castes. On the very first day of training, these specimens and pictorial charts will help the trainees to have a closer look at these, without any fear of bee sting.

ii. Bee Diseases and Enemies: Pictorial charts of bee diseases and enemies will be highly useful in their identification in a season when these diseases and enemies are not available in the apiaries.

iii. Hive Products: Display of hive products other than honey, will encourage beginners to adopt beekeeping as full time occupation because of availability of opportunities for production of so many products from honey bees.

iv. Economics: How much one will be able to earn by adopting beekeeping, is the first question that comes to the mind of the trainees. So, detailed economics of beekeeping, with highlighted profit, will motivate the trainee for taking up beekeeping enterprise.

v. Government Facilities or Funding Schemes: Beekeeping is highly suitable for landless, small and marginal farmers, uneducated rural youth and weaker sections of society. Therefore, display of details of various Government schemes, provisions and procedure for getting subsidy and bank loans will further motivate them to start beekeeping.

vi. Honey Marketing: The way a hive product is presented and marketed will have tremendous impact on profitability of beekeeping. So, display of attractive label design and the information required to be printed on it encourages the beekeepers to go for bottling, labeling and retail marketing for higher returns.

vii. Potential of Beekeeping: Trainees, in the beginning, think honey as sole hive product. But figures depicting potential of beekeeping in production of queen bees, beeswax, pollen, propolis and bee venom etc. and the monetary benefit will further boost development of beekeeping.

viii Equipment with Standard Specifications: Bee hives of specified wood, dimensions and finishing should be used. Honey extractor, drip tray, honey strainers, honey settling tanks should be made of high quality stainless steel only. Displaying poor quality equipment will certainly affect adoption of good equipment and practices.

ix Migratory Beekeeping: Adoption of migratory beekeeping by the training centres will result in maintaining better colony strength throughout the year. This will help in conduct of practicals much more intensively and effectively.

8.1.3 State level Training Centre

i. Trainers' Trainings: Trainers at KVKs need to be updated with the latest developments in beekeeping. So there is a need to conduct trainers' trainings at regular interval. This also will be a platform for answering to their queries regarding various aspects of beekeeping. Feedback obtained from them will help in improving and modifying the training programmes accordingly. The centre for providing these trainings should have excellent training facilities. Faculty for providing such trainings should have advance theoretical and practical skills in beekeeping. They should come up with some solutions to the current problems with timely coordination with research scientists, officials and extension functionaries.

ii. Advance Trainings: Trainers at KVKs not only need to be updated in the management of honey bee colonies, but also need to be provided with advances in production of royal jelly, pollen, propolis, bee venom and queen bees to promote diversification of apiculture. Advances in management of pests and diseases, preferably by adopting non-chemical measures will result in quality honey production by reducing the problems of chemical residues in honey and other hive products. Imparting training to the KVK faculty regarding the latest quality parameters for domestic and export market of hive products will make them more effective in dissemination of this important information for production of quality products.

iii. Benchmark for Further Improvement: A well prepared training schedule adopted in all the trainings will set a minimum benchmark for the topics to be covered and plan of work. Suggestions for further improvement of the trainings should be obtained from all the trainees and the trainers at district level. Benchmark for success should be per cent adoption of beekeeping by the trainees.

8.1.4 Plan of Trainings

8.1.4.1 Trainers' Trainings (for KVK faculty, ADOs and HDOs)

i. Refresher Training Courses: Trainees should be able to provide updated information on management of honey bee colonies, pollination of crops, production, processing and marketing of quality honey, and colony multiplication after undergoing refresher courses.

ii. Specialized Trainings on Diversification of Beekeeping: To promote diversification of beekeeping and to increase profitability of beekeeping, trainers at district level should have complete and latest information on production of queen bees, beeswax, pollen, propolis and bee venom etc.

iii. Specialized Trainings on Bee Diseases and Enemies: One of the major reasons for unwanted use of various chemicals and antibiotics in honey bee colonies is lack of knowledge and ability to properly diagnose attack of various bee diseases and enemies. Therefore, specialized training in bee diseases and enemies will train the trainers at district level to diagnose and guide beekeepers. This will definitely reduce the problem of residue of these chemicals in honey and other hive products.

8.2 Advance Trainings for Progressive Beekeepers

8.2.1 Advance Trainings on Mass Queen Bee Rearing:

To promote selection of best performing colonies with least attack of bee diseases

and enemies, beekeepers need to have training in mass queen bee rearing. This will not only improve productivity of their colonies but will also increase their income through sale of queen bees to other beekeepers.

8.2.2 Advance Trainings on Production, Processing and Marketing of Hive Products:

Till recent times, income from beekeeping in India was mainly dependent on sale of honey and bees. To further increase profitability of beekeeping, progressive beekeepers should go for production of queen bees, beeswax, pollen, propolis and bee venom etc. Further, training on processing, packaging, labeling and marketing of hive products will strengthen technical base of beekeepers and broaden the options available to them.

8.2.3 Advance Trainings on Bee Management :

Even after years of experience in beekeeping, still there are some problems with the management of honey bee colonies by the beekeepers witch need to be addressed. By providing training in scientific management of honey bee colonies, productivity of honey bee colonies may be improved.

8.3 Basic Trainings

8.3.1 For Beginners:

Proper, practical and complete training is needed for the beginners to start beekeeping occupation and then succeed in it. They need to be provided training in purchase and shift healthy colonies to the selected apiary site, management of colonies in different seasons, management of various bee diseases and enemies, extraction of honey and beeswax. For confident handling of colonies, the beginner beekeepers should be trained in colony examination.

8.3.2 For Self Help Groups (SHGs):

Members of a Self Help Group (SHG) are to be provided with same training as to other individual beginner. In addition to this, SHG should be trained in dividing the tasks and coordinating various activities in production, processing and marketing of hive products. They should be informed about the government facilities they as a group can benefit from. Such trainings may be organized at village level also.

8.4 Exposure Visits

Exposure visits to the related institutes or industry will be highly useful in widening their horizon of knowledge. These visits can be divided as follows:

8.4.1 CBRTI/SAUs/ICAR Institutes:

Visits to such institutes will provide an opportunity to beekeepers to learn about the latest technologies. Beekeepers can discuss some of their questions and apprehensions with the experts in these institutes.

8.4.2 Honey Exporting Units:

Visit to honey exporting units will help the beekeepers to learn about the large scale handling and quality testing by the exporter.

8.4.3 Progressive Beekeepers:

Visit to progressive beekeepers will provide the beginners with an opportunity to have first hand information about the profitability, honey production, pricing and the problems faced by the beekeeper.

8.5 Conduct of Trainings

8.5.1 In Accordance with the Level of Participants:

Language used, instructional material, speed of delivery should be as per level of the trainees.

8.5.2 Demonstration for Confidence Build up:

To induce confidence in trainees, trainers should demonstrate all management practices themselves. This will encourage the trainees to go for learning by doing.

8.5.3 Learning by Doing:

Hands-on practice of various colony management practices will have long lasting memory and will make the trainees more confident for handling bees.

8.5.4 Suitable Number of Participants per batch:

Number of trainees in each batch should be about 30. This will facilitate in making small groups during practicals which will enable the trainees to have hands-on practice and better learning.

8.5.5 Encourage Participation:

Praising those trainees in the class who try to do practicals actively, will encourage other trainees also to go for hands-on practice.

8.5.6 Interaction :

The trainees should not just deliver the lectures or just demonstrate and finish the class. At least 10-15 minutes should be kept for discussion. Discussion amy be initiated by inviting questions.

8.6 Motivation, Facilitation and Follow up

8.6.1 Motivate Trainees:

During and after the training motivate the trainees to start beekeeping, as many trainees lose interest after passage of time. Try maintaining contact either in person or telephonically so that motivation level remains high.

8.6.2 Facilitate to Start Beekeeping:

Helping the trainees with information regarding from where to get hives, honey bees and other equipment. Facilitate them in applying for subsidy and getting loans. This way the trainees will remain in the frame of mind that beekeeping is going to be his/her next venture.

8.6.3 Follow up for Establishment:

Once a trainee has started beekeeping, help him in establishment of his/her apiary by providing him timely technical guidance. Because this initial phase is very vulnerable stage, failure at this stage will be very discouraging, whereas your time to time guidance will help the trainees to succeed in this phase and it will act as self propelling and motivating.

8.6.4 Beekeeping Workshops:

Quarterly workshops of the beekeepers will provide them with a platform where they can discuss their problems, success and can get technical information from the experts in the field of apiculture, marketing, and quality control. To avoid any confusion, dates should be fixed for the whole year. This will enable the beekeepers to plan well in advance.

8.7 Felicitation of Innovative and Successful Beekeepers

8.7.1 Awards:

A provision should be made to give State and district level awards to the innovative and successful beekeepers to encourage other beekeepers to go for excellence. However, the detailed criteria for these awards will maintain its sanctity.

8.7.2 Success Stories:

Publishing success stories of the successful beekeepers and those who are further motivating others to take up beekeeping as an occupation, will be moral boosting for these beekeepers as well as for the others. This will also attract people towards beekeeping profession.

8.7.3 Feed Back:

Regular feedback from successful beekeepers will not only be useful for giving right direction to the training programme but will keep their motivation level very high.

8.7.4 Torch Bearers:

Presenting successful beekeepers as torch bearers in their respective regions will keep them involved in the development of beekeeping in their region. That also will set an example for other unemployed persons to take up beekeeping as an occupation and succeed.

8.7.5 Organising Honey Festivals:

Organize honey festival to provide beekeepers, traders, exporters and equipment fabricators to showcase their products and have publicity. Holding such festivals near or preferably within city will provide an opportunity to local public to purchase honey. Pamphlets describing usefulness of honey may be distributed to boost honey consumption.

8.8 Telephonic and on-farm Consultancy

8.8.1 Promotion of Honey

8.8.2 Print Media:

Advertisement and pamphlets in newspapers will be useful in encouraging honey consumption.

8.8.3 Electronic Media:

Electronic media has very wide distribution, so advertisement in electronic media will reach millions of people in a very short period of time.

8.8.4 Social Networking:

Nowadays, almost all youngsters are active on social networking sites. So a short and effective message can be shared very quickly and widely. Giving health benefits of honey will attract elders also to honey consumption.

8.8.5 As Gift Item:

Encourage beekeepers and officials for giving honey as a gift on festivals or marriages. Since it will last for several weeks or may be for a few months, this healthy gift will keep you in the memory of people.

8.8.6 Healthy Alternative to Sugar :

During trainings, include topics on using honey in preparation of various food items and use of honey in place of sugar as a healthy alternative. Use of honey as an alternative at home will encourage some proportion of guests to switch to use of honey.

8.9 Scientific literature

8.9.1 Leaflets:

Print leaflets on composition and health benefits of honey and crystallization of honey. Various recipies and methods of eating honey will give people more reasons for consuming honey, because most people still use honey as a medicine only or consume spoonful of honey as such.

8.9.2 Booklets:

Small booklets giving tips on starting beekeeping, managing colonies and honey extraction may be distributed to the interested persons to take their level of interest to the occupation level.

8.9.3 Books:

Publish books on beekeeping in local language, Hindi and English. These books should be very elaborate, up to date with coloured photographs especially of bee diseases and enemies for conveying the information in a better and effective way.

8.9.4 Magazines:

Monthly or quarterly magazine will be helpful in providing technical information with respect to current or coming season. This will keep beekeepers updated and will enable them to manage their colonies scientifically and profitably.

8.10 Honey Day:

There is a trend of celebrating various days. So why not have a Honey Day? At least once a year it will make people think about honey.

8.11 Education & Research

8.11.1 Research & Training Activities of HAIC

HAIC has set up HAIC Agro Research & Development Centre in Murthal, with the main objective of developing and boosting agricultural research activities, promotion of latest crops cultivation technologies, irrigation technologies, processing technologies, post production technologies, setting up of demonstration farm, tissue culture, bee keeping and organic farming etc & for promotion of research and development activities in the State of Haryana.

HAIC Agro Research & Development Centre imparts training & carries out research programs. HAIC also intends to set up similar units in the other parts of the state of Haryana.

8.11.2 Honey Processing Unit

The Centre has set up a Honey Processing Unit at Murthal. The Bee-Keepers of Haryana can get Honey processed on custom basis at very reasonable rates.

8.11.3 Bee Keeping Training Scheme

Under this scheme HAIC imparts training to bee-keepers, farmers, unemployed youth and SC/ST aspirants free of cost. Free boarding and lodging is provided during the training.

8.11.4 What is expected from SAU's

Inorder to promote honeybee keeping in the state of Haryana it should strengthen teaching, research and extension activities by

i) Creating separate research units for undertaking research on various aspects of honeybees

ii) Recruit scientific staff trained in teaching and conducting research

iii) Organise advanced trainings on different aspects of bee keeping (management,bee health, breeding, and honey extraction including its packing and markeeting)

8.12 Role of Bitechnology in Apiculture

8.12.1 Biotech Intervention in Apiculture

Research on Apiculture, honey and other by-products has been continuing for many years in our country. however the potential of biotech intervention for improving quality and quantity of products has not been fully exploited. Therefore, there is a need to develop a network programme which will look at the Biotechnological interventions which can contribute to the improvement of both Honey Bee and Honey products. The following priorities need to be examined:

i. **Genetic diversity:**

Morphometric and molecular analysis and characterization to study the diversity of all honey bees including non Apis species.

ii. **Pollination studies:**

a. Bee colonies are rented in parts of H.P. for pollination services in apple orchards. The same may be replicated in other parts of the country as per the requirement.

b. Studies may be initiated to study the pollination capability of different species including non-honey producing bees which are smaller in size.

c. Studies on using pheromones to attract honey bees for increased pollination of selected crops.iii.

iii. **Development of breeding techniques/mass rearing of honey bees:**

a. Standardization of artificial insemination technique for different bee species for hybridization studies for which expertise is currently lacking in our country.

b. Since recombinant DNA technique is not a possibility, other techniques to be utilized for introducing a gene of interest for example introduction of a gene which codes for a protein (Cecropin which gives resistance against several pests).

c. Breeding/rearing of different species of bee in the different ecosystems as per their behaviour.

d. Breeding of selected disease and pest resistant and also pesticide resistant bees for higher yield, better pollination ability and other desired characters.

e. Breeding and rearing of different species – stingless bees, other species of *Apis*, Mass rearing of queen bee.

f. Management practices/harvesting and conservation for rearing of honey bees perfect, e.g. hive designing, directed nectar harvesting for a particular crop.

g. Studies on disease/pest resistance including development of immunological diagnostic tools.

8.12.2 Molecular Markers:

a. Development of molecular markers for *Apis cerana* and other *Apis* and non-*Apis species*. No work on development of molecular markers have been takenup for any of the Indian species. The genome size of *Apis mellifera* is about 200 mbp organized in 16 chromosomes. New set of genetic markers to study diversity in honey bees. Basic analysis for comparative genomics like hygienic behavior, foraging behavior etc.

b. Screening of population for specific traits such as disease and pest resistance, higher yield and quality, role in pollination, foraging behavior, hygienic behavior etc.

c. The technologies for production of hive products other than honey do not exist in the country.

POLICY LEVEL RECOMMENDATIONS FOR IMPLEMENTATION OF SCIENTIFIC AND TECHNICAL ACTION PLAN (VISION 2030)

INTRODUCTION:

In Haryana, the beekeeping has potential to raise the bee colonies to the fully exploit the diverse floral resources, which exist in this state. Hence, there is a need to affect a paradigm shift at the policy level in its Research, Training and Extension programs. The following policy level recommendations should be considered.

1. Multiplication and Distribution of Bee Colonies

For the expansion of the beekeeping industry in the Haryana state, it is essential to double the number of bee colonies for distribution amongst farmers from the existing number of 2.5 lakhs within a period of next five years. To achieve this target, a mission mode programme (target oriented and time bound) should be started in all the regions of the state. Each of these extension centers would need to be strengthened by providing the necessary infrastructure and sufficient technical manpower both for "Train the farmer" and multiplication/distribution of bee colonies. Each extension centre should have a target of raising 20,000 to 30,000 bee colonies every year, which is possibly a realistic target.

2. Commercialization of the Beekeeping Industry

As per the new policy of Govt. of India, commercialization of agriculture has been given top priority in India. We have a great diversity of bee floral resources, which offer great scope for commercialization of apiculture like other farming activities. It is only through commercialization of the beekeeping industry that the target of raising 10 million bee colonies at National level and 4 lakhs bee colonies at Haryana state level can be achieved through utilization of its diverse pollen and nectar resources which would otherwise be wasted in nature. Currently, there are only a few big business houses like Dabur, Zandu, Patanjali, Kashmir apiaries etc. that are primarily involved in processing and marketing of honey at National level. These big companies have sufficient resources and should be encouraged to start their own commercial apiaries to produce diverse hive products (honey, beeswax, pollen, propolis, royal jelly and bee venom) and also establish honey parks. Such companies should also be invited to the State of Haryana for the upliftment and modernization of the beekeeping Industry and active entrepreneurs should be given full encouragement and motivation.

Tremendous scope exists for the diversification of beekeeping in Haryana. It can be diversified into many full-fledged industries like production of bee hive products namely pollen, Propolis, Royal Jelly and Bee venom; marketing of honey and value added hive products; using bees for pollination purposes, for developing packaged bees, queen trade; manufacturing of equipment and tools, etc. Government of Haryana must encourage Beekeepers and assure quality control and explore export market for bee hive products.

3. Adoption of Scientific Beekeeping

Majority of the beekeepers in Haryana are following unscientific beekeeping. Utter disregard to minimum distance between colonies, maintaining colonies in single chamber

rather than at supers, not using queen excluder, use of inferior wood for hives with arbitrary dimensions, migration of single chamber colonies, not maintaining safe distance among the migratory apiaries, honey extraction from brood combs, fixed floor board rather than separable floor board, non use of inner cover, open feeding etc. are some of the unscientific practices which are now becoming quite common among beekeepers. These practices have bearing not only on low honey production but have also resulted in faster spread of bee diseases and mites. If scientific beekeeping is not adopted at this juncture its further progress in the State will be very difficult to achieve. Crowding of colonies at one place should be discouraged. There should be at least 5 km distance between the two apiaries. There is a need to create awareness amongst beekeepers that instead of having large number of weak or average strength colonies, they should maintain strong colonies.

Most of the bee hives being used in Haryana are not the standard hives with all needed components. Most of the beekeepers do not use inner cover as well as supers. This has caused several problems, including contamination and high moisture content in honey. In most of the cases, even standard seasoned wood is not used for manufacturing of the bee hives which results in appearance of cracks within a year. The nodal agency in the State Government must ensure that beekeepers use standard bee hives for European bees.

4. Streamlining Migratory Beekeeping Practices

Generally the bee forage seasons in different agro climatic zones of Haryana state alternate. Advantage of this fact can be taken by inter-migration of bee colonies for honey production, colony multiplication and pollination of crops. Further, the crop rotation or cropping patterns can also be modified so as to provide forage to bees for a longer period. Further, there is need for providing financial assistance to the beekeepers for the migration of their bee colonies. During migration, a permit/Identity card may be issued by Government agency to registered beekeepers so that policeman and octroi persons do not create any hindrance during migration of bee colonies.

5. Organic Beekeeping

In recent years, a lot of emphasis has been laid on organic farming because of certain well-known problems of conventional agriculture, like crop pests, diseases, harmful effect of pesticides etc. Organic farming does not mean, just not using pesticides, but it includes a lot of agri-based practices, like beekeeping, dairy management, vermi-composting, fisheries, bio-gas production etc. In a recent study in Northern India, it was revealed that, beekeeping and vermi-composting can contribute more to organic farming than dairy farming & fisheries, therefore, there is a need to lay emphasis on organic beekeeping in Haryana, as a prime agri-horticulture and forest based industry.

Honey industry in Haryana, can become a major source of earning for farmers & beekeepers as well as a major step towards foreign exchange, if international standards are met. Besides honey, emphasis should be laid on other hive products too, like beeswax, bee venom, royal jelly, propolis and pollen for the promotion of organic beekeeping in this State.

6. Establishment of Honey Bee Parks

At present, the beekeepers cannot place their bee colonies in the forest area or in the farm land owned by Government. It is suggested that there should be some Honeybee Park or Garden where farmers can keep their bee colonies temporarily during honey flow season as well as during lean / dearth period.

7. Processing, Packaging and Marketing of Honey

The existence of only monopolistic private trade houses, lack of channelized market and Government support, fluid honey market, low price for the beekeepers' produce, the current low demand of Indian honey at the global level and exorbitant price in the domestic retail market, need to be urgently addressed. The unregulated import of low priced / spurious honey is not only hitting our bee industry, but is also hazardous to humans health. The projection of honey as medicine only and that at exorbitant price inter alia are among the causes of low domestic consumption. The best quality honey is exported at much lower price. Further, the beekeepers are poor and due to many factors like low product retention capacity, lack of capital, lack of knowledge, etc. are unable to market their produce at a remunerative price. The State Government must have a comprehensive support system right from crop forecast, procurement, processing, value addition, advertisement, awareness, prices and sale of honey and other bee hive products. Further, the Government should also fix minimum support price for the honey and other bee hive products so as to safeguard the interest of the beekeepers.

There is no proper facility for the processing and packaging of honey in the State. One cannot buy honey in small pouches. The honey processing plant installed by Haryana Agro-Industries Corporation (HAIC) Ltd. at Murthal, Sonepat is still not properly functional. Rs. 5/kg towards processing of farmers honey is being charged, but there is very poor response from the beekeepers. State Government should look into the possibility of processing farmer's honey at subsidized rates. The honey processing policy is required to be formulated and steps should be taken to use the non-functional processing plants in the State. Further, to meet the demand of the farmers, more facilities for the processing and packaging of honey can be created at Integrated Beekeeping Development Centre (IBDC), Ram Nagar, Kurukshetra.

8. Establishment of Honey Testing and Disease Diagnostic Laboratories

With a great magnitude of contaminants in Indian honey, its export is jeopardized owing to policy of "zero tolerance of contaminants" in importing countries. This is mainly leading to several honey marketing problems and restrictions on honey consignments for export, besides wasteful expenditures on application of control measures. To analyze an array of contaminants, it is absolutely necessary to establish a centralized honey testing lab in the State for the benefit of beekeepers. At present, we have three different standards for honey namely (i) Regulatory authorities for prevention of Food Adulteration (PFA) now Food Safety and Standards Authority of India (FSSAI), (ii) Agricultural produce Grading and Marking (AGMARK) and (iii) Bureau of Indian Standards (BIS). Since we have to follow International standards for the export of honey, therefore, this discrepancy needs to be removed to safeguard the interest of beekeeping industry in the Haryana State / Country.

Bee diseases and mite diagnostic is the major concern for the development of beekeeping in Haryana. Due to lack of these facilities, wrong identifications/diagnosis are leading to injudicious use and misuse of chemicals in beekeeping industry. Lack of any impetus to practical bee pathology, lack of human resource expertise in the field and lack of any diagnostic laboratories are proving the bee scientists and the development personnel handicapped in tackling the potentially huge problems. There is need to improve hive hygiene and control of bee ailment. In this regard, one disease diagnostic laboratory is urgently required to be established in the State.

9. Apitherapy: A New Alternate System of Indian Medicine

There is now sufficient scientific evidence available to prove that different bee products such as honey, beeswax, pollen, propolis, royal jelly and bee venom are beneficial for the treatment and cure of several human ailments ranging from simple cut/wounds to complicated diseases such as cancer. In Eastern Europe and China, there are now 40-50 beds' hospitals where different human diseases and disorders are treated exclusively through bee products. The western world too is now seriously considering Apitherapy as a substitute for some diseases that are presently cured/treated by Allopathy. Like yoga, Apitherapy also has its origin in India, but has yet not been explored on scientific lines. The time is now appropriate, for Ministry of Health and Family Welfare to include Apitherapy as one of the important subjects under the alternate system of Indian medicine and provide the necessary support to all interested organizations for its promotion. A lead can be taken by Govt. of Haryana for making use of Apitherapy for cure of many human diseases and for the welfare of human beings.

10. Crop Pollination and Judicious Use of Pesticides

At present, in Haryana state, A. mellifera is playing an important role in increasing the productivity of vegetables, oilseed crops, fruits, fodder and other miscellaneous crops. But in recent years, pollinator population is on decline in Haryana state as in other parts of the Indian subcontinent due to a number of factors. So there is a need to check the trend through various practices including green accounting. Moreover, managed crop pollination practices should be introduced in Haryana state on the pattern of adjoining states. Beekeeping and pesticides are both essential inputs for modern agriculture. Application of pesticides may be inevitable, but this should be done judiciously by avoiding the spray during the flowering period of the crops. Further, use of broad spectrum pesticides should be avoided. Only selective and relatively environmental friendly pesticides should be used. If possible, the spray of pesticides should be done in early morning or late in the evening to avoid mortality of honeybees.

11. Artificial Insemination of Honey Bees

For mass production of quality queen bees, their controlled mating with selected drone bees has to be ensured. To achieve this objective, the bee scientists / breeders should be given the training on artificial insemination of queen bees.

12. Administrative Reforms

Our beekeepers face several administrative problems such as various taxes like income tax, transport difficulties / monopoly of trade unions, difficulties in getting loans , lack of effective insurance policy, forest departments policies, free availability and sale of unregistered and unlabeled drugs for use in beekeeping industry, non-availability of effective registered chemicals / drugs, etc. Doing away with these would boost this Gandhian cottage industry in the state.

There is tax on honey and beekeeping implements in Haryana. Honey produced in the state is, not reflected as its own production, but is rather sold off to neighboring states like Punjab. It is suggested that beekeeping should be treated as an agriculture activity should be abolished immediately on the above said items.

13. Management of Financial Resources

At National level, KVIC and Ministry of Agriculture has been preparing perspective plans for the development of beekeeping from time to time, but major hurdle always comes in the form of financial resources needed for upliftment of beekeeping technology which also ensures the welfare of weaker sections of the society. Both these organizations have included bee colony multiplication and their distribution; training; marketing of honey; beekeeping equipment assistance and hive product diversification as their major activities. Similar situation prevails in the State of Haryana with regards to financial resources needed for beekeeping development programmes. Special provisions should be provided in the State Budget that may be sufficient to meet inputs, supplies and training needs. On the other hand, well-trained scientific and experienced staff would be needed to meet the target of raising the appropriate number of bee colonies required for honey production and pollination activities; otherwise most of these funds will remain unutilized.

14. Coordination Amongst Beekeeping and R & D Organizations

There are at present more than one dozen organizations engaged in beekeeping R & D program in the country. Amongst these, two major ones are: KVIC and Ministry of Agriculture, Govt. of India. Both these organizations have different priorities as well as assigned functions for the promotion and development of the beekeeping industry in the country and lack proper co-ordination. For example, KVIC perceives beekeeping as an income and off-farm employment generating activity through production and sale of hive products (especially honey and beeswax) for the weaker section of rural society. On the other hand, the primary focus of the Ministry of Agriculture, GOI is on increasing productivity of agricultural crops through pollination activities of honeybees. It is now well documented that a good honey yielding bee colony is also a better pollinator of crops and both these activities are complimentary to each other. Similar situation prevails now in the state of Haryana as regards to different R & D and Govt. organizations involved in beekeeping development programmes.

It is, therefore, important that, a special short duration course (5-7 days) should be designed for sensitizing policy makers and planners in educating them about the role, that bees and beekeeping can play, in providing sustainable livelihood and alleviating poverty in weaker sections of the society. Self-help groups should be created common facilities like honey processing, bottling and marketing. A comprehensive roadmap for the development of beekeeping and for commercial production of honey is required to be prepared based on biodiversity and other resources available in the State.

15. Upgrading Beekeeping Extension and HRD Component

Beekeeping is a highly specialized, scientific and technical activity in comparison to other branches of agricultural sciences such as Crop husbandry, Horticulture, Livestock, Sericulture etc. There are more than 60,000 individual bees in a bee hive which, through their social life act as a micro-manipulator of pollen and nectar in nature and produce a diversity of bee-products for use by mankind. In order to make a bee colony more productive, it needs special care, management and manipulation by the beekeepers. The present policy of distribution of bee colonies to the farmers and little subsequent follow up for their management in terms of food resources, abiotic and biotic stresses of

colonies in these hives leads to absconding. It has been estimated that out of the present 2.5 lakhs bee colonies in Haryana, a great number of them are just empty hives as bees have deserted them because of poor management. Therefore, a network of well-trained beekeeping extension staff is needed to monitor the behaviour and strength of bee colonies as this industry requires more intensive extension services than other farming activities. With beekeeping being treated as an insignificant ancillary activity, the present tendency is to depute inefficient or unwanted staff to look after beekeeping and many such personnel have no knowledge or training in beekeeping. Therefore, there is a need to create a cadre of well - trained and skilled beekeeping extension experts for proper monitoring and management of bee colonies kept by farmers, otherwise all other beekeeping inputs provided by development agencies would be wasted. Experienced beekeepers can even act as good extension agents and some mechanism needs to be evolved to utilize their services.

Frequent beekeeping workshop-cum-training programs should be organized to update the knowledge of beekeepers, promote scientific beekeeping and feedback for further development of beekeeping in Haryana. On this platform, beekeepers can share their problems and beekeeping experts can solve their problems on the spot. In addition they can also talk about the latest technologies developed in beekeeping.

The recent problem of fast booming unscientific beekeeping in the State is due to lack of specialized trained man-power in the field and training oriented fully equipped institutes. There is an urgent need for the State level Training centers which must have highly qualified, specialized and experienced apiculture professionals and such centers must be fully equipped with desired infrastructure and facilities for both theoretical as well as practical training. Further, they would not only provide training to new beekeepers, but also advanced training to progressive beekeepers and extension functionaries of the State. Government should consider this aspect while formulating schemes on beekeeping. There is also a need to launch an awareness campaign among masses about the benefits of beekeeping.

16. Bridging Knowledge – Practice Gap

In the state of Haryana, although need based and location specific, appropriate beekeeping technologies have been evolved through assessment and refinement of existing ones, mass scale dissemination and use of these technologies amongst primary stakeholders (farmers) has not been adequately attempted. There is a need to create a cadre of "Train the Trainer" and "Train the Farmer" experts in beekeeping. For the former, CCS Haryana Agricultural University, Hisar; Agriculture and forest Departments and other allied agencies should be made well equipped to design and deliver tailor made courses. For 'Train the Farmer" program in beekeeping, Zonal Extension Centers of KVIC, State Departments; NGOs and professional beekeepers should be involved and provided with sufficient facilities and support.

17. Special Independent Status for Beekeeping Industry

The direct and indirect value of bees and beekeeping in providing ecological nutrition, health and ecological security has often been under estimated. The fact that this activity is pro-poor, pro-gender and pro-environment has not been sufficiently highlighted at both the National and State levels, rather the beekeeping industry is treated as an insignificant ancillary activity, attached to agriculture, horticulture, forestry or state industries departments.

Beekeeping industry in developed countries in itself is worth several billion dollars, besides contributing to boosting crop productivity and conserving biodiversity. Keeping in view these benefits of the beekeeping industry, this activity needs special independent status. In other developing countries of Asia such as Nepal, Thailand, Indonesia beekeeping has been given a special status and has been listed directly under His Majesty the King/Prime Minister priority programs. The Central Govt. should lay special thrust and initiate National projects on the same lines as it has been done for "Save the Tiger Project" and "Operation Flood" in the Dairy industry. At present, beekeeping is lacking its right place at National level; as well as in the state of Haryana. Hence, Haryana should take lead to lay more emphasis on making beekeeping as an entrepreneur based industry useful for common man.

Through such initiatives, there exists a potential to bring a **"Sweet Revolution"** in the State.

18. Role of Women un Beekeeping

Women constitute nearly 50% of working agriculture population of Haryana state and their contribution to agriculture is even higher, but they invariably, do not get, due importance in decision making, planning/managing/sharing earnings etc. Therefore, there is a need for engendering of the women through training, education of recognition of their traditional talents to enhance beekeeping in the State of Haryana.

19. Recognition of Beekeeping In Educational Institutions

In spite of beekeeping being adopted at rocket pace, an emerging highly important and remunerative component of diversification in agriculture with great potential in itself and in increasing crop productivity, apiculture could not get its due recognition in educational institutions (Schools, Colleges and Universities) and at Government level. Unless apiculture is considered an important discipline and strengthened, beekeeping progress would be limited and it shall be far from meeting the desired targets and realizing the desired outcome.

20. Capacity Building

Capacity building is one of the important components, for the growth of any industry or entrepreneurship including beekeeping, but at present, academic communities, institutions & private sector players have their own understanding of capacity building with regard to beekeeping, crop productivity and sustainable agriculture. Therefore, there is a need to prepare & disseminate a standardized curriculum as well as `developing modules for training of different target groups & stakeholders like academic community, extension workers, farmers, service providers etc.

21. Upgrading Beekeeping Scientific Database and Statistics

One major problem while planning strategies for beekeeping development in India, is the lack of accurate scientific database. Different National organizations involved in beekeeping and R & D programs give different and contradictory figures about potential, present status and future prospects of the beekeeping industry in India. Similarly, in Haryana, there is a need to evolve scientific database on beekeeping which will be extremely useful to Scientists, Agriculturists, Beekeepers, Planners and Policy makers.

SALIENT RECOMMENDATIONS

MAJOR STRATEGIES FOR PROMOTION OF BEEKEEPING IN HARYANA

An assessment of present status and potential of beekeeping in Haryana indicates that there is indeed an enormous scope for apicultural development in the state and it can be converted into a land of honey through modern scientific beekeeping. For this following strategies needs to be adopted at a faster pace:

General:

1. Adoption, Diversification, Judicious use of pesticides, use of standard bee hives for beekeeping and streamlining migratory beekeeping practices
2. Conservation and augmentation of melliferous resources
3. Awareness campaigns to educate the beekeepers to maintain only strong colonies. Crowding of colonies at one place be discouraged. There should be at least 5 km distance between the two apiaries.
4. During migration, a permit/Identity card may be issued by Govt. Agency to registered beekeepers so that they do not face any problems at Police check posts and octroi
5. Beekeepers may be encouraged to develop their own domestic and local market for honey. Premium for ripe honey should be introduced to encourage beekeepers to produce better quality of honey. Major focus should be on nutrition value of honey rather than on its use as medicinal value product.
6. Establishment of Training centers for Human Resource Development and frequent beekeeping Workshops-cum-Trainings should be organised.
7. Self-help groups may be created to have common facilities for honey processing, bottling and marketing etc
8. A comprehensive roadmap for the promotion of beekeeping and also for commercial production of honey is required to be developed based on biodiversity and other resources available in the State

Researchable Areas

1. Conservation of bee genetic resources
2. Development of a database on pollinators in terms of diversity, distribution, abundance, efficiency of pollinators, nesting requirements etc
3. Monitoring the decline of wild and domesticated pollinators, causes of decline, and their impact on pollination services, competition of exotic pollinators with local/native pollinators.
4. To identify, document, and disseminate innovation technologies, ITK practices of farmers and fruit growers for sustaining pollinator diversity
5. Preparation of extensive floral calendars for different ecological zones
6. Establishment of a network of web sites with pollen data bank/data base on different aspects of beekeeping.
7. Physico-chemical characterization of honey obtained from different floral resources and analyzing the systems of value addition of honey.

8. Analyses of traditional and modern methods of honey production and refinement of scientific beekeeping practices for increasing honey production and crop pollination
9. Surveillance of bee diseases, pests and predators in various eco-geographical zones of Haryana
10. For better management of bee brood mites, use of inner cover in bee hives should be practised with development of non-chemical strategies for management of bee diseases and pests
11. Development of strategies for minimizing the use of chemicals in honeybee colonies
12. Monitoring of antibiotic/pesticide residues in honey sold in domestic market
13. Selective division of honeybee colonies at small scale and mass queen bee rearing at large scale should be adopted.
14. Artificial insemination technique should be standardized for *A. mellifera* in Haryana

Policy Level:

1. Adoption of apiforestry and sensitising forestry department about making beekeeping and social forestry programmes complementary to each other
2. Large scale mass planting of trees under social forestry should be planned, which will serve as multipurpose source for fuel, fodder and bee forage
3. Strengthening of processing, storage and quality control measures of honey and effective utilization of existing honey processing plants in the state
4. Impact of National and International honey production patterns on Haryana honey market
5. Market surveys of existing mechanisms of honey and beeswax trade and enlisting of important traders
6. Strategies to promote region specific unifloral honey to fetch higher prices
7. Regulation of honey markets and commercialization of hive products other than honey
8. Ban on sale of illegal bee health products and restrictions should be imposed on selling insecticides without proper specification
9. There is an urgent need to create adequate disease diagnostic facilities, and testing of quality of bee hive products
10. Creation of early warning systems of disease outbreak
11. Manufacturing and availability of safe drugs for control of bee diseases and pests
12. Need to enforcement strict quarantine measures and proper certification of honey and bee hive products
13. Awareness should be created among farmers about the benefits of beekeeping to society and beekeeping should be promoted as a tool for women empowerment and economic freedom
14. Provision of honey bee parks or gardens where farmers could keep their bee colonies temporarily during honey flow season as well as during lean/dearth period

15. As per government policy for agricultural crops, registered beekeepers, should be compensated for poor honey harvest due to unfavorable weather conditions
16. Beekeepers/bee breeders be provided loans/ subsidy for buying bee hives and for honey processing by the cooperative societies /self help groups of beekeepers
17. Tax on honey and beekeeping implements in Haryana should be abolished
18. Government should extend insurance policy/scheme for beekeeping in Haryana
19. Supply of bee colonies to the farmers under NHM scheme should be made mainly during September to November
20. In Haryana, there are only very few Agriculture Development Officers (ADOs) & Horticulture Development Officers (HDOs) who are engaged in the development of beekeeping. Thus, there is an urgent need to have sufficient number of ADO's (Beekeeping) for expansion and (HDOs)promotion of apiculture
21. Advance trainings/workshops should be organised for the progressive beekeepers at established research centres/institutes. Exposure visit of state beekeepers to entrepreneurs and Universities/ Institutes in the adjoining states should be encouraged
22. Ex-servicemen should be involved and motivated for undertaking beekeeping as a profession under skill development programme
24. Registration and insurance of beekeepers by the nodal agency of beekeeping
25. Efforts be made to enhance funding for the promotion of Apiculture research and training. National Horticulture Mission should disseminate information regarding Govt. policies and schemes on beekeeping
26. Apiculture be included in the curricula at school level. Beekeeping booklets in easy and simple language should be prepared and distributed to farmers/beekeepers/ students/entrepreneur
27. Beekeeping should be popularized through audio-visual aids and print media. Government should recognize beekeeping as an important agricultural sector and consumers should be made aware about the health benefits of honey and other hive products
28. Haryana Bee Board consisting of members drawn from scientific community, concerned Government officials and beekeeper's association, etc. be constituted
29. Indo-Israel centre for promotion of beekeeping in Haryana may be strengthened with both scientific and technical manpower so that this centre could cater to the needs of the beekeeping industry in the state
30. Establishment of basic research centre on beekeeping in every zone of the state
31. Services of experienced apiculture scientists and extension workers, now working in other fields may also utilized for the promotion of beekeeping in Haryana
32. Managed crop pollination services should be introduced in the state of Haryana for increasing the productivity of different Agricultural and Horticultural crops
33. There is a need to check the decline in pollinator population including honey bees and methods like green accounting could help in bringing a sweet revolution in this state

MEETINGS /WORKSHOPS/ FIELD VISITS

Sr. No	Date	Venue	Remark
MEETINGS			
1.	24 March, 2014	Haryana Kisan Ayog, Panchkula	Meeting of working group to discuss the present status and problems of beekeeping in Haryana
2.	15 April, 2014	Haryana Kisan Ayog, Panchkula	Consultation meeting with Directors and senior officers of state Agriculture and lined departments
3.	29 December, 2014	Haryana Kisan Ayog, Panchkula	Meeting of Working Group
4.	16 January, 2015	Horticulture Training Institute, Karnal	Interface meeting with Beekeepers/ Farmers
5.	3 September, 2015	Haryana Kisan Ayog, Panchkula	Meeting of Working Group for drafting of report
6.	19 October, 2015	Haryana Kisan Ayog, Panchkula	Meeting of Working Group for drafting of report
7	9 July, 2016	Haryana Kisan Ayog, Panchkula	Meeting of Working Group for review of the contents of the report
8	10 July, 2016	Haryana Kisan Ayog, Panchkula	Meeting of Working Group for drafting of the report
9	11 July, 2016	Haryana Kisan Ayog, Panchkula	Meeting of Working Group for drafting and finalization of report
10	25 July, 2016	Haryana Kisan Ayog, Panchkula	Meeting of Working Group for drafting and finalization of report
11	26 July, 2016	Haryana Kisan Ayog, Panchkula	Meeting of Working Group for drafting and finalization of report
12	27 July, 2016	Haryana Kisan Ayog, Panchkula	Finalization and Presentation Of Draft Report
WORKSHOP			
7.	24 June, 2014	Kisan Bhawan, Sector-14Panchkula	Workshop on Promotion of Honeybee keeping in Haryana
FIELD VISITS			
8.	11March, 2015	Punjab Agricultural University,Ludhina, Punjab	A study visit of working group to Honeybee keeping centre, PAU, Ludhiana
9.	11 March, 2015	Doraha, Punjab	M/s Kashmir Apiaries and Exports, Doraha, Punjab

ABBREVATIONS

A. mellifera	-	*Apis mellifera*
A. cerana	-	*Apis cerana*
A.dorsata	-	*Apis dorsata*
A. florea	-	*Apis florae*
ADO	-	Agriculture Development Officer
AGMARK	-	Agricultural Produce Grading & Marketing
AICRP	-	All India Coordinator Research Project
BIS	-	Bureau of India Standards
CBRTI	-	Centre Bee Research and Training Institute
CCSHAU	-	Chudhary Charan Singh Hisar Agricultural University
CFTRI	-	Central Food and Technology Research Institute
DNK	-	Do Not Know
EIC	-	Export Inspection Council
EU	-	European Union
FSSAI	-	Food Safety and Standards Authority of India
Gm	-	Grams
GDP	-	Gross Domestic Product
Govt.	-	Government
Hec	-	Hectare
HAFED	-	Haryana Government Federation
HAIC	-	Haryana Agro-indutries Corporation
HDO	-	Horticulture Development Officer
HMF	-	Hydroxyl Methyl Furfural
HRD	-	Human Resource Development
IBDC	-	Integrated beekeeping Development centre
ITK	-	Indigenous Technology Knowledge
Kg	-	Kilogram
KVIC	-	Khadi Village and Industries Commission
MT	-	Metric Tonnes
NBB	-	National Bee Board
NGO	-	Non Government Organization
NHM	-	National Horticulture Mission
PAU	-	Punjab Agricultural University
PEM	-	Protein Energy Malnutrition
PFA	-	Prevention of Food Adultration
R & D	-	Research and Development
RMP	-	Residue Monitoring Plan
V. auraria	-	*Vespa auraria*
V. magnifica	-	*Vespa magnifica*
V. basalis	-	*Vespa basalis*

INTEGRATED BEEKEEPING DEVELOPMENT CENTRE
RAMNAGAR (KURUKSHETRA)

Integrated Beekeeping Development Centre, Ramnagar (Kurukshetra) is one of the first projects in the country established with the cooperation of Israel in 25 Acre area with a cost of Rs. 10.50 crores under Department of Horticulture, Haryana for welfare and growth of Beekeeping by providing advanced scientific technique and infrastructure to Beekeepers / Small Farmers / Landless persons. The centre was inaugurated by Hon'ble Chief Minister Haryana, Sh. Manohar Lal and Ambassador of Israel to India in presence of other dignitaries on November10, 2017.

This project is a result of joint exercise of Haryana Government, MASHAV (Israel) & CINADCO with the assistance of professional & technical experts from India and Israel. Apiculture is considered such as an agriculture activity which does not require own agricultural land, sheds or structure, involves least time and labour and minimum drudgery and hence beekeeping is regarded as very low cost enterprise.

This centre for honey bees has been well furnished with infrastructural facilities for beekeepers and farmers training programme as well as with technical speech like management of bee hives, pests & diseases, multiplication of queens and role of bee in pollination of Agricultural & Horticultural crops. The centre is also promoting management of honey bees colonies, honey extraction, processing of honey and quality control with value addition of honey for the advancement of beekeepers in the state.

Technical Collaboration with Israel :

- Technology for Bee improvement and Mass Multiplication / Rearing of Honey Queens Bee.
- Technology for Artificial Insemination of Queen Bees.
- Technology for the management of Honey Bee Diseases and Control of Mites.
- Technology for the collection of Royal Jelly, Bee Venom, Propolis and Pollen.
- Exchange program of technical persons for training and execution of the project work.
- Technology for promotion of BUMBLE BEE for pollination support in protected cultivation.

Major Objectives of the Project :

- To promote Scientific Beekeeping using latest technologies and equipment.
- To promote Apis mellifera for increasing agriculture production through pollination support
- To develop quality Breeding Stock of Honey Bees for Commercial Beekeeping.
- Management practices for maintaining healthy and disease free Honey Bee Colonies
- To provide Super Bee Hive Boxes and Comb Foundation Sheet to the Beekeepers.
- To provide Raw Honey Processing, Bottling, Grading, Labeling facility to the Beekeepers.

- Demonstration of techniques for Extraction, Storage, Testing, Marketing and Value Addition of Honey Products
- To develop a cadre of well trained bee keepers in the State of Haryana & increase Mandays.
- To double Farmers' Income from honey production as well as pollination support
- To provide qualitative training facilities to the Beekeepers/Farmers on important aspects of Beekeeping.

Facilities for Beekeepers / Farmers at IBDC Ramnagar :

Apiary Unit (Apis mellifera) : We have established an Apiary Unit of Apis mellifera bees to develop nucleus stock of diseases free bee colonies.

Bee Hive Manufacturing Unit : We have established Bee Hive Manufacturing unit where annually 20,000 Bee Hive Boxes will be manufactured using latest technology machines with Kail wood, Pine Wood and Tun Wood for distribution to farmers on subsidized rates.

Comb Foundation Mill : We have established a Comb Foundation Mill with capacity of making 540 sheets per hour using 45 to 50 kg. wax.

Automatic Honey Processing Plant : A capacity to process one ton raw honey in 8 hour shift and filling 180 bottles of 500 gms in an hour to provide processing, bottling, labelling and grading facility to the Beekeepers.

Quality Control Lab : A well equipped Quality Control laboratory has been established at the centre so as to provide Honey testing facility to the Beekeepers by the experts.

Bee Diseases Lab : Honey Bee Disease Diagnostic Laboratory has been established at the centre for the control of bee diseases.

Bumble Bee Lab : A Bumble Bee Lab is being established at the centre for where Queen Bee and related technology will be provided by Israeli Experts. It is under process as on now.

Auditorium / Training Hall : We have established a well furnished Auditorium Hall with a capacity of sitting 108 persons to conduct various training Programmes, Workshops, Seminars, Conferences and other Promotional activities for the benefit and welfare of Beekeepers.

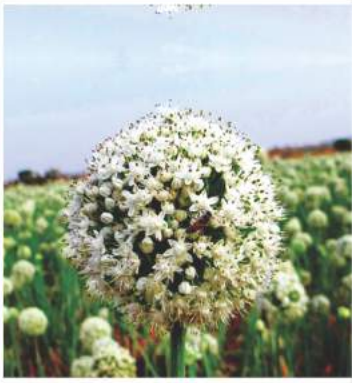
Bee Knowledge Park : We have developed a Bee Knowledge Park at the centre, where 76 species of flower plants are grown to provide regular nectar and pollen to the bees. Another objective behind developing this park is also to make people and children familiar with friendly behavior of Honey Bees so as to encourage them for Beekeeping.

Farmer Hostel-cum-Faculty House : Boarding and Lodging facility is also provided to the Scientists and Beekeepers in the well furnished Faculty House situated at the centre during Beekeeping Training Programmes and other Conferences, Seminar etc.













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